



MASTER PLAN FOR AGRICULTURAL DEVELOPMENT IN THE SOUTHERN REGION OF BANGLADESH



**Ministry of Agriculture
Government of the People's Republic of Bangladesh
&
Food and Agriculture Organization of the United Nations**

June 2012



Master Plan for Agricultural Development in the Southern Region of Bangladesh

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Government of the People's Republic of Bangladesh
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Food and Agriculture Organization of the United Nations**

March 2013

This Master Plan for Agricultural Development in the Southern Region of Bangladesh has been prepared by the Ministry of Agriculture in collaboration with the Ministry of Fisheries & Livestock and Ministry of Water Resources, and with technical assistance from the Food and Agriculture Organization of the United Nations (FAO). The preparation process included a multi-disciplinary team of national experts; backstopped by FAO's technical divisions and continuous consultations with the government line ministries and departments, National Agricultural Research System (NARS) institutes, Consultative Group on International Agricultural Research (CGAIR) centers, development partners and other stakeholders including farmers, local government institutions, the academia, community-based organizations (CBOs) the private sector and the civil society.

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Message

There is no denying that agriculture plays a pivotal role in maintaining the pace of development in a developing country; it creates employment, provides livelihood, and ensures food security. In a country like Bangladesh where population is growing by over two millions a year and the cultivable land declining at an alarming rate of one percent per annum, the relevance of agriculture needs no elaboration. So, the ruling political party Awami League has rightly included attaining food self-sufficiency by 2013 in its election manifesto. And the government has truly lived out its commitment. The country produced 36.2 million tons of food grains in 2011-12, enough for its 158 million people. In the process of realizing its goal, the government of Prime Minister Sheikh Hasina has circumvented the global cereal price hike of 2009 and warded off the adverse impact of the economic recession that gripped the world.

While much of this success was the result of sound management of our agriculture over the last three years, we still have a number of challenges to face. Beside the ever increasing population, climate change poses a grave threat. Salinity of the Bay of Bengal is intruding deep inland causing brackish water to inundate the coastal region. Tropical storms are lashing hard the littoral districts with increasing frequency and ferocity. Many of the ageing polders built in 1960s cannot withstand the tidal surges, and the breaches caused by the cyclones render vast tracts of land unsuitable for growing food or fodder. Monsoon has become more erratic and unpredictable, and the drought longer and more severe in the northern Bangladesh. The granary of the country is already under stress as underground aquifers are getting depleted.

Industrialization and migration of rural people to urban centers are reducing the pool of agricultural labor force signaling a need for mechanized agriculture, which, given the poor income of the farmers, will be hard to adopt in the short run. All these phenomena are taking a heavy toll of our agriculture. In order to sustain our recently acquired gains, we need to give proper attention to the southern region whose potential, if unleashed, can address the prevailing challenges. Against these backdrops, the Master Plan for Agricultural Development in Southern Region of Bangladesh has been formulated. And this Plan is a comprehensive document that reflects the priorities of all the concerned ministries, such as Ministry of Water Resources, Ministry of Fisheries and Livestock, Ministry of Disaster Management and Relief, Ministry of Food, and the Local Government Division. These ministries/ divisions have contributed in preparing the Plan by providing valuable inputs and taking part in deliberations to finalize the document. Food and Agriculture Organization of the UN has extended all out assistance in this work. I express gratitude to all for their support.

Once the Master Plan is launched, it will have a deep impact on the lives of one-fifth of our population. It will open up new opportunities for the inhabitants of the coastal areas who are often been battered so much by the caprice of nature. The Master Plan's goal is not only to make their life comfortable through better supply of food for sustenance, it also prescribes for credit facility so that they can build capital to come out of the vicious cycle of poverty. It aims at establishing forward linkages with the market in urban centers of the country. If properly implemented, the Plan will transform the southern delta into a vibrant economy and help put the country on the trajectory to middle income.

I would, however, like to express that this is a grandiose plan which needs support of the concerned ministries/divisions in terms of dedicated allocations and coordinated effort, and a scaled up financial assistance by the development partners. I believe the ministries and their agencies will engage their highest sincerity for implementation of the plan and also hope that the development partners will come forward to supporting the interventions upon which hinges the hope of pulling thirty million people out of poverty.

Matia Chowdhury
Matia Chowdhury

Minister
Ministry of Fisheries & Livestock
 Govt. of the People's Republic of Bangladesh
 Bangladesh Secretariate, Dhaka.



মন্ত্রী
 মৎস্য ও প্রাণিসম্পদ মন্ত্রণালয়
 গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
 বাংলাদেশ সচিবালয়
 ঢাকা

Message

I feel highly delighted to know that the Ministry of Agriculture has prepared a draft master plan for the overall agricultural development of the southern region presenting on outline of development of crops, fisheries and livestock and water resources sectors in particular. I would like to congratulate the Ministry of Agriculture for preparing this master plan. I would also like to thank FAO for rendering technical support and all other concerned ministries and organizations for their collaboration.

Fisheries and Livestock sector in playing a special role in the overall agricultural development of the country. Although the southern region of the country provides the most prominent location for fish harvesting the optimum use of the rich water resources or existing water bodies of the region is remaining beyond our reach. The production and productivity of fish can not be taken to the expected level because of the lack of suitable fish fries, technical limitation of cultivation and low production at the farmer's level. The southern region of the country presents has potential for extending the livestock sector, however, lack of grazing fields, scarcity of fodder and technological limitation has impeded the development of the sub-sector. I do believe that the master plan prepared for ensuring food security through the overall agricultural development of 21% of the country's population living in the fisheries and livestock sector.

I feel glad to know that in addition to identifying obstacles to the development of fisheries and livestock sector, the master plan contains a framework of development programmes that are to be taken. It has emphasized on the maximum use of water resources, proper extension of crops, fisheries and livestock keeping harmonizing with crop cultivation on limited land. The master plan has also put forward an assessment of financial requirement to implement the prioritized programmes. I believe that the implementation of these programmes will bring about a revolution in the agricultural sector in the southern region.

I believe that the well organized master plan prepared for integrated agricultural development of the southern region will definitely show the way of agricultural development of that region. But the challenge lies in the implementation of it. We all need to take concerted efforts to face the challenge. Fulfilling the target of vision 2021 will be easier if the crops as well as fisheries and livestock sectors work together through the proper and maximum utilization of water resources.

I would like to thank those who have rendered continuous efforts in preparing this master plan. I congratulate the Ministry of Agriculture for taking the lead to prepare the master plan and FAO for their all out cooperation. I expect that the Ministry of Fisheries and Livestock and its agencies will implement the plan in coordination with all stakeholders for building a more productive region and ensure fulfilling the target of vision 2021 for supplying nutritious food for 80% of our population.

Joy Bangla, Joy Bangabandhu
 May Bangladesh stay forever.

(Md. Abdul Latif Biswas, MP)

Ramesh Chandra Sen, M.P
Minister
Ministry of Water Resources
Govt. of the People's Republic of Bangladesh



রমেশ চন্দ্র সেন, এম.পি.
মন্ত্রী
পানি সম্পদ মন্ত্রণালয়
গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

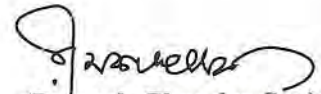
Message

The present government of Bangladesh has been pursuing uniform development throughout the country under the dynamic leadership of Hon'ble Prime Minister Sheikh Hasina. The coastal districts have generally been identified as a disadvantaged region in terms of poverty, food insecurity, environmental vulnerability and limited livelihood opportunities. Agriculture has been considered as one of the sectors that has proven contribution towards development of this region. It was the granary of the country once upon a time, but now suffering from limited productivity in all the sub-sectors of agriculture. The government has therefore undertaken various initiatives for these disadvantaged and poverty stricken southern districts.

I am pleased that the Ministry of agriculture has prepared a comprehensive development plan for agricultural development in the region. The Master Plan for Agricultural Development in the Southern Region of Bangladesh has been prepared with extensive consultations with the stakeholders including water management authority and water user community at different levels. As the most crucial factor for agricultural development, water resources management has therefore given top priority on the development agenda.

I believe that the successful implementation of any development plan largely depends on the identification of proper implementation mechanism and integrated efforts to be taken by different agencies and stakeholders concerned. I expect that the combined outcome of all interventions identified under the Plan will lead to enhanced productivity, balanced growth, value chain management, increased employment and improved access to food and nutrition through appropriate institutional arrangements and sustainable resource management.

Ministry of Water Resources and its agencies will extend fullest support and co-operation to successfully implement the activities in coordination with the agricultural agencies and contribute towards building a more productive region and thereby ensure food security and poverty alleviation in the country.


(Ramesh Chandra Sen)



Mike Robson
FAO Representative in Bangladesh

Message

The Southern Region of Bangladesh has generally been identified as disadvantaged in terms of frequent extreme events; poverty, food insecurity, environmental vulnerability; limited livelihood opportunities. Apart from the limitations and vulnerabilities, the region also has considerable potential to improve the productivity of crops, livestock and fisheries with better use of technology and improved management practices with similar agro-systems utilizing available knowledge within the country, and also taking lessons from other countries.

Considering vulnerabilities and as well the possibilities, the Ministry of Agriculture has taken the initiative to prepare a comprehensive plan for the agricultural development in the Southern region. The issue was highlighted in the Bangladesh Development Forum in 2010 and much emphasis given to preparing such a Plan. The Government of Bangladesh has this need and especially mentioned the need for a Master Plan for the southern region in the Sixth Five Year Plan. FAO has provided both technical and financial assistance to prepare this comprehensive document.

The preparation process included a multi-disciplinary team of national experts; backstopped by FAO's technical divisions in full consultation with the government line agencies, National Agricultural Research System institutes, Consultative Group on International Agricultural Research centers, development partners and other stakeholders including farmers, local government institutions, academia, community-based organizations, the private sector and civil society. A set of interventions have been selected through stakeholder consultations at the agency and regional levels. Prioritization and investment needs have also been determined.

I believe this Master Plan for agricultural development provides a road map for an integrated development effort in Bangladesh's coastal zone aiming at sustainable food security, poverty reduction and livelihood development.

A handwritten signature in black ink, appearing to read 'Mike Robson'.

Mike Robson

Secretary
Ministry of Agriculture
Government of the People's
Republic of Bangladesh



সচিব
কৃষি মন্ত্রণালয়
গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

Foreword

Agriculture is a predominant sector in Bangladesh that greatly contributes to employment generation and livelihood management. It is also the principal source of food and nutrition. Therefore, agricultural farm production and prices are key determinants of poverty and human welfare. The government is firmly committed to ensuring equitable development for alleviating poverty particularly by stressing more on faster growth in disadvantaged regions. Agricultural development is considered a major driver for faster growth in those regions, especially in the coastal districts.

Promoting agricultural growth requires appropriate policies and plans ranging from adoption of new technology and extension services to providing credit to small farmers. The Ministry of Agriculture has prepared a comprehensive plan titled 'Master Plan for Agricultural Development in Southern Region of Bangladesh' to supplement the strategies adopted in the Sixth Five Year Plan for faster development in agriculture in the most disadvantaged southern region of the country. Water Resources has been considered a cross cutting area for intervention that has direct impact on each of the sectors. The Plan has been prepared in consultation with all stakeholders, and after extensive investigation at all levels.

I am pleased that the concerned Ministries/Divisions/Agencies and other stakeholders have participated in the preparation process and helped us prepare a well coordinated plan. I thank them for their continued support and expect the same during the implementation of this plan. I strongly believe that the successful implementation of the plan will contribute towards the goal of Bangladesh becoming a middle income country by 2021.

I would like to extend our sincere thanks to Food and Agriculture Organization (FAO) of the United Nations for assisting the Ministry of Agriculture in preparing this Master Plan. This process has showed their earnest commitment towards development of vulnerable areas and strengthen our ties. I also thank other development partners who have also made valuable suggestions in outlining the areas of interventions. I expect their participation in the implementation of this plan by way of investment and technical assistance.

I express gratitude to the Honourable Minister of Water Resources, Honourable Minister of Fisheries and Livestock, and finally Honourable Minister of Agriculture for their visionary support and suggestions in formulating this Master Plan. Their commitment to develop the southern region of the country has made it possible to outline this visionary plan for ten years.

The Master Plan is a living document and we would revise it as and when necessary. We apologise for any lapses or omissions for which we are alone responsible.

Monzur Hossain
Secretary, Ministry of Agriculture

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ACRONYM

AAI	Action Aid International
ADAB	Association of Development Agencies in Bangladesh
ADP	Annual Development Programme
AEZ	Agro-Ecological Zone
AI	Artificial insemination
ASA	Association for Social Advancement
BADC	Bangladesh Agricultural Development Corporation
BARC	Bangladesh Agricultural Research Council
BARI	Bangladesh Agricultural Research Institute
B.Aus	Broadcast Aus
BBS	Bangladesh Bureau of Statistics
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BD	Bangladesh
BDT	Bangladeshi Taka
BDHS	Bangladesh Demographic & Health Survey
BINA	Bangladesh Institute of Nuclear Agriculture
BRAC	Bangladesh Rural Advancement Committee
BRDB	Bangladesh Rural Development Board
BRII	Bangladesh Rice Research Institute
BSCIC	Bangladesh Small & Cottage Industries Corporation
BWDB	Bangladesh Water Development Board
C	Centigrade
CBO	Community Based Organization
CCP	Chittagong Coastal Plain
CDF	Credit & Development Forum
CDS	Coastal Development Strategy
CDSP	Char Development and Settlement Project
CEGIS	Center for Environmental & Geographic Information System
CEP	Coastal Embankment Project
CEO	Chief Executive Officer
CGIAR	Consultative Group on International Agricultural Research
CIP	Country Investment Plan
CMNS	Child and Mother Nutrition Survey of Bangladesh
CPF	Country Programming Framework
CSO	Civil Society Organization
CVASU	Chittagong Veterinary and Animal Sciences University
DAE	Department of Agricultural Extension
DAM	Department of Agricultural Marketing
DANIDA	Danish International Development Agency
DC	Deputy Commissioner

DFID	Department for International Development
DIC	District Implementation Committee
DLS	Department of Livestock Services
DoC	Department of Cooperatives
DoF	Department of Fisheries
DP	Development Partner
DTW	Deep Tube-Well
DUEO	Dhaka University Earth Observatory
EC	Executive Committee
EEZ	Exclusive Economic Zone
EH	Eastern Hills
EPWAPDA	East Pakistan Water and Power Development Authority
EPZ	Export Processing Zone
ERD	Economic Relations Division
ESCAP	Economic and Social Commission for the Asia and the Pacific
FAO	Food and Agriculture Organization of the United Nations
FD	Forest Department
FFS	Farmer Field School
FY	Financial Year
GBM	Ganges-Brahmaputra-Meghna
GDP	Gross Domestic Product
GED	General Economic Division
GoB	Government of Bangladesh
GPWM	Guidelines for Participatory Water Management
GTPE	Ganges Tidal Plain East
GTPW	Ganges Tidal Plain West
ha	Hectare
HH	Household
HIES	Household Income & Expenditure Survey
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
HL	High land
HR	Human resource
HYV	High Yield Variety
IAIC	Inter-Agency Implementation Committee
ICT	Information and Communication Technology
ICZM	Integrated Coastal Zone Management
ICZMP	Integrated Coastal Zone Management Plan
IFPRI	International Food Policy Research Institute
IMAC	Inter-Ministerial Advisory Committee
IMIC	Inter-Ministerial Implementation Committee
IMICC	Inter-Ministerial Implementation Coordination Committee

InF	Institute of Microfinance
IPCC	Intergovernmental Panel on Climate Change
IPSWAM	Integrated Planning for Sustainable Water Management
km	Kilometer
LCS	Landless Contracting Society
LGD	Local Government Division
LGED	Local Government Engineering Department
LGI	Local Government Institution
LLP	Low Lift Pump
LT	Long Term
m	Meter
MASR	Master Plan for Agricultural Development in the Southern Region
MCS	Monitoring, control and surveillance
MDG	Millennium Development Goals
MDP	Meghna Deltaic Plan
MFI	Microfinance Institution
MHL	Medium high land
mm	Millimeter
MoA	Ministry of Agriculture
MoEF	Ministry of Environment & Forest
MoF	Ministry of Food
MoDMR	Ministry of Disaster Management and Relief
MoFL	Ministry of Fisheries & Livestock
MoL	Ministry of Land
MoWR	Ministry of Water Resources
MRA	Microfinance Regulatory Authority
MT	Medium Term
NAP	National Agriculture Policy
NAPA	National Adaptation Programme of Action
NARS	National Agricultural Research System
NCA	Net Cropped Area
NFP	National Food Policy
NGO	Non Government Organization
NMTPF	National Medium Term Priority Framework
NWMP	National Water Management Plan
NWP	National Water Policy
O&M	Operation and Maintenance
PDO-ICZMP	Program Development Office-Integrated Coastal Zone Management Plan
PPP	Public-private partnership
ppt	Parts per thousand
QPM	Quality Protein Maize

RD	Rural Development
SBCP	Sundarban Biodiversity Conservation Project
SC	South Central
SE	Southeast
SFYP	Sixth Five Year Plan
SLR	Sea level rise
SR	Southern region
SRDI	Soil Resource Development Institute
SSWRD	Small Scale Water Resources Development
SW	Southwest
ST	Short Term
STW	Shallow Tube-well
t	Tonne (metric ton)
TA	Technical Assistance
T.Aman	Transplanted Aman
T.Aus	Transplanted Aus
TCA	Total Cropped Area
TFR	Total Fertility Rate
Tk	Taka
TRM	Tidal River Management
UIC	Upazila Implementation Committee
UNICEF	United Nations Children's Fund
UP	Union Parishad
UNDP	United Nations Development Programme
UNFPA	United Nations Population Fund
USAID	United States Agency for International Development
UZP	Upazila Parishad
WAPDA	Water and Power Development Authority
WARPO	Water Resources Planning Organization
WB	The World Bank
WCS	Water Control Structure
WFP	World Food Programme
WMA	Water Management Association
WMF	Water Management Federation
WMG	Water Management Group
WMO	Water Management Organization

GLOSSARY

Bagda	Brackish water shrimp species
Bahadder	Owner of the fleet of fishing boats and gear
Bawali	Wood-cutter in the Sundarban forest
Beel	Perennial water body in the floodplain
Bele-doash	Sandy loam
Baor	Oxbow lake
Bundh	Cross-dam
Char	Newly accreted land from the river/sea bed
Dadander	Money lender with conditionality of advance purchase of product/labor
District	Administrative unit comprising several upazilas
Doash	Loamy
Golda	Freshwater prawn species
Golpata	Mangrove species; leaves are used as materials for roof
Ilish	Major fish species in Bangladesh (Hilsa ilisha or <i>Tenualosa ilisha</i>)
Khal	Canal
Kharif	Crop season from mid-March to October
Mawali	Honey collector in the Sundarban forest
Mohajan	Moneylender
Muri	Puffed rice
Paiker	Wholesaler
Polder	Reclaimed land with water management system
Pourasabha	Municipality; urban administrative unit
Rabi	Mid-October to mid-March
Salish	A forum of mediation comprising the clergy or influential community leaders
Samaj	A platform based on kinship, neighbourhood and caste
Sundarban	Name of the mangrove forest in southwest Bangladesh
Taka	Bangladesh currency
Union	Lowest level administrative unit comprising several villages
Union Parishad	Local government at the Union level
Upazila	Administrative unit under a District comprising several unions
Upazila Parishad	Local government at the Upazila level
Union Parishad	Elected local government at the union level

CONVERSION

2.471 acre	= 1 hectare
80 taka	= 1 US\$
1 inch	= 2.54 centimeter
1 tonne	= 1,000 kg

EXECUTIVE SUMMARY

1. Introduction

The Master Plan for Agricultural Development in the Southern Region of Bangladesh covers three hydrological regions- south central, southwest and southeast of the coastal zone covering 14 districts. The Master Plan has been developed in accordance with, and as a logical consequence of, several other policies and programmes that are on board.

The coastal districts have generally been identified as a disadvantaged region in terms of poverty, food insecurity, environmental vulnerability and limited livelihood opportunities. The Ministry of Agriculture has therefore taken the initiative to prepare a comprehensive plan for the agricultural development in the region. The issue was highlighted in the Bangladesh Development Forum in 2010 and the Government put much emphasis to prepare such a Plan. The government has, therefore, recognized the current state of the region and especially mentioned the need for a Master Plan for the southern region in the Sixth Five Year Plan. The Ministry of Agriculture has taken the lead in the preparation process of the proposed Master Plan. It provides a detailed plan, estimates of investment need and a list of priority programmes.

The objective of the Master Plan is to provide a road map for an integrated agricultural development in the coastal districts of Bangladesh aiming at sustainable food security, poverty reduction and livelihood development for the poor. The Plan particularly focuses on, among others, the following:

- a. increasing agricultural productivity;
- b. improving water management and rejuvenating productivity of degraded lands;
- c. developing climate resilient infrastructure and improving surface water irrigation system;
- d. improving productivity of brackish water shrimp and capture fisheries; and
- e. promoting smallholder poultry and dairy development.

It is expected that the combined outcome of all these interventions will lead to enhanced productivity, balanced growth, value chain management, increased employment and improved access to food and nutrition through appropriate institutional arrangements and sustainable resource management. The Master Plan covers the period from 2013 to 2021.

The Master Plan has been prepared by the Ministry of Agriculture in collaboration with the Ministry of Fisheries & Livestock and Ministry of Water Resources, and with technical assistance from the Food and Agriculture Organization of the United Nations (FAO). The preparation process included a multi-disciplinary team of national experts; backstopped by FAO's technical divisions and continuous consultations with the government line ministries and departments, National Agricultural Research System (NARS) institutes, Consultative Group on International Agricultural Research (CGIAR) centers, development partners and other stakeholders including farmers, local

government institutions, academia, community-based organizations (CBOs), the private sector and civil society. A set of interventions have been selected through stakeholder consultations at the agency and regional levels. Prioritization and investment needs have also been determined through stakeholder consultations.

2. Social Profile

The southern region accounts for 27 percent of the area and 21 percent of the population of the country. The region has a total area of 39,617 sq. km, 6.38 million households and 29.86 million people as of March 2011. Non-farm households are 46 percent of total households. The extent of landlessness is as high as 65 percent in the southern region. Farmers and agriculture laborers are major livelihood groups. There are other occupational groups who earn their living from activities determined by coastal conditions, such as shrimp fry collector, salt farmer, shrimp farmer, fisher, etc.

Land is highly concentrated in few hands. Top 7 percent of households (medium and large farmers) own 36 percent land and top one percent of households (large farmers) own 10 percent land, while the bottom 46 percent households own only 13 percent land in the region.

Primary school enrolment rate is lower in the region than the national average, while literacy rate is higher. On the other hand, health situation is poorer in terms of population-hospital bed ratio, as well as the extent of severe child malnutrition. State of reproductive health is also relatively poor in the region.

3. Resource Base

The region has a network of many rivers and channels, most of which are under seasonal dependent tidal regime. Around 1.1 billion tons 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.

Groundwater salinity in the coastal areas and offshore islands is a limiting factor in some parts of the region, 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.

Surface water salinity is a normal hazard in many parts of the study area. In the southwest 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 for normal agricultural practices.

In the monsoon, most of the rivers and *khals* are navigable. But in the dry season, most of these contain less water. Many internal rivers and *khals* in the network have been silted up and water is not desirably available in the dry season.

Wetlands (ponds, *beels* and *baors*) are common features in the landscape and are used as water

reservoirs. Ponds are used for fish culture and other household uses. *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.

The natural environment of the region is largely diversified. The region has different land types, soils, and agro-ecological systems and is also rich in biodiversity comprising different bio-ecological zones. Intertidal areas are biologically active and play a crucial role in the food and reproduction cycles of many marine species, and form potentially new cultivable land.

Two-thirds of the net cropped area is under poorly-drained condition. The dominance of poorly-drained soil of the region indicates that the removal of salinity from soil is a major constraint for agriculture.

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.

Soil salinity is one of the main constraints for crop production in the southern region. The withdrawal of fresh water from upstream, irregular rainfall, introduction of brackish water for shrimp culture, faulty management of sluice gate and polders, regular intrusion of tidal saline water during high tide in the unprotected lands, capillary rise of soluble salts etc. are the main causes of increased soil salinity in the surface soil. About 1.05 million hectares in the region are affected by soil salinity. Most of the areas are under low level of available soil moisture.

4. Resource Management

The region lags behind the country in terms of the intensity of agricultural (crop) land use. Land is predominantly single (50%) and double (40%) cropped, the cropping intensity being 159 percent, compared to 176 percent in Bangladesh as a whole, according to agricultural census of 2008. In the southern region, 15 percent of total cultivable land is either fallow and/or not being used. Major physical factors responsible for land being not used intensively are soil salinity, water salinity, subsidence, water logging, lack of surface water irrigation system (lifting device) and farmers' knowledge gap. The major cropping patterns are Fallow-T.Aman-Fallow (38.5% of the NCA), followed by B.Aus-T.Aman-Rabi (24.1% of the NCA) and T.Aus-T.Aman-Fallow (14.1% of the NCA).

Minor irrigation programme is overwhelmingly dependent on extraction of groundwater. The extent of surface water irrigation using low-lift pumps (LLP) is small.

Polders, numbering 139, are major interventions in the region. Over the period of time, a lot of changes have occurred. While these contributed significantly in enhancing food production in the initial period, they are now gripped in second generation problems, both social and environmental.

- **Siltation:** Due to empoldering, natural inundation outside the polders has been obstructed by embankments resulting in higher elevation of land outside the polder and no siltation inside.
- **Drainage:** Because of siltation of outfall channels, channels within polders have significantly lost drainage capability resulting in water logging. The problem has been compounded by siltation of internal drainage channels.
- **Water logging:** Because of land accretion, particularly in the Meghna estuary, many rivers and *khals* (drainage canals) have been silted up. Onrush of upstream flow and prolonged rainfall often cause water logging. This problem has been aggravated by empoldering.
- **Salinity:** Though soil salinity declines in the long run because of empoldering, problem recurs because of erosion and embankment failure mainly due to breaches or overtopping by storm surge.

5. Challenges

The region is overwhelmingly conditioned by its geographical location, hydrological and morphological character and geo-physical and bio-physical characteristics. Proximity to the sea has added further dimensions to its vulnerabilities and opportunities. The region faces many challenges.

Sea Level Rise and Climate Change

It is estimated that inundated area in the region will increase by 14 percent by 2100 with a sea level rise scenario of 88 cm. The adverse impact of climatic events will manifest in lower crop productivity and less cropping intensity. Increased frequency of extreme events such as cyclone, storm surge, sea level rise, soil and water salinity, incidence of pest attack and diseases, erratic rainfall and higher temperature will be observed. People's food security will be at risk.

Erosion

Coastal and river bank erosion has been a regular phenomenon in off-shore islands, particularly in Bhola, Hatiya, Sandwip and Kutubdia. Due to bank erosion, Sandwip has lost 180 km² in last 100 years; Bhola Island has been squeezed to 3,400 km² from 6,400 km² since 1960 and Kutubdia, lost 65 percent of its area in last 100 years.

Salinity

Salinity is a major constraint that hinders production of crops. But all areas are not saline at all times. In the southern region, Khulna, Bagerhat and Satkhira are the worst hit by water salinity, while Feni, Lakhshmipur and Pirojpur are least affected. Embankments and polders are constructed surrounding these areas to protect agricultural land. But occasionally high tidal surge hits these areas and saline water enters inside the polders and destroys standing crops.

Water logging

Water logging, both perennial and seasonal, is a severe problem. The drainage system consists of a dense network of different types of natural canals and drains. The system includes the major

perennial rivers such as the Gorai flowing along northern boundary and other rivers marking the eastern boundary, which are either distributaries or tributaries of these rivers and flowing mostly from north to south. Off take of these distributaries and outfall of the tributaries are silted up disconnecting water flow in the dry season. As a result of interrupting drainage system and siltation of rivers/canals, permanent water logging in the form of 'Beel' has been created in this

region. Among the major *beels* are Beel Dakatia in Jessore and Khulna and Bhutiar Beel in Bagerhat. Noakhali Khal is the main drainage channel of the region which is completely silted up causing severe water-logging.

Vulnerable polders

Many polders are in dilapidated conditions in terms of breach and slip in the embankment, erosion, poor repair works, drainage congestion and location in the risk zone. Water control structures in many places are damaged or non-functional. The emerging threat of climate change and consequent sea level rise has made many of these polders more vulnerable. Bangladesh Water Development Board (BWDB) has categorized 51 polders as "most vulnerable" and another 55 polders as "medium vulnerable".

Land use conflict

Shrimp farmers bring saline water inside the polder by cutting embankment or using LLP. This affects salinity balance inside the polders and causes damage to crops in surrounding fields. Competing land use often results in confrontation and violence and thereby affects the social fabric. Polders have not been designed for the multi-functional land use and the BWDB has no mechanism to deal with land use conflicts. The state of water management is generally poor. Competing land use between crop and shrimp often results in confrontation among the farmers.

Lack of availability of quality surface water for irrigation

The southern region has a network of rivers and canals and plenty of water is available in the main rivers around the year. But during *rabi* and *pre-kharif* season there is a dearth of quality surface water for irrigation. Most of the rivers are tidally influenced and water salinity is higher than the irrigation threshold level for agricultural crops. Other than some pockets, expansion of surface water irrigation is constrained by poor quality water, mostly brackish and saline. The areas identified for expansion of surface water for *boro* and *T. aus* crops also require investment for infrastructure development and creation of lifting devices.

Availability of very limited number of stress tolerant crops and cultivars

The NARS system has developed many promising technologies including development of new varieties of crops and management practices for the favorable eco-system of Bangladesh. However, very few salt, drought and submersive tolerant cultivars or appropriate management practices to improve cropping intensity for boosting agricultural production have been developed so far for the southern region. The productivity of already developed cultivars is also not promising against the severe stresses encountered.

Population and employment

Population of the region is increasing while availability of land for agriculture is decreasing. This means that in future, availability of food will be constrained, with the risk of further malnutrition. With increasing urbanization and demand for infrastructure, cultivable land will be more and more shifted to other land uses. There will be increased pressure on the natural resource base, with risks of further degradation of land and water quality. With increasing social mobility, particularly of women, and with increased adult population, the supply of labor force will increase. There is a need for additional 0.2 million jobs every year to maintain at least the present level of employment, if not more.

Credit

Volume of institutional credit is conspicuously low. About 80 percent of the volume of credit available comes from non-institutional sources largely dominated by *mohajans* and *dadanders*. They charge interest on loans at exorbitant rates, generally 10 percent per month. Loan conditionality of *dadanders* is quite stringent, as they lend money with the guarantee of repayment in the form of products whose price is fixed unilaterally by them in advance. This is a common practice for fishers who borrow money from *bahadders* before taking the fleet to the estuary and the sea, and dispose of the catch at a price or proportion determined by the *bahadder*. Advance sale of labor in crop fields in exchange for loans (cash or rice) is also common.

Market linkage

Density of market in the region is low compared to other locations of Bangladesh. Post-harvest loss is very high, particularly in the monsoon season, due to absence of market infrastructure and facilities. There are few collection centers/packing houses for sorting, grading/packaging. Warehousing facilities at village/union level for perishable commodities are absent. Market places are exposed and so highly vulnerable to cyclone and tidal surge.

Other challenges

The other challenges are poor land use and low productivity, changing of fish migratory routes due to insufficient upstream flow, siltation and pollution, fresh water scarcity for domestic purpose and irrigation, absence of coordination among service providers, conflicting demand for natural resources, narrow project approach, water management organizations have not been developed, or system collapses after withdrawal of the project, minimum accountability of service providers, lack of a holistic approach on farming system, etc.

6. Current Scenario and Development Potentials

Despite these many challenges, the region has considerable potential for crop, horticulture, fishery, livestock and value chain enhancement. The region is largely dominated by medium high land which is suitable for different agricultural practices around the year. The productivity of rice in all seasons can be increased more than two tonnes per hectare through expansion of suitable HYV cultivars, better agronomic management practices and on-farm water control. There is opportunity

for increasing surface water irrigation. The salinity level in many areas is less than the threshold limit of many crops, indicating that about 0.7 million ha of land could be brought under surface water irrigation.

There is scope to increase coverage and productivity of T. Aus rice in the region using improved management practices. Total potential T.Aus area is 740,346 ha of which 38% is suitable and 40% is moderately suitable. Potential surface water irrigation area in the region is 695,200 ha, while potential Boro area under surface water irrigation is estimated at 467,000 ha.

The following strategic interventions are suggested for increasing **productivity** of different crops and sustaining cropping patterns:

- Productivity increase of T.Aman in tidal and non-tidal areas;
- Productivity enhancement of T.Aus along with development of HYV Aus varieties, as well as introduction of short duration (85-90 days) and submergence tolerant varieties;
- Expansion of *boro* cultivation and productivity enhancement;
- Promotion of pulses (khesari, mungbean, cowpea and chickpea), oilseeds (sesame, sunflower, groundnut etc.) and new crops (maize, chili, sugar beet, soybean, mushroom, jute and chewing sugarcane).

In addition to these, the following should be emphasized for diversifying food and nutritional sources:

- promote mixed fruit orchards and intercropping for increasing production of horticulture food crops at low cost, e.g. maize, sorghum, millets, etc;
- encourage intercropping in order to produce more non staple food crops;
- encourage development of biotechnology in animal and plant breeding and facilitate exchanges of new advances in biotechnology;
- capacity building for promoting post harvest handling, processing, preservation and storage with a focus on preserving micronutrient rich foods.

There is also good potential to increase production of fish by developing capture fisheries, promoting cage culture, fish seed multiplication farms and marine fish production. Brackish water shrimp farming has expanded fast, but with very low yields. With improved organization it is possible to double productivity in this area through improved technology, better scientific management and more investments. While it is necessary to restrict unplanned expansion of shrimp culture in areas (149,730 ha) where the potential is low, it is also important to promote it in areas where the suitability is high (150,508 ha).

Possibility of fish productivity enhancement through cage/pen culture exists in the south-central area. Total area suitable for cage/pen culture is estimated at 7,900 ha. Marine fishery has also very high potential, but needs appropriate management and a conservation strategy. The major interventions needed are:

- Piloting of community based pen and cage culture;

- Community based open water stocking and biological management;
- Enhance productivity of pond culture;
- Enforcing land zoning and productivity enhancement of shrimp;
- Establishing and maintaining fish sanctuaries.

The region has a wide coverage of fallow land, river and canal and vast accreted area, which can be utilized for livestock rearing. The density of sheep, goat and duck in Noakhali, Bhola and Patuakhali is high and can be further expanded. At the household level, back-yard poultry rearing is a common practice and can be further promoted. Following interventions are considered:

- Replication and upscaling of community livestock rearing including poultry, duck and dairy development in the southern region;
- Upscaling community-based dairy farming as that of the Satkhira model;
- Promotion of HYV fodder cultivation;
- Strengthening animal health care services;
- Establishing Artificial Insemination (AI) service center in each union.

There is a large potential to **augment water resources** by reactivating the silted-up rivers through re-excavation. In Barisal region, dry season irrigation can be greatly facilitated using surface water, which remains fresh almost all year round. In other areas, rainwater harvesting could be a potential source of irrigation and livestock rearing.

Potential areas for intervention are:

- Excavation/re-excavation of silted and dried up canals, construction of water control structures and pump houses
- Surface water conservation through construction of rubber dam / cross-dam / regulator, etc for development of minor irrigation
- Excavation of reservoir/ pond for water conservation for surface water irrigation development
- Restoration of severely waterlogged areas in Noakhali mainland
- Improving drainage, water logging and flood management through capital dredging of silted and dried up rivers
- Community-driven tidal river management (TRM) in severely waterlogged areas in the southwest region
- Integrated on-farm water management
- Rainwater harvesting through construction of water reservoirs
- Promotion of solar energy for operating irrigation equipment
- Rehabilitation and improvement of Muhuri, Bhola and Barisal Irrigation Project
- Operation and Maintenance (O&M) of irrigation structures by community-based institutions
- Legal framework for implementation of local level institutional arrangements
- Repair and rehabilitation of damaged polders

- Redesigning and new construction of climate resilient polders
- Accelerating land accretion through construction of cross-dam
- Sustainable use of accreted land resources

Areas of potential in **agri-business development** are:

Crops and agro-forestry

- Oil extraction plant for Soybean in Noakhali and coconut in Khulna and Noakhali
- Promoting value addition to farm produce and processed products by environmental and user-friendly post harvest technologies and byproduct utilization
- Developing refrigerated and/or non-refrigerated storage technology for preservation of potato, sweet potato, aroids, onion, spices and fresh vegetables
- Developing refrigerated storage technology for fresh cut vegetables and fruit cobbler
- Developing processing and preservation technologies for fruits, vegetables and spices
- Establishment of fruit processing plants

Fisheries

- Support establishment of shrimp and fish processing and preservation plants in private sector in Khulna, Satkhira, Barisal, Bhola, Noakhali and Cox's Bazar
- Support to environment friendly quality fish drying plants in Noakhali, Khulna and Cox's Bazar
- Support to establishment of modern hatcheries in the private sector

Livestock

- Expansion of Milk Vita activities in Bhola, Chittagong and Khulna region. Other milk processors also need to be encouraged with special incentives
- Meat processing plant could be established in Chittagong, Noakhali, Khulna, Barisal and Bhola
- Establishment and expansion of feed mills in Chittagong, Noakhali and Khulna
- Promotion of private veterinary health care practices through training of professionals and para-professionals and providing credit facilities.

Transport

- Building and improving roads and river transport network with good cargo handling facilities
- Develop growth centers and inland ports
- Improving safety standards for transporting agricultural commodities

In addition, **homestead gardening and nutrition education** programmes need to be scaled up. Future agricultural intervention programmes should include explicit objectives of improving nutritional status with a focus on addressing child malnutrition. Child stunting needs to be addressed through strengthening linkages between complementary feeding

requirements/practices and agricultural production.

7. Prioritization of Investment Needs

Based on field study, regional consultations and interaction with various stakeholders, 85 interventions have been identified under 26 programs across 10 components. The components are crops, horticulture and agro-forestry; fisheries; livestock; nutrition; water management; drainage management; polder improvement; agri-business; agricultural credit; and capacity building.

Priorities are grouped into four categories in line with the criteria used in the Country Investment Plan (CIP). These are:

- 1) **Top:** Interventions will provide immediate benefits to large sections of the population and there is already commitment from the Government of Bangladesh.
- 2) **High:** Interventions where efforts will benefit people in specific areas and are needed to be implemented immediately.
- 3) **Medium:** Important interventions where implementation may be needed in future.
- 4) **Low:** Interventions where implementation depends on the availability of resources (Table 1).

Table 1: Interventions and investment need by priority

Priority	No. of interventions	Investment need (million)	
		BDT	US\$
Top	24	258,673	3,196
High	37	265,955	2,778
Medium	19	46,795	1,169
Low	5	6,603	83
Total	85	578,026	7,225

Numbers may not add to totals due to rounding

Financing

Financing of the programmes outlined in the Master Plan is important and challenging. Concerted efforts are required in this direction by bringing all possible funding sources on board. Financing sources will include, among others, the following.

Special allocations will be made in the Annual Development Programme (ADP). The ADP will be aligned and harmonized in line with investment needs and priorities of the Master Plan. The resource gap will be met through financial assistance from the Development Partners (DPs). This is very much expected as the Bangladesh Development Forum also requested for such a Master Plan in 2010. In addition, many interventions already have some activities underway.

The private sector, such as the Chambers of Commerce and Industries, is a key player, which needs to take a lead role in the Master Plan, particularly in financing agri-business programs. The

construction of the Padma Bridge will open considerable opportunities for the private sector to contribute to the national development, particularly in the southern region.

8. Implementation and Management

The southern region contains a large number of polders. But what matters more than infrastructure is the need for a people-centred focus which must be embedded in all planning exercises. In the context of polders, the spotlight should be on farmers and their endogenous institutions. All service providing agencies should harmonize their roles and relationships and work out an arrangement that would yield maximum benefit for the people living in polders.

A sustainable institutional framework is yet to be put in place. Union Parishad (UP) is the most sustainable Local Government Institution (LGI) that has passed the test of time. UP must have a broader mandate to play a facilitating role in developing and promoting field level institutions, as well as in providing umbrella support to all community-based institutions. Lessons learnt from the Netherlands and Vietnam on engagement of local communities in implementation and O&M of polders need to be utilized in the implementation process of the Master Plan.

The Master Plan is a multi-level and multi-sectoral collaboration involving several ministries, departments, and other entities including the local government and the private sector. Certain programmes are of very local nature; others will involve more than one district. Thus, institutionalization of the Master Plan requires a functional mechanism for coordination and interaction between and among the many parties involved at national, district and local levels.

It is recommended that relevant line agencies will implement their respective sectoral programmes as per existing administrative norms. However, new institutional arrangements need to be in place to facilitate coordination among the stakeholders whose activities affect one another.

To coordinate the implementation, the Ministry of Agriculture will continue to function as the lead Ministry, while the Department of Agricultural Extension will be the lead agency. An Inter-Ministerial Implementation Coordination Committee will be responsible for overall coordination and amount oversight. To ensure overall coordination of implementation, the following arrangements are recommended:

- Inter-Ministerial Implementation Coordination Committee (IMICC): The Minister in charge of the Ministry of Agriculture will be the Chair, while Ministers of the Ministry of Water Resources and Ministry of Fisheries and Livestock will be the Co-Chairs. The members of the committee will comprise of the Secretaries of the Ministry of Agriculture, Ministry of Water Resources, Ministry of Fisheries and Livestock, Ministry of Water Resources, Ministry of Fisheries and Livestock, Ministry of Food, Ministry of Disaster Management and Relief, Ministry of Land, Local Government Division, Rural Development and Co-operative Division, Economic Relations Division, Member-Generals of the Economics Division, Agriculture, Water resources and Rural Institution Division and Planning Commission and Chief Executives of all participating departments/organizations..

Inter-Ministerial Implementation Committee (IMIC): The Secretary of the Ministry of Agriculture

will be the Chair. Secretaries of the Ministry of Agriculture, Ministry of Water Resources, Ministry of Fisheries and Livestock, Ministry of Environment and Forests Ministry of Food, Ministry of Disaster management and Relief, Ministry of Land, Local Government Division, Rural Development and Co-operative Division, Economic Relations Division and Member-General of Economics Division and Agriculture, Water resources and Rural Institution Division of the Planning Commission and chief executives of all participating departments/ organizations/ forums will be the member. Members of the committee will consist of the Secretaries of the Ministry of Agriculture, Ministry of Water Resources, Ministry of Fisheries and Livestock, Ministry of Environment and Forests Ministry of Food, Ministry of Disaster Management and Relief, Ministry of Land, Local Government Division, Rural Development and Co-operative Division, Economic Relations Division, Member-Generals of Economics Division and Agriculture, Water Resource and Rural Institution Division of the Planning Commission and Chief Executives of all participating departments/organizations/forums.

- A District Implementation Committee (DIC) will be in place involving all available Division/District level members of the relevant organizations. The Additional Director of the Department of Agricultural Extension covering the district will be the Chair.
- An Upazila Implementation Committee (UIC) will be set up at the Upazila level. The Deputy Director of the Department of Agricultural Extension covering the Upazila will be the Chair.
- A senior officer of the Ministry of Agriculture not below the rank of an Additional Secretary will be responsible for day to day coordination of the implementation process from Dhaka.
- Each participating department/organization will nominate a focal point as operational contact in relation to Master Plan activities and maintain contact with the lead agency for liaison and coordination.
- Committees at all levels will meet on a regular basis.

It has to be acknowledged that all stakeholders are important and relevant. Their participation as partners will definitely add strengthen and legitimacy for the implementation of the Master Plan.

1.1 Context

Bangladesh, the largest deltaic flood plain in the world, slopes gently from the north to the south, meeting the Bay of Bengal at the southern end. The coast of Bangladesh is physiologically and ecologically diverse, and environmentally vulnerable.

Preparation of a Master Plan for Agricultural Development in the Southern Region was initiated following the meeting of the Bangladesh Development Forum in 2010. The Cabinet Division of the Government of Bangladesh felt the need and asked the Ministry of Agriculture to coordinate the preparation process. Later, the Ministry of Agriculture requested the Food and Agriculture Organization of the United Nations (FAO) to facilitate the process of its preparation.

The Ministry of Agriculture and FAO, in the Country Programming Framework (CPF) 2010, identified the southern region of Bangladesh as one of the major potential areas for agricultural development, poverty reduction and food security. Later the Government prepared a Country Investment Plan (CIP) for agricultural development and food security in 2011 which entails a road map towards investment in agriculture, food security and nutrition. The programme was inserted in the Sixth Five Year Plan (SFYP) 2011-2015 as the Master Plan for Agricultural Development in the Southern Region of Bangladesh.

FAO developed a concept note on the Master Plan through a consultative process. The Government approved the concept note and requested FAO to facilitate the formulation process of Master Plan for Agricultural Development in the Southern Region. The Master Plan has been aligned with the SFYP and other planning documents (Figure 1.1).

The Master Plan covers three hydrological regions- South Central (SC), Southwest (SW) and also Southeast (SE) of the coastal zone, which includes 14 districts (Figure 1.2). Reserve forests, unclassified state forests, coastal plantations and protected areas (1.286 million ha) have been excluded from the purview of this Master Plan. Because of wide diversity in forestry, it needs a different management system and hence a separate master plan is suggested.



Figure 1.1: Linkage of the Master Plan with national policies and programmes

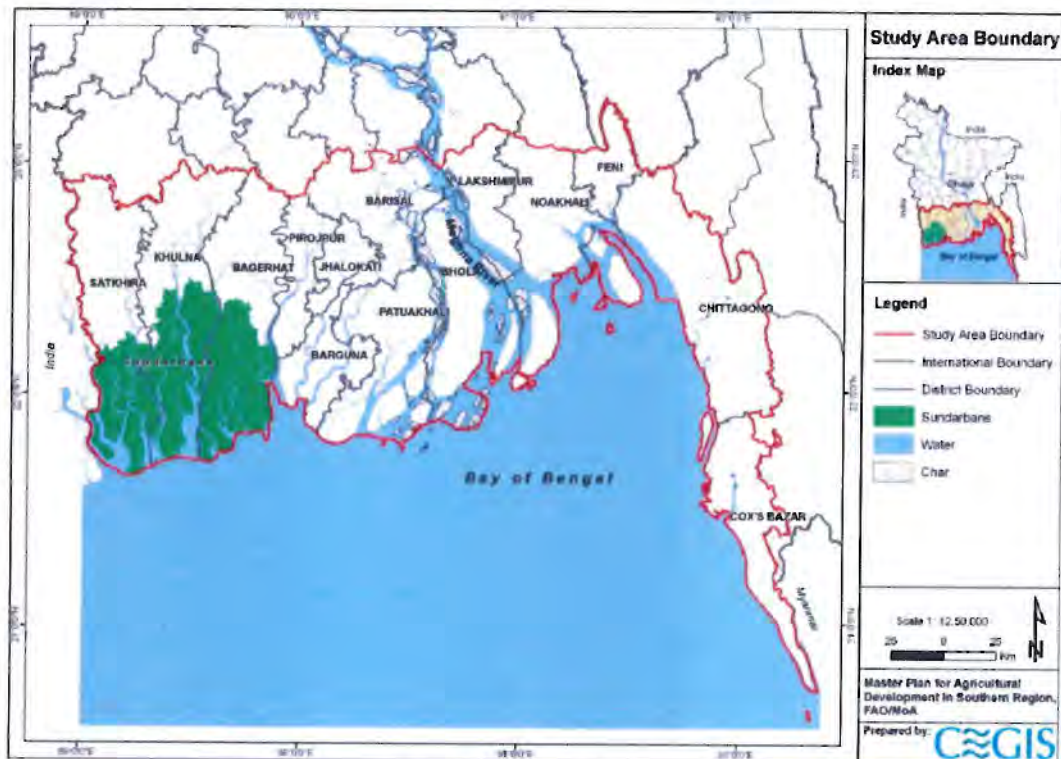


Figure 1.2: Study area

1.2 Linkage with CIP

In 2010, the Government of Bangladesh prepared the CIP, which provides guidance on investments in agriculture. The CIP has put strong emphasis on regional issues to address food security. The coastal districts have generally been identified as a disadvantaged region in terms of poverty, food insecurity, environmental vulnerability and limited livelihood opportunities.

The CIP is a planning, fund mobilization and alignment tool. It supports public investment to increase and diversify food availability in a sustainable manner and improve access to food and nutrition security for the country. It provides a coherent set of 12 priority investment programmes to improve food security and nutrition in an integrated way. These programmes have been grouped under three components, such as, food availability, food access and food utilization.

The government has also recognized the current state of the southern region and especially mentioned for a need in the SFYP to prepare a Master Plan for the southern region of Bangladesh. The Master Plan for Agricultural Development in the Southern Region provides a detailed plan, investment need and priority programmes, which is directly linked with the CIP. The Master Plan further elaborates the CIP in eight programme areas with a regional focus that would operationalize the CIP. Ancillary to the CIP programmes, irrigation and drainage improvement, polder management and agricultural credit have also been incorporated in the Master Plan. These programmes would supplement initiatives on production of and access to food through

infrastructure development, productivity enhancement, employment generation and livelihoods improvement.

1.3 Objectives

The declared objective of the Master Plan is "to provide a road map for an integrated agricultural development in the coastal zone of Bangladesh aiming at sustainable food security, poverty reduction and livelihood development for the poor." The Plan particularly focuses on, among others, the following:

- a. increasing agricultural productivity;
- b. improving water management and rejuvenating productivity of degraded lands;
- c. developing climate resilient infrastructure and improving surface water irrigation system; improving productivity of brackish water shrimp and capture fisheries;
- d. promoting smallholder poultry and dairy development;
- e. promoting agribusiness development through improving agricultural marketing through value addition activities.

It is expected that the combined outcome of all these interventions will lead to enhanced productivity, balanced growth, value chain management, increased employment and improved access to food and nutrition through appropriate institutional arrangements and sustainable resource management.

The Master Plan covers the period to 2021.

1.4 Current Policies and Programmes

The Master Plan has been developed with cognizance of several other policies and programs that are on board. It is vertically and horizontally linked with a host of government policies and plans that substantiates the government's declared objective for sustainable development along with economic growth and poverty reduction.

Perspective Plan 2010-2021

The government has embarked on a Perspective Plan covering the period from 2010 to 2021 which aims at implementing Vision 2021. "Achieving food security" and "pursuing environmental friendly development" have been specifically mentioned under broad development goals of the Perspective Plan. This would be translated through successive five year plans. Priority attention in planned crop intensification in the coastal zone has been particularly mentioned in the plan document.

Sixth Five Year Plan 2011-15

The Sixth Five Year Plan (SFYP) provides strategy, framework and guidelines for reducing regional disparity, developing human capacity, managing land constraints, using natural resources, increasing agricultural productivity, household income and employment and ensuring food security. "Ensuring food security" has been outlined as a key strategy in the SFYP. In case of food production, climate change adaptation strategy in the agriculture sector will be prioritized.

Particular attention would be given to develop and adopt technologies and improved agricultural practices in ecologically vulnerable areas such as saline prone areas and flood and drought prone locations. Special emphasis is given to development of agro-processing and non-farm economic activities in the backward regions. Master Plan for Agricultural Development in the Southern Region of Bangladesh has particularly been mentioned for integrated development in agriculture in southern regions.

Country Programming Framework 2010

The Ministry of Agriculture and FAO prepared the Country Programming Framework (CPF) which identified southern part of Bangladesh as an ecologically stressed and economically deprived area, and considered it as a thrust area for agricultural development and food security.

Bangladesh Climate Change Strategy and Action Plan 2009

Bangladesh Climate Change Strategy and Action Plan (BCCSAP) was prepared in 2008 by the government and revised in 2009. This is a comprehensive strategy to address climate change challenges in Bangladesh specifically in the coastal zone and has six thematic areas: (a) food security, social protection and health; (b) comprehensive disaster management; (c) infrastructure development; (d) research and knowledge management; (e) mitigation and low-carbon development; and (f) capacity building and institutional strengthening. Forty four programmes have been identified and prioritized within these six thematic areas.

National Adaptation Programme of Action 2009

The country launched the National Adaptation Programme of Action (NAPA) in 2005 which identified 15 priority activities, including general awareness raising, capacity building, and project implementation in vulnerable regions with special focus on agriculture and water resources. NAPA was further updated in 2009 and identified 45 adaptation measures with 18 immediate and medium term adaptation measures.

National Food Policy 2008

The Ministry of Food and Disaster Management prepared the National Food Policy, which strives for adequate and stable supply of safe and nutritious food with interventions in technology generation, use and management of water resources, supply and sustainable use of agricultural inputs, crop diversification and market infrastructure development.

National Poultry Development Policy 2008

The Ministry of Fisheries and Livestock prepared the National Poultry Development Policy for the development of poultry industry. It put emphasis on the development of indigenous and backyard poultry, promotion of commercial poultry and regulations to combat contagious diseases.

National Livestock Development Policy 2007

The Ministry of Fisheries and Livestock adopted the National Livestock Development Policy to address the key challenges and opportunity for a comprehensive sustainable development of the

livestock sub-sector through creating an enabling policy framework. It especially emphasized promotion of smallholder dairy and poultry development and sustainable improvements in productivity of milk, meat and egg production including processing and value addition.

Coastal Development Strategy 2006

The Coastal Development Strategy (CDS) of the Ministry of Water Resources focuses on the implementation of the Coastal Zone Policy 2005. The CDS was approved at the second meeting of the Inter-Ministerial Steering Committee on ICZMP held on 13 February 2006. This strategy is an attempt to unlock the potentials of the coastal zone along with strategies to mitigate natural and human-made hazards and to preserve, restore and enhance coastal ecosystems. The CDS focuses on participation and partnership.

Coastal Zone Policy 2005

The Ministry of Water Resources developed the Coastal Zone Policy in 2005 which is of immense importance to agriculture and livelihoods in the coastal zone. Among the recommended measures is sustainable use of coastal resources and, to that end, limiting harvesting, extraction or utilization to the corresponding cycles of their regeneration. Efforts will be given to make sustainable resource use, e.g. agriculture, forestry and fishing including aquaculture taking advantage of the complementarities and trade-offs between competing uses.

Land Use Policy 2001

The Ministry of Land enacted the Land Use Policy in 2001 focusing on importance of afforestation, environment and mutual sustainability of land use. The main objective is to ensure best possible use of land resources and delivery of land related services to the people through modernized and efficient land administration for sustainable development with accelerated poverty reduction. It especially highlighted the need for land zoning in the coast. Subsequently, the Ministry of Land has taken up a pilot project on the study of detailed coastal land zoning in two districts of plain land.

National Water Management Plan 2001

In order to guide the management of the country's water resources, Water Resources Planning Organization (WARPO) prepared the National Water Management Plan (NWMP) in December 2001. NWMP is a framework plan for relevant ministries to define strategies to prepare projects, and acts as a guideline for those who are responsible for the maintenance and delivery of water and water-related services and development of water resources.

National Agriculture Policy 1999

The National Agricultural Policy (NAP) 1999 of the Ministry of Agriculture emphasized regional agricultural development. It states that target oriented research and extension programs would be conducted for region-wise adaptations. It supports climate change adaptation investment in agriculture to mitigate environmental vulnerability. Subsequently, the Ministry of Agriculture has prepared a Draft National Agriculture Policy 2012. The draft policy, in addition to many other areas, emphasizes agricultural marketing linkage and infrastructure development.

National Water Policy 1999

The National Water Policy (NWP) of the Ministry of Water Resources was the first ever water policy document on water resources management for the country pronounced in January 1999. It considers framing rules, procedures and guidelines for combining water use and land use planning for agriculture. It highlights the importance of preparing and implementing sub-regional and local level water management plans. It calls for improvement of resource utilization through conjunctive use of all forms of surface water and groundwater.

National Fisheries Policy 1998

The National Fisheries Policy was developed by the Ministry of Fisheries and Livestock in 1998. The policy concentrates on, in addition to enhancing production, conserving fish habitats from damage and taking appropriate care during the implementation of all developmental activities, such as, flood control, irrigation and drainage, agriculture, industry, road and urban development.

Environment Policy and Implementation Plan 1992

The Ministry of Environment and Forests pronounced the Environmental Policy and Implementation Programme in 1992. Consideration was given in the policy to favour investments to adaptation for coping with adverse impacts of natural calamity, salinity intrusion in rivers, land erosion, rapid reduction of forest area, variable climatic and weather conditions and other environmental problems.

Coastal Environmental Management Plan for Bangladesh 1988

In the late 1980s, the Economic and Social Commission for Asia and the Pacific (ESCAP) took the first initiative to formulate a coastal management policy in Bangladesh. A report titled "Coastal Environmental Management Plan for Bangladesh" was produced that addressed the most obvious problems of the coastal zone. Integration of socio-economic considerations into environmental issues was one aspect of the study.

1.5 Methodology

The Master Plan has been prepared by the Ministry of Agriculture with technical assistance from the Food and Agriculture Organization of the United Nations (FAO). The preparation process included a multi-disciplinary team of national experts; backstopped by FAO's technical divisions and continuous consultations with the government line agencies, National Agricultural Research System (NARS) institutes, Consultative Group on International Agricultural Research (CGAIR) centers, development partners and other stakeholders including farmers, local government institutions, the academia, community-based organizations (CBOs), the private sector and the civil society. A set of interventions have been selected through stakeholder consultations at the agency and regional levels. Prioritization and investment needs have also been determined through stakeholder consultations. A set of interventions have been selected through stakeholder consultations at the agency and regional levels. Prioritization and investment needs have also been determined through stakeholder consultation.

Regional consultations were held in Khulna, Barisal, Noakhali and Chittagong (Table 1.1).

- Seven consultations were held in the beginning to identify issues and to generate ideas on challenges and potentials, and to collect quantitative and qualitative data of regional relevance;
- After the preparation of the first draft report, second round of consultations were held in the same locations to determine prioritization and investment needs of recommended interventions.

Table 1.1: List of regional consultations

Location	Date	Venue	No. of participants
First round			
Chittagong	15 May 2011	DAE	35
Noakhali	16 May 2011	BDS	35
Barisal	24 May 2011	DAE	45
Barisal	25 May 2011	DAE	90
Chittagong	4 July 2011	CVASU	70
Noakhali	3 July 2011	LGED	90
Khulna	16 July 2011	Circuit House	80
Second round			
Barisal	29 January 2012	DAE office	49
Khulna	14 February 2012	DAE	55
Chittagong	7 March 2012	BFRI	45
Noakhali	8 March 2012	RHD	37

Some physical information has been obtained from the Soil Resource Development Institute (SRDI) and Center for Environmental and Geographic Information Services (CEGIS).

The preparation of the Master Plan involved the following processes and activities:

- formation of an Inter-Ministerial Committee (IMC) and a Government of Bangladesh Technical Group in March 2011;
- constituting the study team by FAO;
- literature review;
- field visits by members of the study team to collect primary data from local level officials of government agencies, farmers and other stakeholders;
- regional consultation in Khulna, Barisal, Noakhali and Chittagong for identifying issues and generating ideas;
- meeting and interaction with key professionals of relevant government agencies to generate data and to validate data obtained from the field;
- backstopping support and input from FAO technical divisions;
- sharing of the first draft in the IMC;
- regional consultations for validation and prioritization in Khulna, Barisal, Noakhali and Chittagong;
- sharing of the final draft in the IMC; and
- finalization of the Master Plan in June 2012 accommodating comments and feedback from IMC members.

2.1 Demographic Features

The southern region of Bangladesh includes 14 coastal districts,¹ which accounts for 27 percent of the area and 21 percent of the population of the country. According to the preliminary results of the Population & Housing Census 2011, the region has a total area of 39,617 sq. km, 6.38 million households and 29.86 million people (Table 2.1).² Population density per km² is relatively lower in the southern region (754) compared to Bangladesh (964) (BBS, 2011), largely because of net outmigration.

Disaggregate data on urban population is not yet available for 2011 census. Based on 2001 census data, 26.1 percent of the population is urban-dweller in the southern region. This proportion is higher than that of the country (23.5 percent). Among the SR districts, concentration of urban population is the highest in Khulna (54%), followed by Chittagong (51%). On the other hand, the least urbanized districts are Satkhira, Barguna and Patuakhali with 12 percent or less urban population (BBS, 2007).

Table 2.1: Area and population of the southern region

District	Area (km ²)	Household (000)	Population (000)			HH/ km ²	Population density/km ²
			Total	Male	Female		
Barguna	1,831	215	882	433	449	4.1	482
Barisal	2,790	510	2,291	1,123	1,168	4.5	821
Bhola	3,737	372	1,758	874	884	4.7	470
Jhalokati	758	139	596	288	308	4.3	786
Patuakhali	3,220	347	1,517	745	772	4.4	471
Pirojpur	1,308	255	1,103	544	559	4.3	843
Chittagong	5,283	1,523	7,509	3,783	3,726	4.9	1,421
Cox's Bazar	2,493	418	2,275	1,163	1,112	5.4	913
Feni	928	277	1,420	687	733	5.1	1,530
Lakshmipur	1,456	364	1,711	820	891	4.7	1,175
Noakhali	3,601	591	3,072	1,468	1,604	5.2	853
Bagerhat	3,959	355	1,461	732	729	4.1	369
Khulna	4,395	546	2,294	1,164	1,130	4.2	522
Satkhira	3,858	471	1,973	977	996	4.2	511
SR total	39,617	6,382	29,862	14,801	15,061	4.7	754
Bangladesh	147,570	32,068	142,319	71,255	71,064	4.4	964
SR%	27	20	21	21	21		

¹ The "coastal zone" of Bangladesh includes 19 districts as per the Gazette notification of the government of Bangladesh. The "southern region" as defined in this Master Plan is comprised of 14 districts of the coastal zone exposed to the Bay of Bengal.

² Population of 2011 is likely to increase after adjustment for net undercount. The State of World Population 2011 (UNFPA, 2011) cites Bangladesh population as 150.5 million. According to projections based on 2001 census data, Bangladesh population would be 151 million and that of the southern region would be 32 million in 2011 (BBS, 2007).

There are more women (50.4%) than men (49.6%) in the southern region. The average number of member per household is 4.7. This is higher than the national average (4.4) and is indicative of a higher dependency ratio (BBS, 2011).

2.2 Access to Land

According to popular perception, land is the most important natural asset. Land is scarce in the country and even more so in the southern region. According to census of agriculture 2008, average ownership of land per household is 0.79 acre in Bangladesh (BBS, 2010). But in the southern region, average land ownership per household is 0.72 acre (0.29 ha). The situation is also worse in the southern region in terms of homestead area, average per household being 0.07 (0.028 ha) acre compared to the national average of 0.08 acre (Table 2.2).

Table 2.2: Land endowment

District	Number of holdings	Own land (acre)		Average land per holding (acre)	
		Total	Homestead	Total	Homestead
Barguna	201,929	231,438	16,196	1.15	0.08
Barisal	482,075	367,715	31,617	0.76	0.07
Bhola	347,515	276,200	20,788	0.79	0.06
Jhalokati	133,204	120,723	8,146	0.91	0.06
Patuakhali	323,502	375,633	23,196	1.16	0.07
Pirojpur	243,057	215,184	14,270	0.89	0.06
Chittagong	1,298,834	504,104	89,722	0.39	0.07
Cox's Bazar	335,825	180,261	33,225	0.54	0.10
Feni	237,575	149,420	20,226	0.63	0.09
Lakshmipur	332,818	197,862	20,981	0.59	0.06
Noakhali	544,943	419,446	45,947	0.77	0.08
Bagerhat	339,217	346,181	21,673	1.02	0.06
Khulna	502,835	379,965	30,070	0.76	0.06
Satkhira	436,178	401,627	25,861	0.92	0.06
SR total	5,759,507	4,165,759	401,918	0.72	0.07
Bangladesh	28,695,763	22,755,331	2,166,302	0.79	0.08

Households are broadly categorized into four major groups in the BBS literature. These are

- *non-farm* holdings, owning no land or less than 0.05 acre of land;
- *small farmer*, owning 0.05 to 2.49 acres of land;
- *medium farmer*, owning 2.50 to 7.49 acres of land; and
- *large farmer* owning 7.50 acres or more.

Non-farm households are 46 percent of total households. Another 19 percent own less than 0.5 acre each who are considered as "functionally landless". Hence the extent of landlessness is as high as 65 percent in the southern region.

households (medium and large farmers) own 36 percent land and top one percent households (large farmers) own 10 percent land, while the bottom 46 percent households own only 13 percent land in the southern region. The highly unequal distribution of land is reflected in Figure 2.1 through a land endowment curve. If all households would have equal ownership of land, then the curve would have taken the shape of the diagonal. The further the curve is from the diagonal, higher is the degree of inequality.

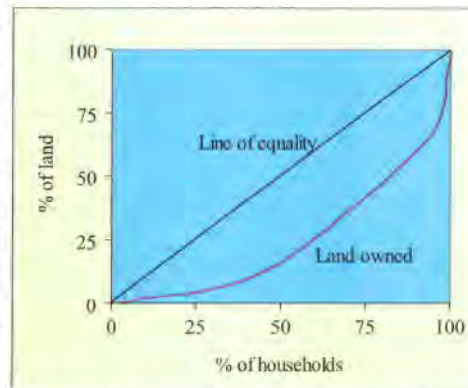


Figure 2.1: Distribution of Land Holdings

Table 2.3: Land ownership pattern in the southern region

Farm strata	Percentage		Cumulative percentage	
	Household	Acreage	Household	Acreage
Non-farm	46	13	46	13
Small	46	51	92	64
Medium	6	26	98	90
Large	2	10	100	100

From 1960 to 1996, number of non-farm and small farmer households in the region increased, while the proportion of medium and large farms declined considerably (Table 2.4). Data from agriculture census 2008 shows further increase of non-farm households, whereas households in other three categories decreased.

2.3 Livelihoods

Certain activities are common everywhere and some are typical of the southern region. Specific activities in the southern region are those which stem from geo-physical characteristics of the area conditioned by its unique natural systems and opportunities. Some occupations can be exclusively attributed to the southern region and some are prevalent in the region to a greater extent than other regions of the country.

In the southern region, farmers and agriculture labourers are major livelihood groups. There are other occupational groups who earn their living from activities determined by coastal conditions. They often vary from each other in terms of production relations. Some of them work independently (shrimp fry collector); some work as lessee or sharecropper (salt farmer, shrimp farmer) and some are contractual labourer (fishers hired by a *bahadder*). Some live by utilizing natural resources (salt farmer, fry collector, fisher, honey collector) and some live on skill-based activities (boat-building carpentry, net making). Profiles of some livelihood groups are briefly presented below.

Table 2.4: Trend in Land Ownership Pattern

Strata	Percentage of households*		
	1960	1996	2008
Non-farm	19	30	46
Small	41	57	46
Medium	31	11	6
Large	9	2	2
Total	100	100	100

2.3.1 Small farmer

According to 2008 agriculture census, there are about 3.1 million farm households in the southern region. Among them 2.7 million are small farmers who own less than 2.5 acres each. They are 46 percent of total households in the region, which is slightly higher than that of Bangladesh (45%). They are the largest occupational group. Among "farm households", overwhelming majority small farmers, percentage of such households being 87 and 84 respectively in the southern region and Bangladesh (BBS, 2010). They are more concentrated in Lakshmipur, Feni, Barisal and Cox's Bazar (90% or more).

2.3.2 Agricultural labourer

The next largest occupational group is agricultural labourer. There are over 1.6 million households in the southern region whose predominant source of livelihood is agricultural labour. They compose 28 percent of total households in the region compared to 31 percent in Bangladesh (BBS, 2010). Satkhira has the highest proportion of agricultural labourer households (52%), followed by Bagerhat (43%). Chittagong, Jhalokati and Feni have less proportion of such households (14%, 16% and 21% respectively).

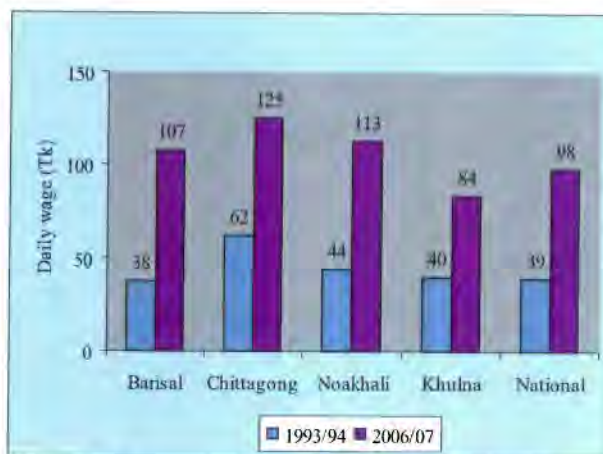


Figure 2.2: Average wage rate for male agriculture workers

Distinct livelihood conditions of this group are:

- seasonal employment / unemployment;
- low demand for labour in most periods of the year in many parts of the region, as those areas are single-cropped;
- low wage in the lean season (period between plantation and harvesting);
- discriminatory wage for women; and
- chronic indebtedness.

Average daily wage for agricultural labourers is relatively higher in Chittagong and Noakhali (Figure 2.2) (Planning Commission, 2011).

2.3.3 Salt farmer

Salt farming is overwhelmingly concentrated in Cox's Bazar district where 15 percent of total rural households are salt farmers. They meet bulk of the demand for raw salt in the country. Moheshkhali Upazila has the highest concentration of salt farmers (BSCIC, 2003). According to Bangladesh Small and Cottage Industry Corporation (BSCIC) sources, target area for salt farming in 2011-12 is estimated at 29,138 ha. About 55,000 farmers would be engaged and the production target is 1.4 million tonnes (Daily *Prothom Alo*, 21 November 2011).

2.3.4 Fisher

Eight percent of rural farm households in Bangladesh live on fishing. But in the southern region, fishing is the predominant source of livelihood for 14 percent of households, which is currently 0.8 million households (BBS, 1999, 2010). They operate in the estuary, on coastal waters and sometimes in the deep sea. Barguna has the highest proportion of fisher households (38%), followed by Khulna (29%) and Jhalokati (26%).

Monsoon months are the main fishing season. A small stratum of bahadders (boat-owners), with nets and cash resources exercise control over fishers' lives. With increasing poverty at one end (landlessness) and growing entrepreneurship at the other end (investments in boat and gear), more and more people are encroaching into the domain of traditional fishers. As a result, fish resources along the coast are dwindling fast.

2.3.5 Shrimp fry collector

Estimated number of fry collectors in the coastal zone was about half a million (Frankenberger, 2002). A large number of them are children.

The cycle of fry collection is from mid-February to mid-August. In Khulna region, the main period of bagda fry collection is mid-November to mid-July. However, golda fry is collected round the year, though the peak season is April-May.

The number of fry collectors is high in Patuakhali and Barguna, which indicates the dependence of poor people on this particular activity. Although shrimp farms are more concentrated in the greater Khulna district, there are fewer fry collectors from that region. Opportunity (or lack of opportunity) for gainful employment in other activities is plausible explanation for this employment pattern (Ahmad, 2004).

2.3.6 Extractor of forest resources

Many households depend on forest resources for their livelihood. According to a baseline survey conducted by the Sundarban Biodiversity Conservation Project (SBCP), 18 percent households in 17 upazilas of five districts in the Sundarban-impact zone are dependent on Sundarban resources, having a population of 3.5 millions (SBCP, 2001). Among them are fry collector (35%), fishers (33%), bawali (22%), boatman (4%), golpata collector (3%), shell/crab collector (2%), mawali, and medicinal plant collector. Many poor households depend on recently planted forests in chars and islands in Patuakhali, Bhola and Noakhali for fuel wood and materials for house construction.

2.4. Poverty

2.4.1: Extent of Poverty

In Bangladesh, 31.5 percent are below the upper poverty line³ based on the Household Income and Expenditure Survey (HIES) 2010 of BBS (Table 2.5). Barisal Division has the highest number of poor people (39.4%). With respect to the lower poverty line indicating extreme or hardcore poverty, Barisal division has also the highest concentration of poor people (26.7%) compared to Bangladesh (17.6%) (Planning Commission, 2011).

³ Upper poverty line indicating 'absolute poverty' corresponds to a level of minimum dietary energy consumption of 2122 kcal/capita/day. The lower poverty line indicating 'extreme or hardcore poverty' corresponds to dietary consumption of 1805 kcal/capita/day.

Table 2.5: Percentage of population in poverty

Division	Extreme poverty			Absolute poverty		
	Total	Rural	Urban	Total	Rural	Urban
Barisal	26.7	27.3	24.2	39.4	39.2	39.9
Chittagong	13.1	16.2	4.0	26.2	31.0	11.8
Khulna	15.4	15.2	16.4	32.1	31.0	35.8
Bangladesh	17.6	21.1	7.7	31.5	35.2	21.3

In terms of several human development indicators, the situation in the southern region is mixed. For example, primary school enrolment rate is lower, while literacy rate is higher. Access to sanitation is slightly better (Table 2.6). On the other hand, the health situation is poorer in terms of population-hospital bed ratio, as well as the extent of severe child malnutrition (Ahmad, 2003).

2.4.2: Poverty and vulnerability

Poverty does not necessarily correspond to low income or low consumption alone, but also to lack of linkage, opportunity and power, and susceptibility to exogenous factors. Often poverty is defined as vulnerability. For poor people, vulnerability is both a condition and a determinant of poverty, referring to the ability of the people to avoid, withstand or recover from adverse impacts of factors that disrupt their lives, and that are beyond their immediate control. This includes:

- shocks (sudden change, such as natural disasters, conflict or collapsing prices);
- seasonality (low demand for farm labor between plantation and harvesting periods); and
- trend (environmental degradation, deteriorating terms of trade).

Table 2.6: Position of the coastal zone with respect to country situation

Strength	Weakness
○ Agriculture wage rate is high	○ Average size of household is high
○ Literacy rate is high	○ Demographic dependency ratio is high
○ Primary school density is high	○ Proportion of small farm households is high
○ Proportion of households with durable wall is high	○ Per capita GDP is low
○ Proportion of households with sanitary latrine is high	○ Poverty (both absolute and extreme) is high
○ Density of road is high	○ Primary school enrolment rate is low
○ Land is accreting in some areas	○ Severe child malnutrition is high
	○ Population per hospital bed is high
	○ <i>Union Parishad</i> density is low
	○ Per capita gross cropped area is low
	○ Proportion of functionally landless is high
	○ Proportion of households with durable roof is low
	○ Proportion of households with electricity connection is low
	○ Proportion of households with access to tap and tube well is low
	○ Household coverage by major micro-credit NGOs is low
	○ Share of industrial sector in GDP is low
	○ Density of growth centers is low
	○ Land erosion is severe in some areas
	○ Susceptible to cyclone and storm surge

In the southern region, a wide range of vulnerabilities is identified. These are:

- ◇ the threat of cyclones and storm surges that cause deaths and destruction;
- ◇ the threat of land erosion;
- ◇ deterioration and the declining viability of many distinctive and threatened coastal ecosystems;
- ◇ limited livelihoods opportunities (especially outside agriculture) and poorly developed economic linkages;
- ◇ poor level of service provision that make the isolation of many coastal areas worse.
- ◇ changing patterns of land use (including the growth of shrimp and salt production) that are affecting the coast's morphology and water resources characteristic;
- ◇ resource degradation;
- ◇ salinization including saline intrusion into the freshwater aquifers; and
- ◇ flood and congestion of drainage system.

These vulnerabilities affect different households differently. The more affluent a household is and, in particular, the more assets it possesses, the more resilient it is to disruption of its livelihood base from these phenomena (PDO-ICZMP, 2002).

2.5 Gender Aspects

State of reproductive health, in Barisal Division, according to Bangladesh Demographic and Health Survey (BDHS) 2007, 46 percent of women receive ante-natal care from medically trained providers, while the percentage of deliveries assisted by medically trained providers is only 13 percent. Such proportions are 52 percent and 18 percent respectively for Bangladesh (Planning Commission, 2011).

Households are overwhelmingly male-headed with only 5.0 percent being headed by women in the southern region and 4.6 percent in the country (BBS, 2010). This data may not reflect the ground reality. Men are socially perceived as "head of the household", though there are many more "women-managed households". When men migrate to other areas for one season or more for employment, women become de facto head of the household.

Households often resort to more than one economic activity to maximize income and to minimize risks. Choices are largely determined by opportunities, skills and cultural norms. Many activities are of seasonal nature and people seek employment as many days as possible by diversifying their choices. Besides household chores, women also engage themselves in multiple remunerative activities (Table 2.7) (Ahmad, 2003).

Table 2.7: Combination of livelihood activities

MALE	FEMALE
◇ Agriculture, day labour;	◇ Homestead gardening, poultry keeping, labour management;
◇ Agriculture, trading;	◇ Agriculture, livestock rearing, pond aquaculture, poultry keeping;
◇ Agriculture, sawing (timber)	◇ Agriculture (harvesting), paddy husking, net making;
◇ Agriculture, salt production, trading;	◇ Agriculture, poultry keeping, livestock rearing, making of cow-dung fuel;
◇ Agriculture, rickshaw van driving;	◇ Agriculture (harvesting), <i>muri</i> trading, paddy husking, livestock rearing, poultry keeping, egg selling;
◇ Agriculture, fishing, rickshaw van driving;	◇ Day labour, salt farming;
◇ Agriculture, work in brickfield;	◇ Day labour, net making, earthwork, crab collection, <i>kantha</i> making;
◇ Agriculture, paddy husking;	◇ Day labour, net repairing, shrimp fry collection,
◇ Agriculture, fishing, cattle trading, pond aquaculture	◇ Day labour, spice grinding;
◇ Agriculture, shrimp farming, pond aquaculture, day labour;	◇ Day labour, housemaid, fuel collection;
◇ Day labour, salt farming;	◇ Day labour, shrimp fry collection, paddy husking, earth work, <i>kantha</i> making;
◇ Day labour, net repairing, shrimp fry collection	◇ Fishing, net making;
◇ Fishing, net making;	◇ Embroidery, handicraft making, block printing;
◇ Pond aquaculture, trading.	◇ Making cow-dung fuel, poultry keeping.

2.6 Nutritional Status

As of 2009, 45% of children under the age of five are underweight. Since 2000 the fall has been quite slow. During the period from 2005 to 2009, there has hardly been any improvement. Against this backdrop, it seems unlikely that Bangladesh will reach the MDG target of 33% prevalence rate by 2015. As per projections, the malnutrition prevalence rate would be 39% in 2015 (GED, Planning Commission, 2011).

According to Child and Mother Nutrition Survey of Bangladesh (CMNS) 2005, prevalence of child malnutrition in the southern region is the highest in Barisal Division in terms of all available indicators (Table 2.8).

Table 2.8: Extent of child malnutrition (2005)

Area	Children with malnutrition (%)			
	Underweight	Stunted	Wasted	Overweight
Barisal	41.6	52.9	14.7	3.4
Chittagong	39.7	51.4	13.4	1.2
Khulna	35.1	43.6	8.4	0.1
Bangladesh: All	39.7	46.2	14.5	1.4

2.7 Institutions

In Bangladesh, the institutional setting is quite complex, comprising national government, local government, private sector and a wide range of civil society organizations including NGOs which play complementary roles in development. Besides, there are formal and informal functional

groups and coalitions of the people at the community level who are increasingly being acknowledged as focus of development efforts. All these social and institutional entities operate within a network of power relations and linkages, which frame the overall institutional environment (Figure 2.3).

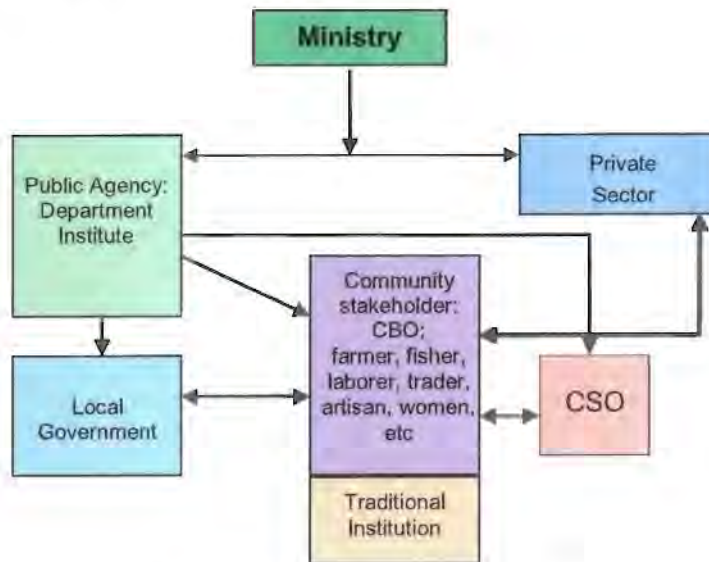


Figure 2.3: Current institutional setting

2.7.1 Public agency

The people have intricate relationship with these government institutions. They utilize services provided such as physical infrastructures, health, education, relief and rehabilitation and agricultural extension. Among other services are law and order, justice, natural resource management and credit.

Roles played by public agencies are very important. But access to services is influenced by socio-economic factors, and various rules and regulations. Several of these agencies have offices up to the district and upazila level, while some of them cover the entire country from their headquarters.

2.7.2 Local government

Union Parishad (UP) is the lowest level local government in the administrative structure of the country. It is an elected body with designated administrative, development and extension roles. There are 996 unions in the southern region out of 4,466 in the country. The next higher level local government is the *Upazila Parishad* (UZP) based in each Upazila. There are 117 upazilas in the southern region out of 508 in the country (23%). In urban areas, the local government is named as the *Pourasabha* (for smaller ones) and the *City Corporation* (for the larger ones). There are 49 municipalities/ city corporations out of 223 in the country (BBS, 2010a) (Table 2.9).

Table 2.9: Distribution of administrative units (2010)

Region	Upazila	Union	Village	Municipality
Southern region	117	996	12,213	49
Bangladesh	508	4,466	87,362	223
SR%	23	22	14	22

2.7.3 Traditional informal institution

In rural areas, many traditional institutions are also present. These are centuries-old, informal, but functional. Among these are *samaj* (a platform based on kinship, neighbourhood or caste) and *salish* (a forum for mediation comprising the clergy or influential community leaders), which play roles in different contexts.

2.7.4 Community based organization

There are many community based organizations (CBOs) operating with different objectives, mandates and functions. These sometimes evolve based on needs of particular interest groups or are induced by public agencies or NGOs. These are mainly membership organizations. Among these are various types of

- *samabaya samity* (cooperative society) linked with BRDB and the Department of Cooperatives (DoC);
- water management group (WMG) linked with the BWDB and LGED;
- landless contracting society (LCS) linked with BWDB and LGED; and
- savings and credit groups linked with NGOs.
- IPM Clubs emerging from Farmer Field Schools (FFS).

2.7.5 Private sector

Private sector is expanding in many spheres. It contributes to the construction of infrastructure (as contractors), production (manufacturing, agriculture), marketing (input distribution, value chain management) and services (health, education, etc). Private sector institutions are mainly membership organizations. Among these are Bazar Committee, Chamber of Commerce and Industry, Trade Association, Employers Association, etc. Most of these have local level committees.

2.7.6 Civil society organizations (CSOs)

Civil society organizations (CSOs) including NGOs are active in all the coastal districts. Chittagong district has the highest number of NGOs, closely followed by Khulna and Barisal, while Feni is covered by the lowest number of NGOs, followed by Jhalokati (ADAB, 2000). Among NGOs which work exclusively in rural areas, the highest number is involved in water and sanitation (53%), closely followed by environment and social forestry (51%), fisheries (49%) and micro-credit (48%) (Ahmad, 2003a).

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 Coastal 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 criss-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.

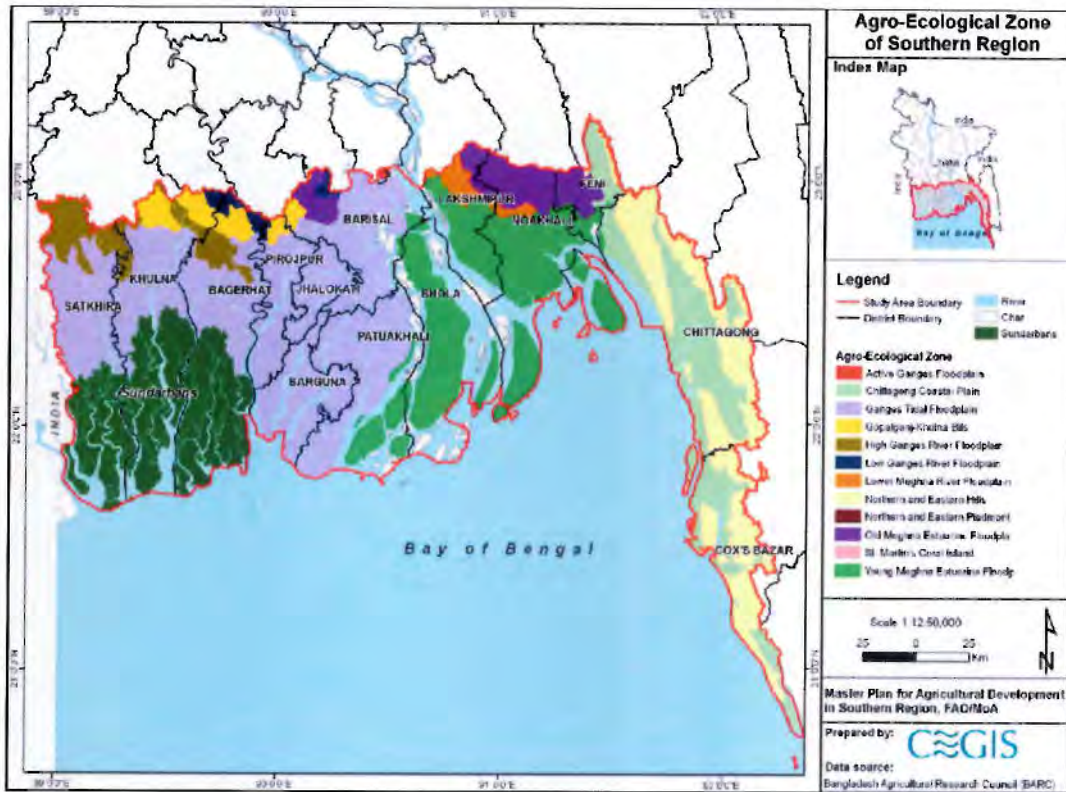


Figure 3.1: Agro-ecological zones in the southern region

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

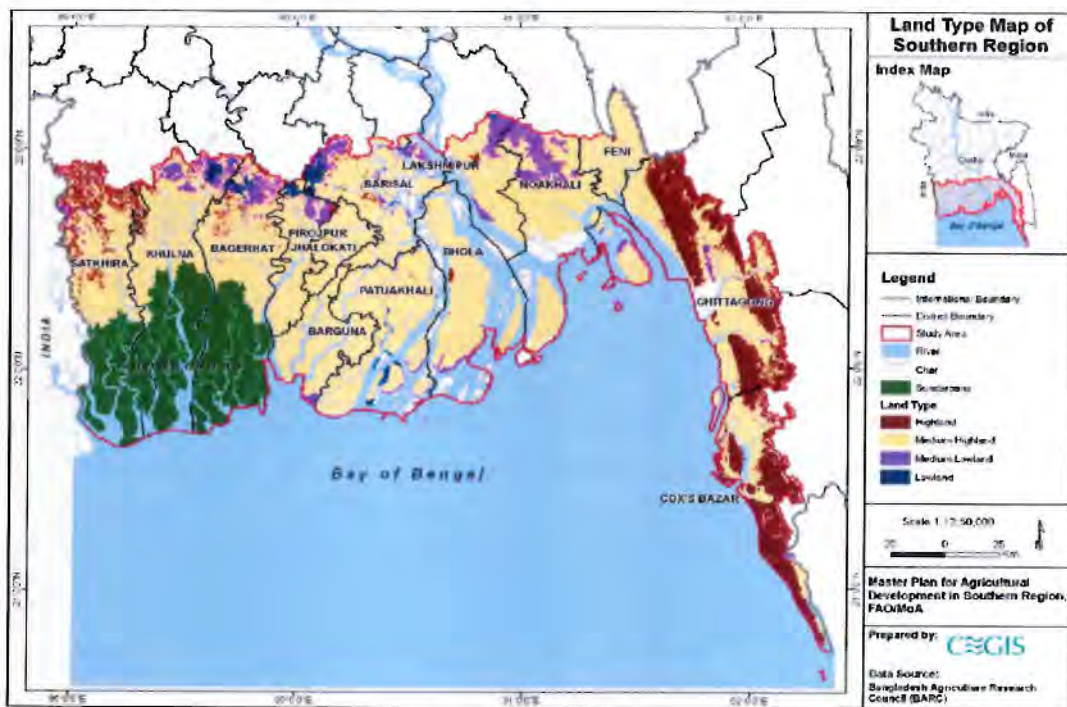


Figure 3.2: Land types in the southern region

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).

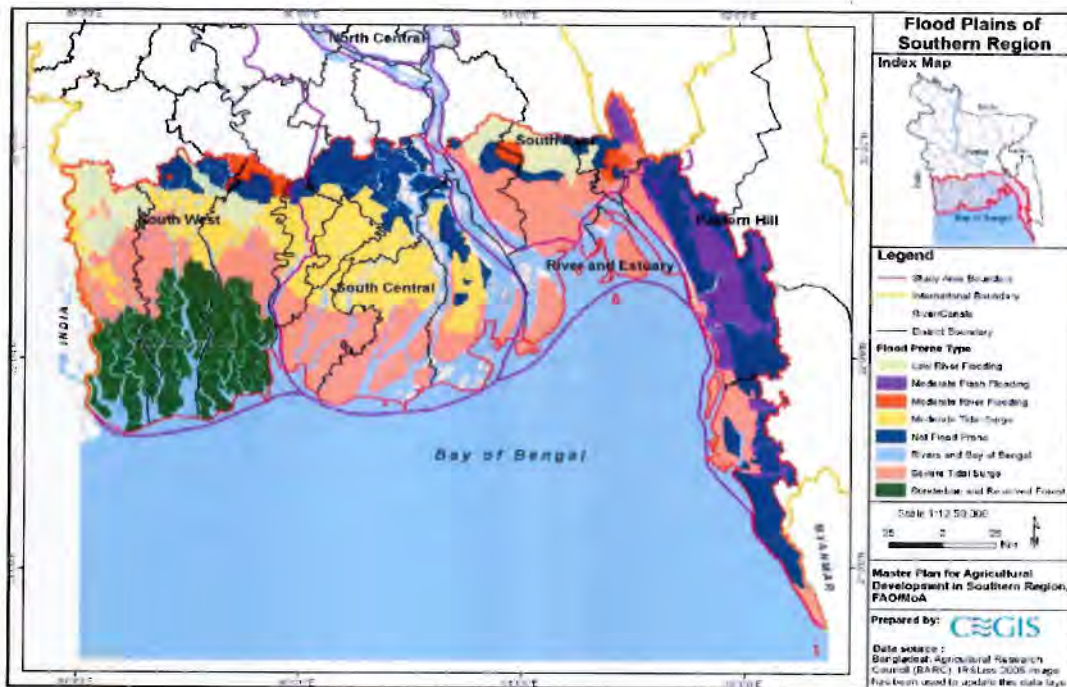


Figure 3.3: Floodplains of the study area

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).

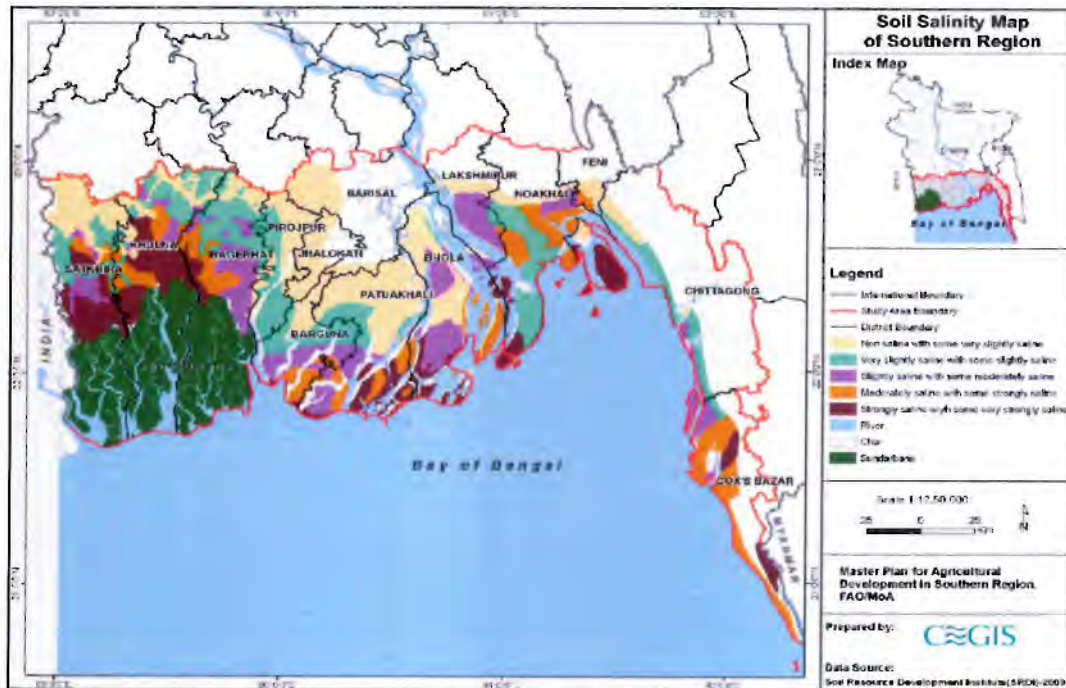


Figure 3.4: Soil salinity

3.4 Climate

In the southwest region, the maximum and minimum temperatures are 43°C, and 3.6°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°C and 3.6°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°C and 4.9°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;

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

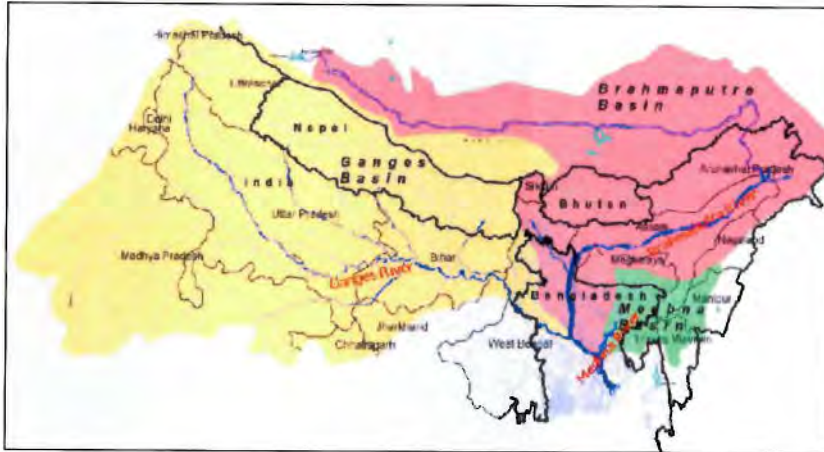


Figure 3.5: River basins

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).

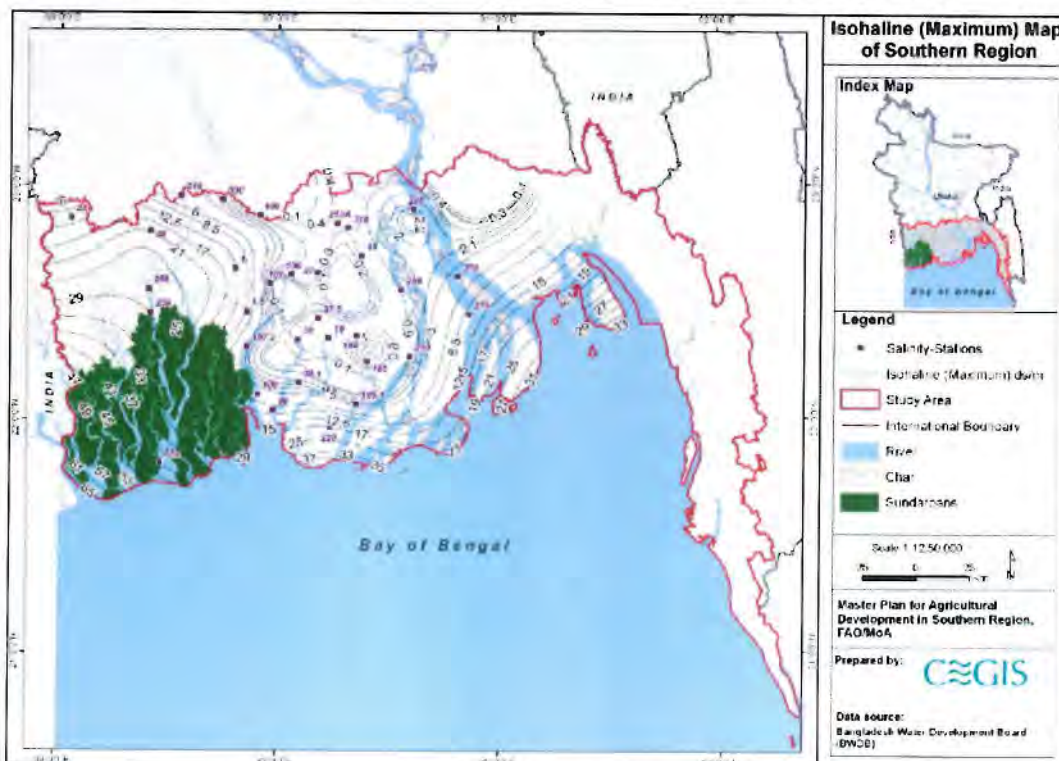


Figure 3.7: Isohaline (maximum) of the southern region

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* (*Portaesia 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 hypoleucos*), 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.

4.1 Land Use

Out of the total area of the southern region, 26 percent are used for settlements, water bodies, reserved forest etc, about one percent is used for salt farming (along the Chittagong-Cox’s Bazar coast) and 73 percent is the net cropped area (CEGIS estimation). The region lags behind the country in terms of the intensity of agricultural (crop) land use. Land is predominantly single (50%) and double (40%) cropped, the cropping intensity being 159 percent, compared to 176 percent in Bangladesh (Figure 4.1, Table 4.1) (BBS, 2010).

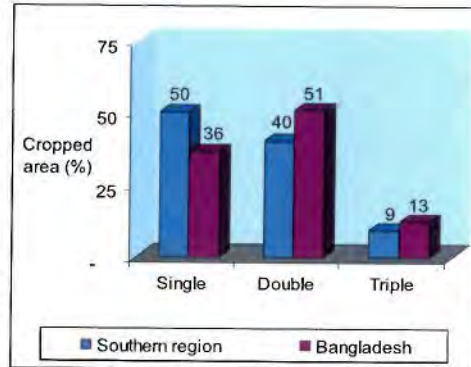


Figure 4.1: Agricultural land use

Table 4.1: Land use (000 ha)

Region/ greater district	Cultivable waste	Current fallow	Single	Double	Triple	Net Cropped Area (NCA) ⁴	Total Cropped Area (TCA) ⁵
Chittagong	20	27	101	132	32	264	460
Noakhali	13	4	92	145	47	284	522
Barisal	24	40	195	178	46	418	688
Patuakhali	6	49	155	112	16	283	427
Khulna	12	47	284	98	16	397	526
SR total	75	169	826	664	156	1,646	2,622
Bangladesh	257	614	2,844	3,975	978	7,797	13,728
SR (%)	5	10	50	40	9	100	159
BD (%)	3	8	36	51	13	100	176

Major cropping patterns are Fallow-T.Aman-Fallow (38.5% of NCA), B.Aus-T.Aman-Rabi (24.1% of NCA) and T.Aus-T.Aman-Fallow (14.1% of NCA) (Table 4.2, Figure 4.2).

Table 4.2: Cropping pattern

Current cropping pattern			% of net cropped area
Kharif-I	Kharif-II	Rabi	
Fallow	Fallow	Boro	1.01
Fallow	T.Aman	Boro	13.7
B.Aman	B.Aman	Fallow	2.1
B.Aus	T.Aman	Fallow	1.6
Fallow	T.Aman	Fallow	38.5
Mixed B.Aus & Aman	Mixed B.Aus & Aman	Fallow	1.4
T.Aus	T.Aman	Fallow	14.1
B.Aus	Fallow	Rabi	0.5
B.Aus	T.Aman	Rabi	24.1
Mixed B.Aus & Aman	Mixed B.Aus & Aman	Rabi	2.9
Total			100.0

⁴ Net Cropped Area (NCA) is the total land area of the country minus land used for non-crop purposes (including wasteland).

⁵ Total Cropped Area (TCA) = NCA x Cropping Intensity

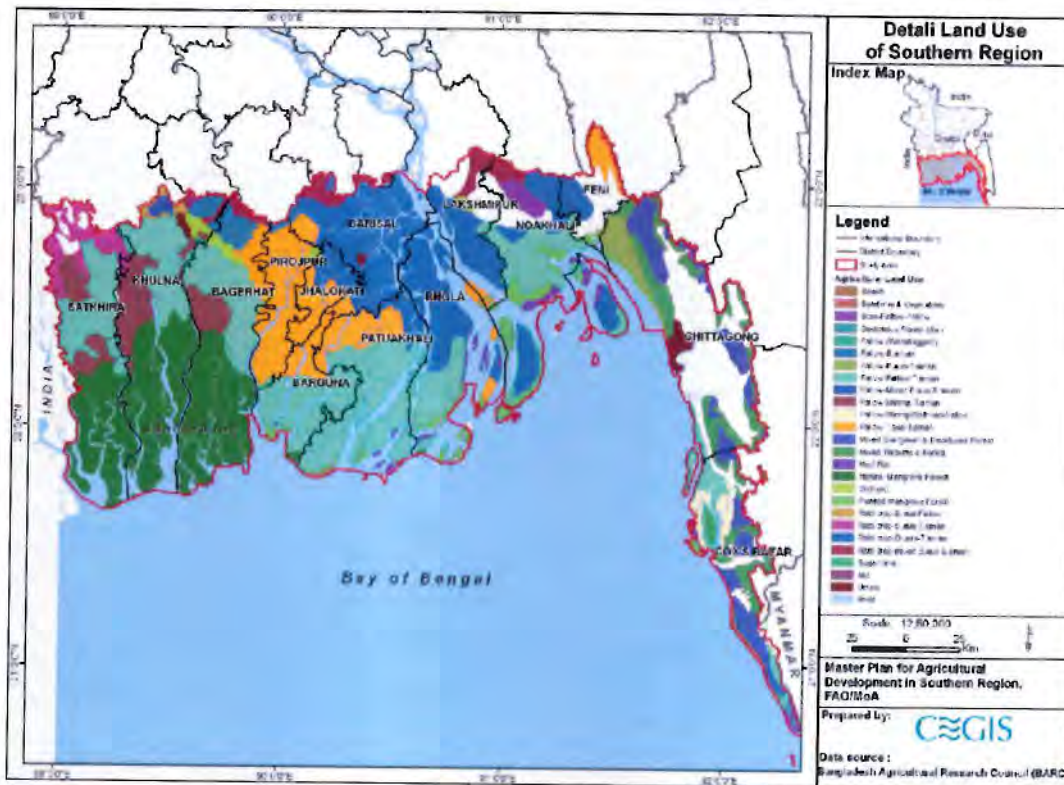


Figure: 4.2: Current cropping pattern

In the southern region, 15 percent of total cultivable land is either fallow and/or not under productive use. Major physical factors responsible for land being not used intensively are soil salinity, water salinity, subsidence and water logging.

4.2 Water Resources Management in Polder Areas

4.2.1 Polders

Polders are major interventions in the southern region with protective structures that provide benefits to the production systems and livelihoods. ‘Polder’ is a Dutch term, meaning a reclaimed landmass with engineering interventions to grow more food by protecting coastal land from saline intrusion caused by tidal flooding. Over the period of time, rice production has increased significantly as a result of empoldering.

The Bangladesh Water Development Board (BWDB) has constructed 139 polders since the 1960s (Figure 4.3). While these have contributed significantly in enhancing food production in the initial decades, they are now gripped in second generation problems, both social and environmental. The current state of the polders has been addressed in a recent International Food Policy Research Institute (IFPRI) study on institutional aspects of polder management in the coastal areas. Problems are mainly manifested through the following phenomena (IFPRI, 2012).

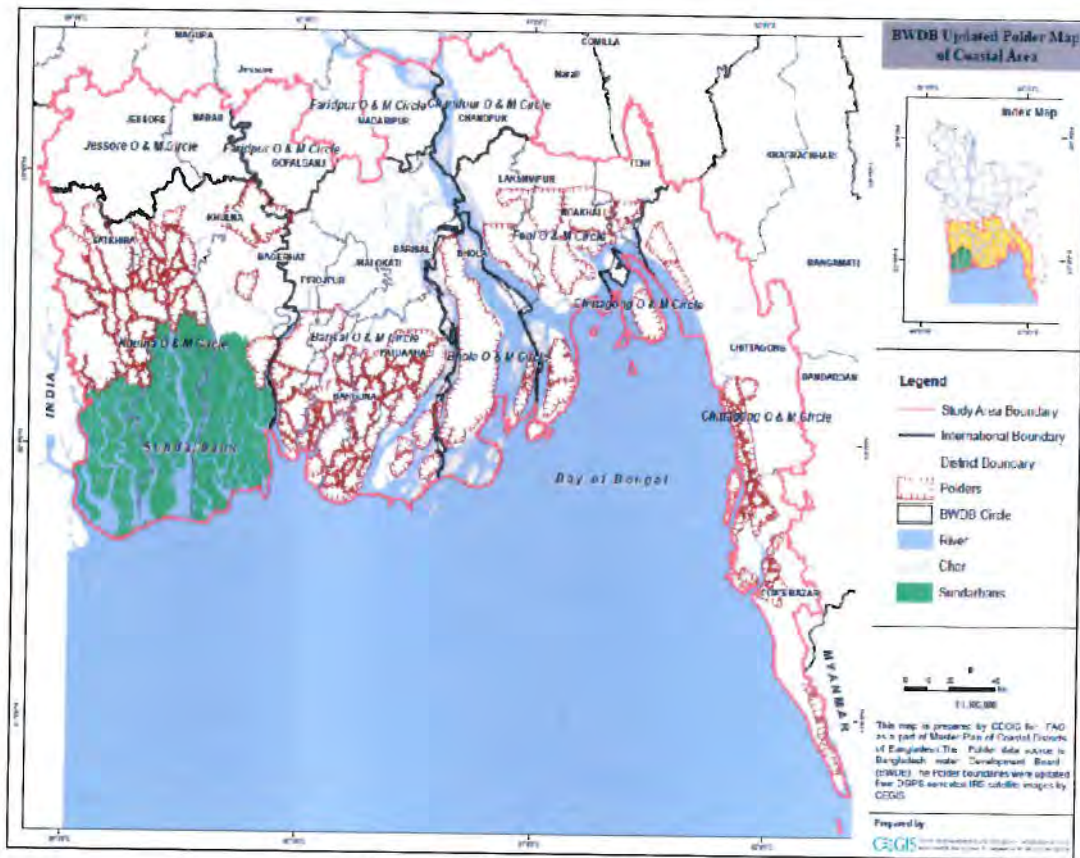


Figure 4.3: Index map of polders

- **Siltation:** Due to empoldering, natural inundation outside the polders has been obstructed by embankments resulting in higher elevation of land outside the polder and no siltation inside.
- **Drainage:** Because of siltation of outfall channels, channels within polders have significantly lost drainage capability resulting in water logging. The problem has been compounded by siltation of internal drainage channels.
- **Water logging:** Because of land accretion, particularly in the Meghna estuary, many rivers and khals (drainage canals) have been silted up. Onrush of upstream flow and prolonged rainfall often cause water logging. This problem has been aggravated by empoldering.
- **Salinity:** Though soil salinity declines in the long run because of empoldering, problem recurs because of erosion and embankment failure (breaches or overtopping by storm surge).
- **Land use conflict:** Shrimp farmers bring saline water inside the polder by cutting embankment or using LLP. This affects salinity balance inside the polder and causes damage to crops in surrounding fields. Competing land use often results in confrontation and violence and thereby affects the social fabric. Polders have not been designed for the multi-functional land use and the BWDB has no mechanism how to deal with land use conflicts.

4.2.2 Operation and maintenance

The state of water management is generally poor in those polders that are not covered by a specific project with an institutional component. Poor operation of sluice gates often harms farmers in low lying areas who are vulnerable to unwanted inundation. *Khals* are hardly maintained (IFPRI, 2012).

Total value of all BWDB investments in the country is estimated at BDT 200 billion. O&M costs are three percent of investment costs as a general rule of thumb. This means, BDT six billion is annually needed for O&M. However, it has not been possible to provide the required allocation to the BWDB. Expenditures are often lower than allocations because of non-availability of cash funds, delay in tendering, adverse weather condition, lack of field staff and more attention for new projects (Pearbolte and Zubair, 2011). Thus proper maintenance is hampered, affecting the quality and functionality of structures.

Local Government and Engineering Department (LGED), through its small scale water resources development (SSWRD) project also works for water management in the polders with the consent of the BWDB.

4.2.3 Conflict

Polders are areas of contention and conflicts that develop around economic interests of groups with different types of land endowment and conflicting land use. The conflict between shrimp growers and rice farmers is age-old. While polders are designed to protect land from saline water intrusion, shrimp growers bring saline water inside the polder. This affects the salinity balance inside the polder and causes damage to crops in surrounding fields. Competing land use often results in confrontation and violence and thereby affects the social fabric. Polders were not designed for multi-functional land use and the BWDB has no mechanism to deal with land use conflicts.

Land elevation in polders is not uniform. There are high lands, as well as low lands with different demand-supply regimes for water. Those who control the sluice gate also control the water according to their own convenience and benefit. When high lands are irrigated, low lands are submerged under deep water and crops are damaged. When water is drained out for the benefit of low lands, high lands suffer. In many villages, farmers of low-lying areas have to make their own internal dikes to protect their crops from inundation, while the high land farmers do the same to retain water. The problem is resolved sometimes by the Water Management Group (WMG) through discussion. In polders, where there is no functional WMG, the powerful people dictate terms.

Some people occupy *khals*. They construct *bundh* (earthen cross-dam) on the *khal* for aquaculture. As a result, the *khals* lose much of their drainage function. On the other hand, farmers in adjacent areas lose access to water of the *khals* for irrigation.

4.2.4 Current institutional setting

The BWDB is a public agency under the Ministry of Water Resources which constructs and anchors coastal polders. The Ministry formulated the National Water Policy (NWP) on 30 January 1999. To implement the NWP, Guidelines for Participatory Water Management (GPWM) was prepared and endorsed by the Ministry of Water Resources in April 2001. Following this, the

BWDB started to develop its own implementation manual. According to the GPWM, Water Management Organizations (WMOs) representing local stakeholders are driving forces in water resources management. Among these are the Water Management Group (WMG), Water Management Association (WMA) and Water Management Federation (WMF). These are meant to be independent organizations with decision making power at all stages of local water resources management. WMOs are responsible for planning, implementation, operation and maintenance of local water resource schemes in a sustainable way. Management responsibilities of schemes/projects are dependent on the size of the project (polder) as follows:

- Schemes/projects over 5,000 ha: Private management through leasing, or management contract or joint management by BWDB along with local government institutions (LGIs) and WMOs, but keeping the ownership with BWDB;
- Schemes / projects over 1,000 ha but not above 5,000 ha: Management by WMOs keeping ownership with the BWDB; and
- Schemes / projects up to 1,000 ha: Management to be transferred gradually to the LGIs, which are being satisfactorily managed by WMOs (Abedin, 2004).

Although BWDB is legitimately concerned about water management, it is also important and relevant for other agencies that deal with public welfare and development. Inter-agency relationship does not flow automatically. The people in a polder need services from a host of agencies. Except in the Char Development and Settlement Project (CDSP) in Noakhali, a multi-agency approach is conspicuously absent. If farmers and fishers in a polder need extension service from the Department of Agricultural Extension, Department of Fisheries or Department of Livestock Services, extension staff of that agency are needed to operate within the framework of her/his parent organization. Unless inter-agency partnership is clearly spelled out in administrative arrangements or statutory frameworks, such services hardly trickle down to polders where they are needed.

Community participation in water management is a key issue and is being attempted in selected polders. The BWDB and the WMA have entered into a contract regarding O&M of the polder. Respective tasks have been delineated. BWDB is responsible for periodic and emergency maintenance, while the WMA is responsible for regular maintenance of physical infrastructures. Delineation of responsibility between the two has been clearly spelled out in the GPWM (BWDB, 2008). In CDSP and IPSWAM polders, the arrangement works. The WMG engages one or two of its members to look after the sluice gate within its jurisdiction.

In polders covered by CDSP and IPSWAM, the project staff of the TA team (consultant) took special efforts to organize the people in the WMGs in line with the GPWM. The WMGs are registered with the Department of Cooperatives (DoC) through its local office. While the WMGs are organized for each village/sub-polder, an apex body of the WMA is formed at the polder level. WMG is more of a 'social unit' representing a neighborhood, and the WMA is an institution that represents a water management system. The WMA is not yet a statutory entity, as it does not fit in the conventional structure of the DoC. However, the WMAs are acknowledged as representative of

water users by the BWDB, which offers them with some *de facto* role and authority. The WMF is formed representing a larger catchment incorporating several WMAs.

4.2.5 Coordination

With increasing population, urbanization and industrialization of the country, patterns of interaction between different types of water users are changing rapidly. This interaction is also diverse and this diversity is a determining feature of life (Local Govt. Division, 2006).

It is widely perceived that the BWDB is the lead agency for water management, and other agencies like Department of Agricultural Extension (DAE), Department of Fisheries (DoF), Forest Department (FD) or DoC have less concern for water management, and O&M of infrastructures. NGOs are virtually exogenous entities that are generally brought into the picture as an extended arm of project technical assistance. In the absence of such funding, NGOs would not be in place or would be more inclined to support activities like savings and credit schemes.

Yet, some 35 public agencies are connected with water as a basic resource to fulfill their organizational mandates. Lack of a coherent policy and planning on the use of water has driven the situation to such a pass that some of the agencies are found to have been working at cross-purposes. Now that the relevant ministries have declared their sub-sector policies and these have generally been found to be compatible with each other, they should start working towards harmonizing the remaining inconsistencies (Local Government Division, 2006).

4.3 Water Management

4.3.1: Surface water

As noted above, the southern region has an extensive network of rivers, *khals* and water bodies. Surface water is widely available due to existence of some large and medium perennial river systems flowing through this region.

In the monsoon, most of the *khals* are navigable. But in the dry season, water is used for irrigation and some of these *khals* contain very little water. Many internal rivers and *khals* in the network have been silted up and water is not available in the dry season at the place of use in time of extreme need.

Many households in the rural areas possess ponds adjoining respective homesteads. Some of these are used for fish culture, some for domestic purposes and some are derelict. Pond water is also used for irrigating selected Rabi crops, fruits and vegetable gardens in close proximity to the homestead.

4.3.2 Groundwater

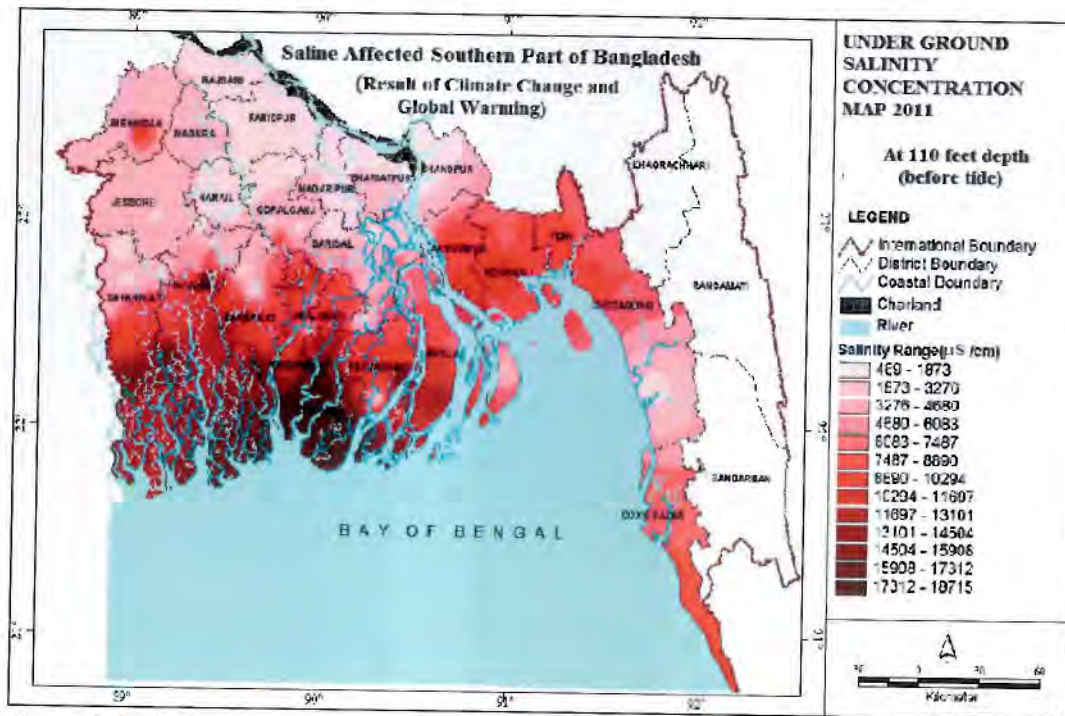
In Barisal region during the monsoon, the groundwater table rises close to the ground level. Groundwater levels fall after mid-October in response to evapo-transpiration and rapid drainage of surface water. The natural rate of fall is the highest in October-November.

Because of high rainfall and widespread water logging in the southern districts and as both the shallow and deep aquifers have good recharge characteristics, they normally remain saturated

almost to the ground level. But under the influence of tidal conditions, the shallow aquifers of Noakhali, Patuakhali, Jhalokati, Pirjopur, Barguna and Bagherhat districts remain saline. For this reason, ground water irrigation area coverage is less in these districts. Moreover, ground water in Noakhali has high concentration of arsenic. In addition, there exists a thin impermeable top clay layer in Noakhali that would hinder installation of Deep Tube-Well (DTW) and Shallow Tube-Well (STW).

Data from the Bangladesh Agricultural Development Corporation (BADC) observation wells reveals that groundwater of coastal belt does not fluctuate too much. Its maximum depth even during the driest period, i.e. April to May, remains within the suction limit of STW. But in terms of quality, it is not suitable for irrigated crop cultivation due to higher salt concentration.

At a depth of 60 to 110 feet below the surface level, salinity concentration varies from 9,347 $\mu\text{S}/\text{cm}$ to 14,021 $\mu\text{S}/\text{cm}$ (Figure 4.4).



Source: BADC 2011

Figure 4.4: Groundwater salinity

4.3.3 Drainage system

Drainage in Barisal Division is served by important river systems, such as, the Meghna, Arial Khan, Kirtankhola, Tetulia, Shandha, etc. Other rivers influence the drainage pattern, such as the distributaries of the Meghna River.

The drainage system in Noakhali region is a complex network of interconnected channels, in which flow directions are often reverse. Flash floods from Tripura Hills carry substantial amount of sediment that cause deterioration of natural drainage system.

There are three principal drainage features: Dakatia River, the WAPDA-Rahmatkhali Khal, the Noakhali Khal and Little Feni River. These are interconnected by a number of *khals* and tributaries. Rahmatkhali/WAPDA Khal forms the principal drainage route in the north of the district. The drainage is provided primarily by WAPDA Khal in Noakhali and the same named as Rahamatkhali Khal in Lakshmipur into the Lower Meghna. This area generally suffers from drainage congestion, and one major feature is the Begumganj depression, which is seasonally water-logged. With land accretion in the south, the primary drainage route from the Noakhali area is now to the west. The BWDB is in the process of diverting the Noakhali Khal to Sandwip channel through the Algir Khal and the Bamni River.

4.3.4 Irrigation

BWDB is the lead agency for implementing large scale water irrigation projects. Among the major irrigation projects in the region are:

- Barisal Irrigation Project (Barisal)
- Muhuri Irrigation Project (Feni)
- Chandpur Irrigation Project (Chandpur, Lakshmipur)

Meanwhile, BADC has been implementing minor irrigation projects facilitating both groundwater and surface water irrigation since 1961 (Table 4.3).

Table 4.3: Minor irrigation in the southern region

District	Equipment used & area irrigated (ha)						Total area (ha)
	DTW		STW		LLP		
	No.	Area	No.	Area	No.	Area	
Bagerhat	0	0	6,349	11,753	12,267	33,212	44,965
Barguna	0	0	0	0	310	1,714	1,714
Barisal	0	0	0	0	5,090	57,156	57,156
Bhola	0	0	0	0	4,146	47,024	47,024
Chittagong	57	1,001	2,924	13,030	5,028	45,266	59,297
Cox's Bazar	2	70	5,140	19,016	2,508	22,391	41,477
Feni	37	1,132	2,927	11,894	1,620	16,987	30,013
Jhalokati	0	0	0	0	1,038	7,868	7,868
Khulna	0	0	13,649	26,508	13,254	24,399	50,907
Lakshmipur	17	617	1,012	2,528	2,843	24,268	27,413
Noakhali	58	2,225	3,100	7,998	6,983	38,875	49,098
Patuakhali	0	0	0	0	940	2,320	2,320
Pirojpur	0	0	0	0	2,509	12,493	12,493
Satkhira	720	11,135	38,445	61,490	2,333	4,415	77,040
Total	32,912	357,595	1,425,136	3,336,652	14,033	128,575	3,822,822

Source: BADC Minor Irrigation Survey Report 2009-10

This minor irrigation programme is overwhelmingly dependent on extraction of groundwater. STW accounts for 88 percent of total irrigated area in the region covered by the BADC (Figure 4.5). The extent of surface water irrigation using the LLP is very small (3% area). Surface water irrigation is particularly low in Jhalokati, Patuakhali, Barguna and Satkhira (BADC, 2010).

The BADC's surface water irrigation program includes double-lifting irrigation using 5-cusec pump in Barisal, Bhola, Lakshmipur and Cox's Bazar. Area covered under this mode using slightly over 13 km of irrigation channels was 10,585 ha in 2010-11.

LGED has 200 small scale water resource development (SSWRD) sub-projects in the southern region covering an area of 135,000 ha.

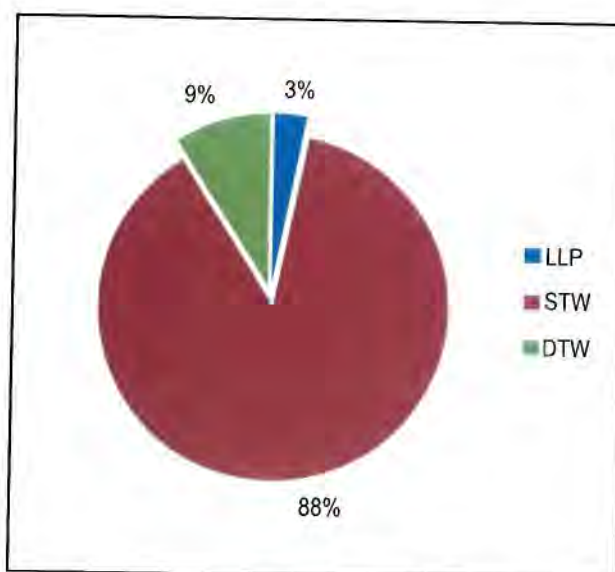


Figure 4.5: Minor irrigation of BADC

The southern region is conditioned by its geographical location, hydrological and morphological character and geo-physical and bio-physical characteristics. Proximity to the sea has added further dimensions to its vulnerabilities and opportunities. The region faces many challenges that threaten its eco-systems and production processes. Among major challenges are the emerging threats of climate change, river bank erosion, salinity, water logging and resource degradation.

5.1 Climate Change and Sea Level Rise

Bangladesh ranks fifth most vulnerable to climate change and hunger among 28 developing countries (UNDP, 2011). Sea level rise (SLR) leading to submergence of low lying coastal areas and saline water intrusion in the coastal rivers and into groundwater aquifers reducing freshwater availability, damage to the biodiversity and overall crop production and drainage congestion inside polders will also adversely affect the agriculture sector. Hazard intensity is high in the southern region compared to other areas of Bangladesh (Figure 5.1).

It is estimated that inundated area in the southern region would increase by 14 percent by 2100 with a SLR of 88 cm. Districts of Bagerhat, Barguna, Patuakhali, Khulna and Satkhira will be worst affected (Table 5.1).

Table 5.1 Increase in inundated area under different SLR scenarios

District	Inundated area (%)	Increase in inundated area (%)		
	2000 0 cm SLR	2030 14 cm SLR	2050 32 cm SLR	2100 88 cm SLR
Bagerhat	49	6	16	35
Barguna	35	2	7	29
Barisal	76	1	2	3
Bhola	11	1	2	3
Lakshmipur	6	1	2	6
Noakhali	24	1	3	7
Patuakhali	37	2	4	23
Khulna	39	3	7	19
Jessore	26	1	2	8
Satkhira	36	3	6	15
Total		2	5	14

The adverse impact of climatic events will manifest in lower crop productivity and reduced cropping intensity. Increased frequency of extreme events such as cyclone, storm surge, SLR, soil and water salinity, incidence of pest attack and diseases, erratic rainfall and higher temperature will be observed. Allied to these phenomena, since people do not have sufficient employment opportunities around the year, their food security will be at risk.

The challenge is to develop capacity and resilience to offset negative impacts of climate change.

CHALLENGES

This needs investment in the construction and maintenance of protective infrastructures, development of climate resilient production technologies and enhancing coping capacity of people and institutions.

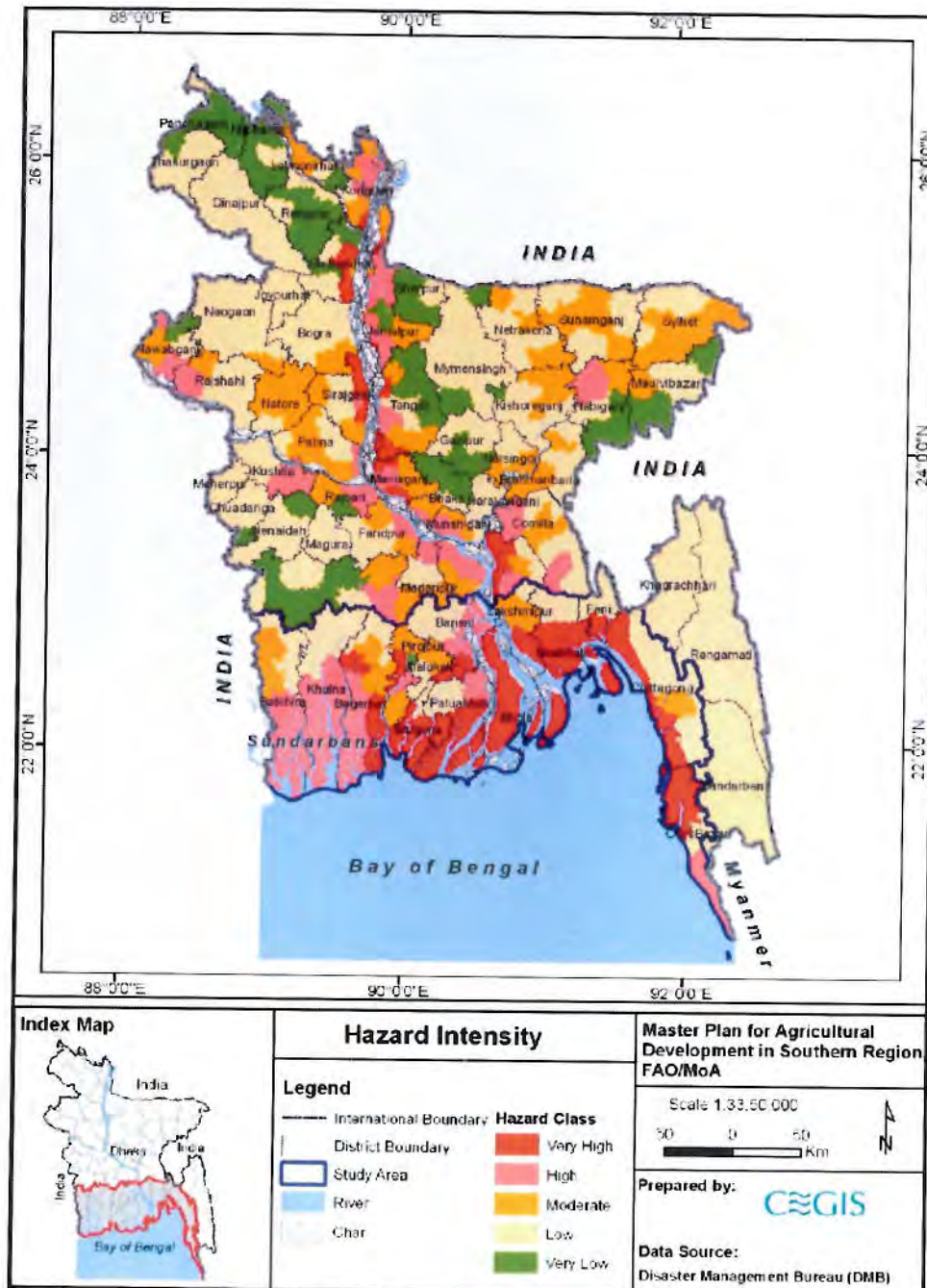


Figure 5.1: Hazard intensity of Bangladesh

5.2 Cyclone

Cyclones, often accompanied by storm surges, are devastating. These cause destruction of life, property, infrastructure and biodiversity. Recent IPCC findings predict increasing severity of devastating cyclones. Cyclones like *Sidr* and *Aila* caused large scale destruction of livelihoods in addition to death of many people. Affected people are yet to recover fully from the effect of these cyclones in 2007 and 2009.

5.3 Erosion

River bank erosion and loss of habitable and cultivable land is another acute problem. It causes huge economic losses. The World Disaster Report 2001 published by IFRCS reveals that, in Bangladesh, annually one million people are displaced and 9,000 ha of land are lost due to river erosion. It is a regular phenomenon in off-shore islands, particularly in Bhola, Hatiya, Sandwip and Kutubdia. Due to bank erosion, Sandwip has lost 180 km² in the last 100 years. During last 40 years, Bhola has been squeezed to 3,400 km² from 6,400 km². Kutubdia, once of 250 km² size, lost around its 65 percent during last 100 years and more than 60 percent of its population had to migrate to other areas. Bank erosion adversely affects the ecosystem, navigation, valuable agricultural land and drainage systems.

Though land is eroding, new land is accreting on the other side of the equation. Fertile and mature land is eroded, while new land becomes productive very slowly, taking four to five decades even after empoldering.

The question may arise whether erosion protection is technically feasible in the context of Bangladesh, or whether the people are being given a false sense of security in the guise of 'protective' structures. The associated question is whether a plan should be in place to discourage people from investing in vulnerable areas, and to have a contingency plan for evacuation to safer areas.

5.4 Salinity

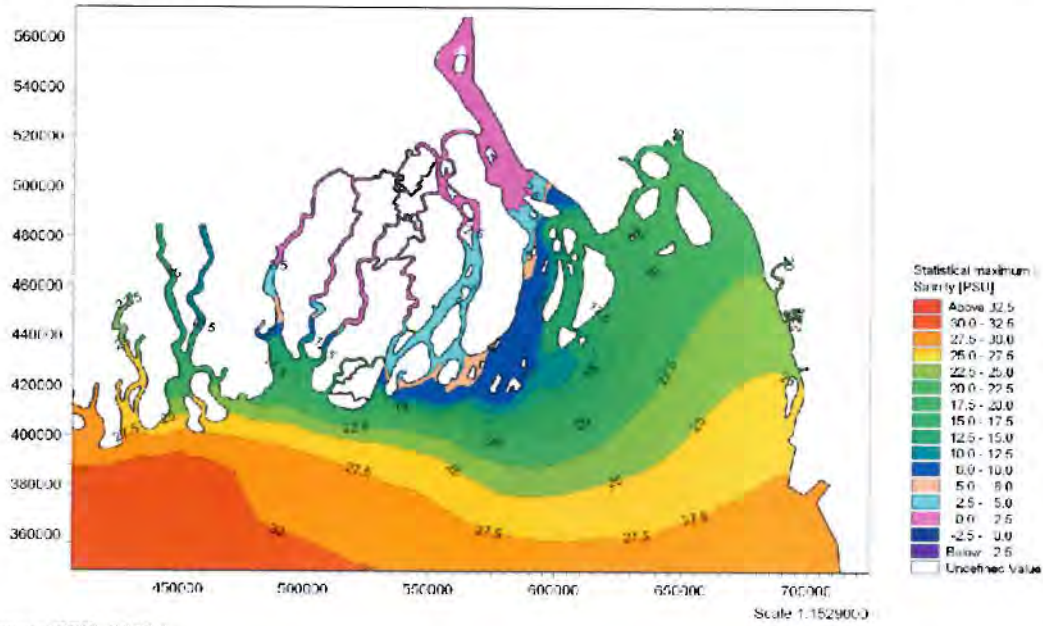
Salinity is a major constraint that hinders production of crops. But all areas are not saline at all times. The lower region of Patuakhali, Barguna, Jhalokati, Pirojpur and Bhola districts are affected by salinity. Embankments and polders are constructed surrounding these areas to protect the agricultural land. But occasionally high tidal surge hits and saline water enters polders and destroys standing crops. Although the lower reach of the drainage system of Barisal district is under influence of tidal effect, saline concentration of water is still less than 1,000 micro-mhos and is suitable for irrigation (Figure 5.2).

Khulna, Bagerhat and Satkhira are the worst hit by water salinity, while Feni, Lakhshmipur and Pirojpur are least affected.

The withdrawal of fresh water from upstream, irregular rainfall, introduction of brackish water for shrimp culture, faulty management of sluice gate and polders, regular intrusion of tidal saline water during high tide in the unprotected lands, capillary rise of soluble salts etc. are the main causes of increased soil salinity in the surface soil. About 1.05 million hectares in the southern region are

affected by soil salinity. Some of the new lands in Satkhira, Patuakhali, Barguna, Barisal, Jhalokati and Pirojpur districts have been affected significantly by different degrees of soil salinity during the last four decades (Table 5.2, Figure 3.4).

A comparative study of the salt affected area between 1973 and 2009 shows that about 0.223 million ha were affected by various degrees of salinity during the last four decades or so. It was also found that about 0.0354 million hectares of new land was affected by various degrees of salinity during 2000-2009.



Source: CEIP, BWDB

Figure 5.2: Salinity contours in the Meghna estuary

Table 5.2: Extent of soil salinity in last four decades (1973-2009) in the region

Salt affected area (000 ha)			Salinity class and area (000 ha)											
			S1 2.0-4.0 dS/m			S2 4.1-8.0dS/m			S3 8.1-16.0 dS/m			S4 >16.0 dS/m		
1973	2000	2009	1973	2000	2009	1973	2000	2009	1973	2000	2009	1973	2000	2009
	833.45	1020.75	1056.26	287.37	289.76	328.43	426.43	307.20	274.22	79.75	336.58	351.69	39.90	87.14

Source: SRDI, SRMAF Project, Ministry of Agriculture, 2010

The plants cannot absorb sufficient amount of water due to high salt concentration. In this situation, plants actually die from water stress or drought in a moist soil if the soluble salt concentration is high. Plants also suffer from toxicities of specific salt and nutritional imbalances.

5.5 Siltation of Rivers and Channels

Most of the rivers and *khals* in the region are silted up due to accelerated erosion caused by poor management of upper riparian countries and decline in upstream flow due to construction of the Farakkha Barrage. For the past 90 years, the region has depended on fresh water inflows from the Gorai to control the salinity front in the dry season. Since the end of the 1980s, the flow in the Gorai River has been decreased by the build-up of sediment in the off-take. This reduction in dry season water levels in the Ganges has accelerated the rise of the bed level of the southern rivers. The situation has worsened due to absence of regular capital dredging.

5.6 Water Logging

Water logging, both perennial and seasonal, is a severe problem in the region. Noakhali tops the list of districts in terms of waterlogged area (Table 5.3).

Drainage congestion and water logging is a major problem of the southwest region. The drainage system consists of dense network of different types of natural canals and drains. The system includes the major perennial rivers, such as the Gorai flowing along northern boundary and other rivers marking the eastern boundary, which are either distributaries or tributaries of these rivers and flowing mostly from north to south. Off-take of these distributaries and outfall of the tributaries are silted up causing disconnection of flow in the dry season. As a result of interrupting drainage system and siltation of rivers and canals, permanent water logging in the form of *Beel* has been created in this region. Among the major *beels* are Beel Dakatia (9,000 ha) in Jessore and Khulna (Daulatpur and Dumuria upazila) and Bhutiar Beel (5,330 ha) in Bagerhat (Terokhada upazila).

Table 5.3: Area affected by water logging

District	Water logged area (ha)
Noakhali	31,221
Bagerhat	7,725
Khulna	7,390
Satkhira	6,600
Lakshimpur	4,589
Feni	3,842
Chittagong	1,500
Total	62,867

Source: BWDB, CEGIS, field visits

The drainage congestion in the southeast region (greater Noakhali) includes repeated inundation of agricultural land and homesteads in monsoon, which is caused by poor drainage capacity. Total waterlogged area in the region is 39,652 ha. Begumganj Upazila alone has 22,186 ha of waterlogged area (52% of the area of the upazila). Poor drainage is also a major constraint to overall development of the locality.

Noakhali Khal is the main drainage line on which drainage of all upazilas of mainland Noakhali (except Hatiya) are directly or indirectly dependant. This has been silted up for a long time. A long sandbar has formed from about 6 km downstream of Sonapur. This prevents drainage towards the south. Catchments to the north of Sonapur drain northward into Begumganj depression and eventually to Rahmatkhali Khal. Later in the monsoon season, as water level rises, flow passes over the sandbar to the south, though not in significant quantity.

5.7 Vulnerable Polders

Many polders are in dilapidated conditions in terms of breach and slip in the embankment, erosion, neglect in repair works, drainage congestion because of siltation and encroachment of canals and, above all, location in the risk zone. Water control structures in many places are damaged or non-functional. Embankments have also caused subsidence inside polders, thus further causing drainage congestion. The emerging threat of climate change and consequent sea level rise has made many polders more vulnerable. All these factors adversely affect the functionality of the polders.

The BWDB has categorized 51 polders as "most vulnerable" and another 55 polders as "medium vulnerable". To cope with vulnerability, it is necessary to rehabilitate damaged infrastructures of the polders. Productive potential of polders can be harnessed through regular and effective O&M. On the other hand, it is necessary to construct climate-resilient polders with appropriate design so that these can withstand rising water level and storm surges.

5.8 Lack of availability of quality surface water for irrigation

The southern region has a network of rivers and canals and in the main rivers there is plenty of water round the year. But during *rabi* and *pre-kharif* season there is a dearth of quality surface water for irrigation. Most of the rivers are tidally influenced and water salinity is higher than the irrigation threshold level for agricultural crops. Other than some pockets, expansion of surface water irrigation is constrained by poor quality water, mostly brackish and saline. The areas identified for expansion of surface water for *boro* and *Taus* crops also requires investment for infrastructure development and creation of lifting devices.

5.9 Limited number of stress tolerant crops and cultivars

The NARS system has developed many promising technologies including development of new varieties of crops and management practices for the favourable eco-systems of Bangladesh. However, few salt-, drought- and stress-tolerant cultivars or appropriate management practices to improve cropping intensity for boosting agricultural production have been developed so far for the southern region. The productivity of already developed cultivars is also not promising against the severe stresses faced.

5.10 Resource Degradation

Degradation of natural resources can be in terms of worsening conditions of land, water and air, and may be natural or anthropogenic (human induced).

5.10.1 Land degradation

Main causes of land degradation are as follows:

- Severe soil degradation by erosion, contamination, compaction, losses of organic matter through improper farming practices, salinization and water logging;
- Soil degradation mainly through land transformation and deforestation;
- Deterioration of natural landscape by artificial replacement for cultivation, urbanization, etc;
- Loss of biodiversity and fragmentation of ecosystems by intensive farming methods, urbanization, etc.

Other causes of land degradation include drought, population pressure, poverty, constraints imposed by recent international trading agreements and local agricultural and land use policies. Intensive agriculture along with imbalance in fertilization has degraded lands seriously. Integrated fertilizer use is not only inadequate but also highly erratic because of high price, irregular supply and lack of appropriate knowledge based on soil test values. The improper fertilizer use patterns along with limited use of organic and bio-fertilizer is a major cause of land degradation. An integrated nutrient management approach, would aim at efficient and judicious use of all major sources of plant nutrients, so as to get maximum economic benefit without any deleterious effect on physical, chemical and biological properties.

Salinization refers to all types of soil degradation brought about by the increase of salt in the soil. Even this may be a human-induced process, due to poor planning and management of irrigation schemes. Also covered are saline intrusion and the incursion of seawater into coastal soils arising from over-abstraction of groundwater. SRDI showed that the salinity area has increased to 1.05 million hectares from 0.83 million hectares in 1975 (Asiatic Society of Bangladesh, 2003).

5.10.2 Subsidence

Subsidence remains a challenge for the region. It is to be noted that Dhaka University Earth Observatory (DUEO) in collaboration with Lamont-Doherty Earth Observatory of Columbia University, New York, has installed 18 continuous geodetic GPS in Bangladesh during the period 2003 to 2007. Based on this observation, Dhaka University conducted a study on subsidence of the coastal area and obtained figures of 12 mm/year in Khulna for subsidence and 10 mm/year in Patuakhali.

5.10.3 Water pollution

Industrial effluents and urban sewage, along with agrochemicals used in crop fields, are threats to the coastal-marine water resource. The two seaports, Chittagong and Mongla, along with the industrial cities of Khulna and Chittagong are of highest concern. Out of 720 industrial units in Chittagong, only 20 percent treat their liquid effluents before disposal. Khulna possesses 300 large industrial units, which discharge about 10 million gallons of liquid waste that finally reach the Bay of Bengal through the Sundarbans. Oil spills in the seaports and ships navigating the area are other sources of pollution. Ship breaking along the Chittagong coast adds to the pollution. All these

pollutants seriously affect the aquatic fauna and mangrove vegetations (Asiatic Society of Bangladesh, 2003).

5.10.4 Loss of biodiversity

Environmental degradation, includes loss of biodiversity (disappearance or extinction of indigenous flora and fauna), declining land quality, loss of genetic diversity because of practice of monoculture and so on. Coastal mangrove forests are now threatened by the expansion of shrimp farms. It is reported that a total of 60,000 ha of mangrove forest area was converted to shrimp farms and for other purposes. Loss of biodiversity due to shrimp culture is of high concern. The wild fry is the largest source of the shrimp fry in commercial farming, collected from the river by thick nets. The collection system is such that all collected wild fries including all other fish fry are kept in a jar/pot, and only the shrimp fries are sorted out, while the rest are all abandoned. Thus, thousands of wild fries of many species of aquatic flora and fauna are lost just for one or two shrimp fries. On the other hand, in the shrimp farm areas, selective species of *bagda* and *golda* are cultured intensively and all other natural aquatic species have declined or are already extinct (Roy, 2001).

5.11 Population and Employment

According to projections based on 2001 census data, population of Bangladesh will increase to 172 million in 2021 and 219 million in 2051. This projection is based on the Total Fertility Rate (TFR) of 2.1% in 2011.⁶ It may be mentioned that TFR has been estimated at 2.15 in 2009. If the proportion of the current population in the southern region (21% of the country's population) remains constant over the next decades, the southern region will have a population of 36 million in 2021. If rural-urban population ratio in the region remains similar to that of the country, 37 percent of the population will live in urban areas in 2021 compared to 29 percent in 2011. By 2051, population of the region will increase to 46 million including urban population of 30 million (64%). This means that there will be rural-urban migration to an increasing scale and/or more rural areas will be converted to urban areas (Figure 5.3).

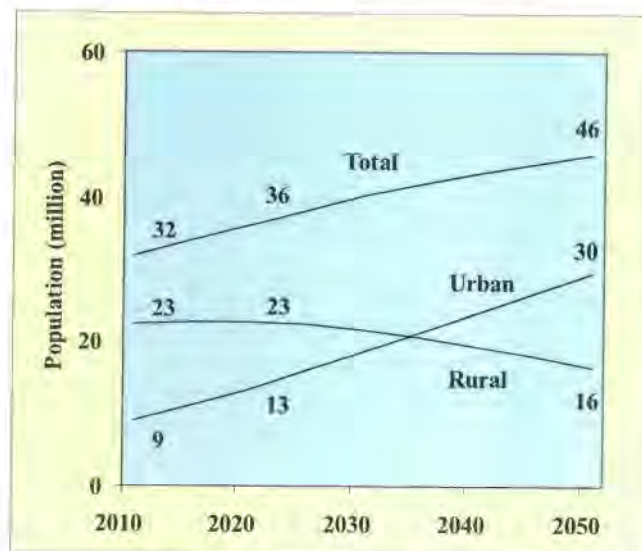


Figure 5.3: Trend of population growth in the southern region

⁶ Total Fertility Rate (TFR) is defined as the average number of children that would be born alive to a woman (or group of women) during her reproductive period if she were to live through all her child-bearing years and bear children according to the age-specific fertility rates of a given year.

It is estimated that 46 percent of the population in the coastal zone are below 15 years of age. This is likely to have serious implications as more workers will compete in the job market in the coming years (Ahmad, 2005).

An increase in population will have following implications.

- Per capita availability of land will decline, while the demand for food, water, housing, energy and recreational facilities will increase.
- With increasing population and declining land resources, availability of food will be constrained, resulting in further malnutrition.
- With increasing urbanization and demand for infrastructure, cultivable land will be more and more shifted to other land uses.
- There will be increased pressure on the natural resource base, with risks of further degradation of land and water quality.
- The demand for social infrastructure in the fields of health and education will increase.
- With increasing social mobility, particularly of women, and with increased adult population, the supply of labour will increase.

The current workforce (economically active population) is 54 percent of the total population (Ahmad, 2005). In that sense, there is a need for additional 0.2 million jobs every year to maintain at least the present level of employment, if not more, which is a huge challenge.

5.12 Credit

5.12.1 Need

Most farmers have hardly any investable surplus. They usually borrow money to meet their deficits. In the southern region, 26 percent households resort to borrowing (BBS, 2010). Household borrowing is quite high in Barguna (45%), followed by Bagerhat and Satkhira (40% each) and Patuakhali (39%). About one half of the households borrow for agricultural purposes. Crop sub-sector alone accounts for the highest number of borrowers, accounting for about four-fifths of agricultural credit (BBS, 2010) (Table 5.4, Figure 5.4).

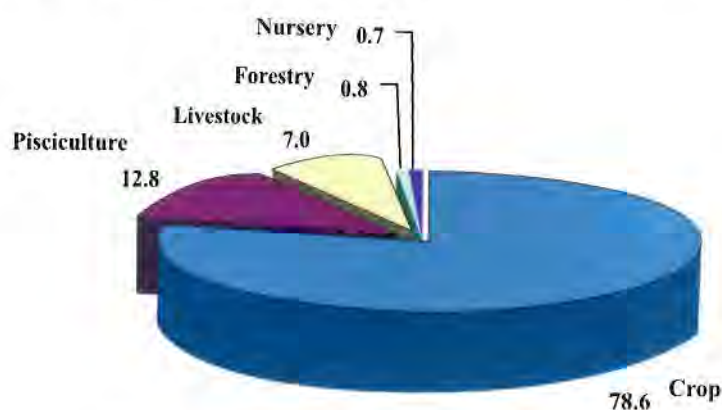


Figure 5.4 Agricultural credit by activity (%)

Demand for credit sharply rises because of sudden 'shock' events like the occurrence of disasters, death of an earner in the family, prolonged sickness of household members, social expenses like marriage or dowry payment, etc. While the affluent families often dispose their savings or assets to overcome such shocks, the poor have to borrow. The situation worsens in the case of recurrent disasters and consequent crop failure, input price hike, downward trend in output price and other forms of market failure. As a result, many farmers are trapped in a vicious cycle of debt.

Table 5.4: Distribution of borrower households by purpose

	All household	Number of borrower households by purpose							Total	%
		Crop	Pisci-culture	Live-stock	Forestry	Nursery	Others			
Barguna	201,929	40,413	3,177	5,882	547	446	41,407	91,872	45	
Barisal	482,075	77,040	4,414	4,653	725	624	82,969	170,425	35	
Bhola	347,515	60,758	2,226	2,647	264	271	47,966	114,132	33	
Jhalokati	133,204	16,392	674	1,641	275	234	22,334	41,550	31	
Patuakhali	323,502	57,690	4,324	8,330	534	548	55,256	126,682	39	
Pirojpur	243,057	33,778	1,740	2,146	361	673	53,513	92,211	38	
Chittagong	1,298,834	33,536	1,394	3,396	704	368	54,875	94,273	7	
Cox's Bazar	335,825	24,211	1,965	1,993	409	327	37,222	66,127	20	
Feni	237,575	16,322	478	893	145	136	31,661	49,635	21	
Lakshmipur	332,818	32,814	1,166	2,047	213	225	45,188	81,653	25	
Noakhali	544,943	53,399	2,390	4,308	336	388	63,161	123,982	23	
Bagerhat	339,217	31,901	29,232	3,119	525	424	70,246	135,447	40	
Khulna	502,835	26,389	17,248	3,321	278	246	59,833	107,315	21	
Satkhira	436,178	47,931	19,853	4,552	309	359	102,730	175,734	40	
SR Total	5,759,507	552,574	90,281	48,928	5,625	5,269	768,361	1,471,038	26	
BD	28,695,763	3,126,194	139,896	323,912	16,774	17,255	3,603,890	7,227,921	25	
SR%	20	18	65	15	34	31	21	20		
SR%		37.6	6.1	3.3	0.4	0.4	52.2	100.0		
BD%		43.3	1.9	4.5	0.2	0.2	49.9	100.0		
SR% (agriculture=100)		78.6	12.8	7.0	0.8	0.7				
BD% (agriculture=100)		86.3	3.9	8.9	0.5	0.5				

5.12.2 Credit market

While demand for credit is increasing with the advent of new technologies and high value crops, the supply side has remained largely erratic. Volume of institutional credit is conspicuously low and the proportion of the public sector in the total volume of institutional credit is even smaller. According to data of Bangladesh Bank, total disbursement of rural credit in 2008-09 stood slightly over BDT 279 billion, of which 25 percent was delivered by the public sector. The remaining 75% has been delivered by micro-finance institutions (MFI) including NGOs and the *Grameen Bank* (Planning Commission, 2011). However, the demand for credit is much greater than that met by institutional sources.

According to one estimate, total domestic credit in December 2003 and December 2004 stood at \$17.62 billion and \$20.77 billion respectively (CDF, 2006). Considering this figure and assuming proportionate share of the southern region, it is roughly estimated that as high as 80 percent of the volume of credit comes from various non-institutional sources largely dominated by *mohajans* and *dadanders*



Figure 5.5: Supply of rural credit

(Figure 5.5). They charge interest on loan at high rates, generally 10 percent per month. Loan conditionality of *dadanders* is quite stringent, as they lend money with the guarantee of repayment in the form of products whose price is fixed unilaterally by them in advance. This is a common practice for fishers who borrow money from *bahadders* before taking the fleet to the estuary or sea and dispose the catch at a price or proportion determined by the *bahadder*. Advance sale of labor in crop fields in exchange of loan (cash or rice) is also common. Use of bonded child labour in fish drying, particularly in Dublar Char, has been widely reported by the mass media.

5.12.3 Institutional sources

Specialized banks, like the *Krishi Bank*, are a major source of agricultural credit. Two-thirds of the credit from public sector agencies is from specialized banks (Planning Commission, 2011).

According to data of 613 micro-finance institutions (MFI) including the *Grameen Bank*, 125 (20%) are local or regional NGOs based in the southern region (CDF & InM). Besides, many national MFIs, such as the *Grameen Bank*, *BRAC*, *ASA*, *TMSS*, *Caritas*, *RIC* and *Proshika* have outlets in the southern region. Their eligibility criteria and recovery systems often alienate the hardcore poor, or those who are engaged in economic activities with longer gestation period. Repayment of principal and service charge (interest) in weekly installment is mandatory for MFIs. Only those households borrow from them which have multiple sources of income and are in a position to pay back in weekly installments.

As of July 2010, there were 527 NGOs registered by the Microfinance Regulatory Authority (MRA) (Ahmad, 2010). The *Grameen Bank*, however, operates as a quasi-NGO specialized bank outside the orbit of the MRA. They usually cover the landless and poor women who are categorized as "non-farm" households (defined as those who own less than 0.05 acre of land). Average amount of microcredit from MFI sources has been Tk. 7,144 (Planning Commission, 2011). Amount of credit received per person would be higher as people borrow from multiple sources.

5.12.4 Problems of institutional credit

Despite the fast growing microfinance sector, there has hardly been any attempt by public sector institutions, particularly specialized banks, to reform their mode of operation and make them user-friendly. Besides few government projects with credit component, public sector credit agencies are

characterized by the following phenomena.

- Access to credit is impeded by procedural complexities, such as, provision of collateral, filling up forms and delay in approval.
- Farmers often find it difficult to understand procedures.
- Hidden and real costs of credit are high in terms of travel time and obscure payments that discourage farmers to go to the banks for credit.
- Poor farmers do not receive satisfactory client service from banks.
- Women are excluded from the banking service as they can hardly offer any collateral (land).

As total demand for credit far outweighs its supply, private moneylenders dominate. The average demand for agricultural credit is assumed at Tk. 20,000, and total annual demand for agricultural credit stands at Tk. 62 billion. Public sector agencies including specialized banks offer around Tk. 15 billion. Hence there is an estimated annual supply gap of Tk. 47 billion that the institutional credit sources could fill up, freeing farmers from obligations to private moneylenders.

5.13 Market Linkage

Market density in the region is low compared to other areas of Bangladesh. The region produces diversified commodities including crops, fish and livestock products. Post-harvest loss is very high, particularly in the monsoon season, due to absence of market infrastructure and processing facilities. There are few collection centers/packing houses for sorting, grading and packaging. Warehousing facilities at village/union level for perishable commodities are absent, and market places are highly vulnerable to cyclone and tidal surge.

5.14 Institutional Environment

People need services from a host of rural development agencies. But often these agencies are not located at doorsteps of farmers, or farmers have little or no access to services that these agencies are supposed to provide. Even if there are agencies with respective mandates, there is no horizontal coordination among them, despite the fact that farmers need all these services for their production processes and livelihoods. Institutional challenges are summarized as follows:

- Minimum coordination among service providers;
- Conflicting demand for natural resources;
- Narrow project-based approaches;
- Water management organizations have not been developed, or systems collapse after withdrawal of the project;
- Minimum accountability of service providers ;
- Lack of a holistic approach on farming systems;
- Poor access to institutional credit.

All these challenges need to be taken into account so that potential interventions are explored based on the contextual reality.

CURRENT SCENARIOS AND DEVELOPMENT POTENTIALS

The region has many challenges confronting agricultural development. Yet, it also has a diversified positive potential in crop, horticulture, fishery, livestock and value chain management systems. The region is largely dominated by medium high land which is suitable for different agricultural practices round the year.

Highland may be suitable for *Khariif* or perennial dry land crops if the soils are permeable. Impermeable soils or soils which can be made impermeable by puddling may be suitable for transplanted Aus and/or *Aman* paddy 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 *Khariif* dry land crops, which mature before flooding starts, can be grown on permeable soils, and late *Khariif* 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* to be grown reliably. 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. Dry land Rabi crops are widely grown on soils which drain in October or November.

Lowland is flooded too deeply for broadcast Aus or transplanted *Aman*. 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.

6.1 Crop

Transplanted *Aman* rice is the dominant crop in the entire region. Major land types and cropping patterns by district are presented below (Table 6.1).

The productivity of rice in all seasons can be increased more than two tonnes per hectare (Figure 6.1). This is possible through expansion of suitable HYV cultivars, better agronomic management practices and on-farm water management.

An analysis of water salinity data for different months provides an opportunity of increasing surface water irrigation in the region (Figure 6.2). Water resources in the region are abundant, the salinity level in many areas is less than the threshold limit of many crops, indicating that about 0.7 million ha of land can be brought under surface water irrigation (Table 6.2).

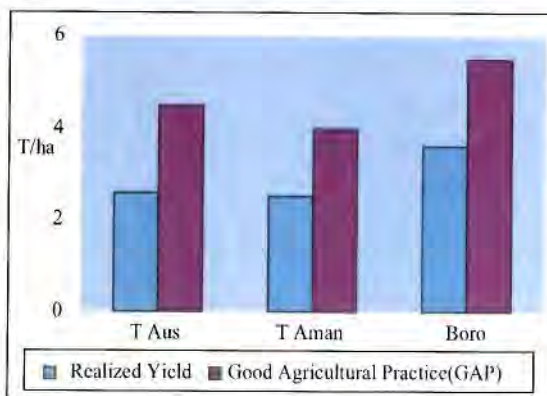


Figure 6.1: Yield of milled rice

Table 6.1: Current land use by land type

Name of district	Land type	Major cropping patterns
Barisal	MHL (56%) followed by MLL (9%) and LL (3%) and 29% Misc. land. Percentage of H L only 3% which mostly used as homestead.	1. Boro – Fallow – T.Aman 2. Boro – Fallow – Fallow 3. Fallow – Aus – T.Aman
Bhola	A total of 47% classified land of which 43% MHL and only 3% MLL. Two percent HL mostly used as domestic purposes	1. Boro – Fallow – T.Aman 2. Chilli – Dibbling Aus – T.Aman 3. Mungbean – Fallow – T.Aman
Barguna	A total of 66% classified and 34% misc. Land type, 61% is MHL and 3% MLL. Only 2% HL is being used as domestic and other purposes	1. Khasari – T.Aus – T.Aman 2. Mungbean – T.Aus – T.Aman 3. Water melon – T.Aus – T.Aman
Jhalokati	A total of 76% classified and 24% misc. Land type, 54% is MHL and 17% MLL. Only 5% HL is being used as domestic and other purposes	1) Rabi crops – T.Aus – T.Aman 2) Fallow – T.Aus – T.Aman 3) Rabi crops/vegetable – Fallow – T.Aman
Patuakhali	A total of 63% classified and 37% misc. land of which 58% MHL and only 4% MLL. One percent HL mostly used as domestic purposes	1. Fallow – Fallow – T.Aman 2. Mungbean – T.Aus – T.Aman 3. Khasari – Fallow – T.Aman
Pirojpur	A total of 69% classified and 31% misc. Land type, 56% is MHL and 6% MLL and 3% LL. Only 4% HL is being used as domestic and other purposes	1. Fallow – T.Aus – T.Aman 2. Boro – Fallow – T.Aman 3. Fallow – Fallow – T.Aman
Khulna	A total of 78% classified and 22% misc. Land out of which 62% is MHL and 10% MLL and 2% LL. Only 4% HL is being used as domestic and other purposes	1. Boro – Fallow – T.Aman 2. Fallow – Fallow – T.Aman 3. Fallow – T.Aus – T.Aman
Satkhira	A total of 82% classified and 18% misc. land of which 62% MHL and only 3% MLL and 17 % HL	1. Fallow – Fallow – T.Aman 2. Boro – Fallow T.Aman 3. Wheat – Jute – T.Aman
Bagerhat	A total of 75% classified and 25% misc. Land out of which 61 % is MHL and 7% MLL and 2% LL. Only 5% HL is being used as domestic and other purposes	1. Fallow – Fallow – T.Aman 2. Boro – Fallow – T.Aman 3. Boro – Fallow – Fallow
Noakhali	A total of 64% classified and 36% misc. of which 51% MHL, 11% MLL and only 1% each of HL and LL	1. Boro – Fallow – Fallow 2. Soybean – Fallow – T.Aman 3. Vegetable /Wheat – T.Aus – T.Aman
Lakshmipur	The land type of the area as per SRDI report 72% classified and 28% misc. of which 62% MHL, 7% MLL and only 2% HL	1. Soybean – Aus – T.Aman 2. Boro – Fallow – T.Aman 3. Soybean – Fallow – T.Aman
Feni	According to SRDI report the land type of the area are 73% classified land and 27% misc. of which 72% MHL and only 1% HL	1. Boro – Fallow – T.Aman 2. Mungbean – T.Aus – T.Aman 3. Vegetable – T.Aus – T.Aman

Source: DAE, SRDI and primary data collected from field.

Table 6.2: Maximum salinity level of surface water (unit: dS/m)

ST. ID	Station name	River name	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1	Bagerhat	Alaipur Khal Daratona	0.98	1.52	3.60	7.25	18.00	20.00	15.30	15.0
1.5	Morrelganj	Alaipur Khal Daratona Gasiakhali	0.93	1.65	4.08	12.00	11.00	16.50	12.00	6.50
106	Patgati	Gorai - Madhumoti	0.56	0.90	1.10	1.07	0.94	0.90	0.85	0.58
107	Pirojpur	Gorai - Madhumoti	0.44	0.40	0.78	0.78	0.80	0.61	0.78	0.58
107.2	Rayanda	Gorai - Madhumoti	0.63	0.91	0.98	1.70	3.60	4.70	4.50	1.00
108	Chardoani	Gorai - Madhumoti	0.66	0.90	1.18	1.55	6.25	6.00	2.00	0.95
136	Kawkhali	Kacha	0.42	0.42	0.58	0.50	0.83	0.62	0.62	0.41
18	Barisal	Barisal-Burisarwar	0.38	0.27	0.41	0.70	0.48	0.48	0.38	0.32
184	Patuakhali	Lohalia	0.35	0.28	0.60	0.85	1.60	1.80	0.79	0.64
185	Galachipa	Lohalia	0.51	0.41	0.43	0.63	1.76	3.40	2.85	0.61
185.1	Gulbumia	Lohalia	0.37	0.45	0.57	1.50	3.40	3.10	1.55	0.80
19	Mirjaganj	Barisal-Burisarwar	0.40	0.39	0.80	0.85	1.28	1.25	0.84	0.50
20	Amtali	Barisal-Burisarwar	0.40	0.36	0.75	0.93	1.00	1.70	1.25	1.50
219	Gazirhat	Nabaganga	0.37	0.40	1.45	1.10	5.00	14.00	13.00	3.0
220	Khepura	Nilakhi	10.00	12.05	17.50	22.00	19.50	22.00	15.40	12.0
23	Kalaroo	Betna-Kholpetua	1.51	3.55	9.00	10.50	20.00	21.00	22.50	9.0
253A	Uzirpur	Sarupkati	0.31	0.41	0.36	0.52	0.44	0.44	0.45	0.54
258	Paikgacha	Shibsa	6.50	8.00	11.95	24.00	28.00	35.00	36.00	40.00
259	Nalianala	Shibsa	4.50	11.00	11.21	24.00	40.00	40.00	40.00	40.00
278	Daulatkhan	Surma-Meghna	0.80	2.00	1.00	6.97	8.00	5.00	1.90	1.30
279	Tajumuddin	Lower-Meghna	0.75	4.00	3.50	9.20	15.00	11.00	4.00	0.85
279.1	Char fession	Lower-Meghna	3.25	8.00	12.30	13.50	19.00	19.00	10.50	3.50
28	Dumuria	Bhadra	1.45	3.10	6.80	16.00	21.60	28.00	26.00	30.0
288	Illishaghat	Tentulia	0.34	0.58	0.64	1.50	3.50	5.00	0.90	0.49
289	Dhulia	Tentulia	0.52	0.55	0.52	0.48	2.15	2.20	0.53	0.36
290	Dasmunia	Tentulia	0.52	0.38	0.49	0.80	2.00	2.20	0.85	0.42
300	Gournadi	Torki	0.44	0.36	0.34	0.55	0.51	0.48	0.51	0.52
318	Babuganj	Babuganj	0.37	0.35	0.38	0.37	0.40	0.40	0.47	0.36
330	Atharabanka	Atharabanka	0.46	0.84	0.70	1.60	4.00	6.36	4.24	0.90
332	Hironpoint	Kunga	23.87	32.00	40.00	49.00	49.00	50.95	49.60	48.0
37	Jhalakati	Bishkhali	0.38	0.25	0.36	0.44	0.45	0.34	0.34	0.31
37.5	Betagi	Bishkhali	0.40	0.95	0.75	0.70	0.42	0.65	0.39	0.42
38	Bamna	Bishkhali	0.50	0.28	0.50	0.49	0.65	0.53	0.48	0.40
38.1	Barguna	Bishkhali	0.47	0.95	0.49	3.50	3.20	2.80	2.00	0.50
39	Patharghata	Bishkhali	1.90	6.00	2.80	5.00	13.00	11.50	6.50	1.05
60	Hajimara	Dakatia	0.24	0.36	0.54	0.54	0.63	0.58	0.50	0.50

Source: BWDB and CEGIS

There is potential to increase productivity of T.Aus, T.Aman and Boro rice with good agricultural practices. T.Aus area can be increased substantially using improved management practices. Total potential T.Aus area in the region is 740,346 ha of which 38% is suitable, 40% is moderately suitable and 22% is marginally suitable (Figure 6.3).



Figure 6.2: Irrigation potential area

Potential Boro area under surface water irrigation in the region is estimated at 467,000 ha. The area mostly lies in the districts of Barisal, Jhalokati, Pirojpur, Barguna, Patuakhali, Bhola, Bagerhat and Lakhshmpur.

The region also has the potential to grow high value crops using groundwater from the shallow aquifer. Potential areas are mainly located in Khulna, Satkhira, Bagerhat, Chittagong, Cox's Bazar, Lakhshmpur and Feni (Figure 6.4).

The following strategic interventions are suggested for increasing productivity of different crops and sustaining cropping patterns:

- Productivity increase of *T.Aman* in tidal and non-tidal areas;
- Productivity enhancement of *T.Aus*, as well as introduction of short duration (85-90 days) varieties may be encouraged. Those varieties can be obtained through technical cooperation with Vietnam;
- Expansion of *Boro* cultivation and productivity enhancement;
- Promotion of pulses (khesari, mungbean, cowpea and chickpea), oilseeds (sesame,

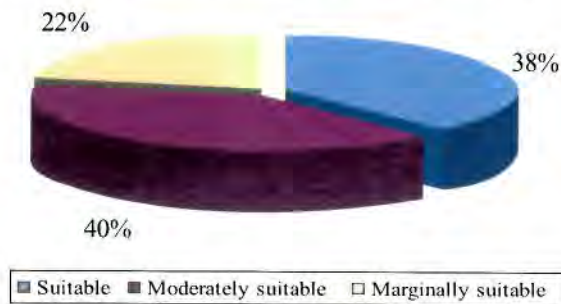


Figure 6.3: T.Aus suitability

sunflower, groundnut etc.) and new crops (maize, chili, sugar beat, soybean, mushroom, jute and sugarcane).

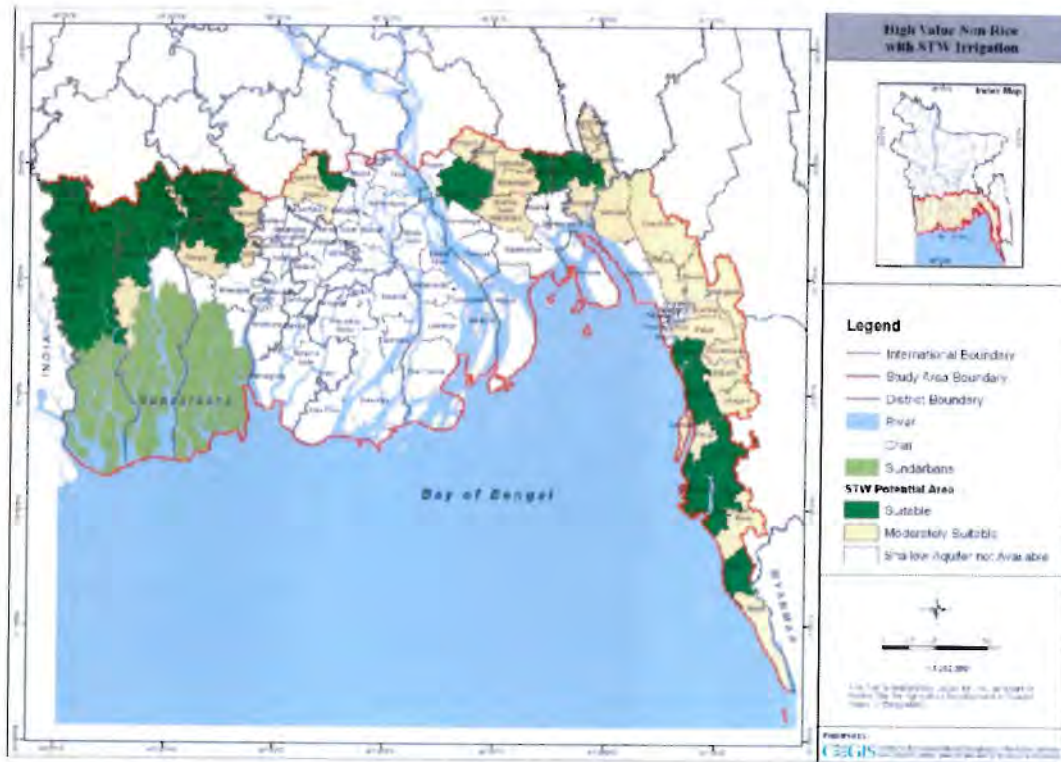


Figure 6.4: Potential area for high value crops using STW

Jute is conspicuously absent in most parts of the region. Bangladesh Jute Research Institute should develop a programme to breed variety and develop management practices suitable for the coastal region that fits in the existing cropping pattern.

Cotton is a salt-resistant crop, but is susceptible to water logging. The Cotton Development Board should consider pilot demonstrations in well-drained highland place in the coast.

Bangladesh Sugarcane Research Institute may establish demonstrations of growing sugarcane in the coastal region.

6.2 Horticulture and Agro-forestry

6.2.1 Horticulture

Because of agro-ecological sensitivity, horticultural crops like fruits, vegetables and spices are not highly suitable in the southern region. Most of the horticultural crops are sensitive to agro climatic conditions. Less availability of high and medium highland; high temperature and humidity; poor drainage and water logging; soil salinity; lack of irrigable water and irrigation facilities hinder horticultural crop production in the region except coconut and areca nut. Despite these constraints,

the area has potential for the expansion of coverage and increase in productivity of horticultural crops with special care and techniques.

A good number of fruits and vegetables grow well. About 80 percent of guava produced in the country comes from the southern region. The region is also famous for some minor fruits having high nutrition and processing potential, such as sapota, velvet apple (gab), hog plum, date palm and palmyra palm. Horticultural crops in the region suffer from large yield gaps (Table 6.3). Potential growth largely lies in management of yield gaps.

Table 6.3: Yield of selected horticultural crops

Crop	Yield (tonne/ha)		
	Present yield	Good farmers' yield (GFY)	Yield gap
Cucumber	10.44	20	9.56
Bitter gourd	9.87	20	10.13
Pumpkin	14.38	20	5.62
Indian spinach	15.94	40	24.06
String bean	8.08	12	3.92
Brinjal	15.9	50	34.10
Okra	8.5	14	5.50
Aroids	13.96	16	2.04
Tomato	18.94	60	41.06
Radish	20.47	50	29.53
Cauliflower	16.65	25	8.35
Cabbage	22.45	30	7.55
Red amaranth	4.48	10	5.52
Onion	6.82	15	8.18
Garlic	5.78	7	1.22
Chili	1.37	4	2.63
Mango	7.70	15	7.30
Litchi	2.86	12	9.14
Banana	17.75	20	2.25
Papaya	17.75	25	7.25
Guava	10.50	20	9.50
Lemon	7.75	12	4.25
Jujube	7.18	20	12.82
Hog plum	12.00	15	3.00
Pumelo	6.60	20	13.40
Sapota	12.00	20	8.00
Coconut	1.00	2	1.00
Areca nut	2.40	4.5	2.10

Source: DAE field demonstration; field level consultation

The salt-affected soil requires hardy species. On the basis of experiment with salt tolerance, fruit crops have been classified as follows:

- High tolerant: date palm, jujube, tamarind;
- Medium tolerant: anola, phalsa, pomegranate, karantia, monkey jack (dewa), ananas, jamun, sapodilla;
- Low tolerant: guava, mango, wood apple (kodbel);
- Susceptible: banana, papaya, pineapple, jackfruit;
- Modern varieties of watermelon would be a promising crop for the silty loam soil of the region;
- Sweet potato can be successfully grown; particularly orange-fleshed sweet potato may be piloted.

Farmers practice some innovative techniques for the production of vegetables and spices. NARS institutes also developed or modified an appreciable number of technologies suitable for the promotion of vegetables and spices in the region. NARS technologies and farmers' innovative practices for vegetable cultivation can be materialized through the use of mound or raised beds in water logged areas, floating bed and hanging basket.

NARS technologies suitable for the region are

- Year round vegetable production on *gher* boundary;
- Ditch and dyke system of vegetables in non-saline tidal areas;
- Vegetable and spice cultivation on the mound/bed.

6.2.2 Vegetables and spices

Summer vegetables

The southern region has huge potentials of summer vegetable area expansion and productivity enhancement in non-tidal and non-saline areas. At present cucurbitaceous vegetables, Indian spinach, String bean, brinjal, okra and aroids are grown in the region. Total area under summer vegetables is about 25,300 ha and yearly production is 321,850t. By removing existing constraints of surface water irrigation, expansion of minor irrigated area and through extension services, summer vegetable area can be expanded to more ridges and adjacent areas in non-tidal and non-saline zone and by adopting special techniques like floating ridge/mound and raised bed techniques. In the southern region, 86,500 ha can easily be brought under summer vegetables and annual production could be raised to 1.2 million tonnes.

Winter vegetables

The region is moderate to less suitable for cultivation of winter vegetables. Unplanned plantation in homesteads has narrowed the area for vegetable cultivation. Winter vegetables are produced in the strip land of non-tidal and non-saline areas. At present winter vegetables are grown in about 26,000 ha of land and annual production is 0.52 million tonnes. With all out support from relevant service providers and through integrated and intensive cultivation, winter vegetable area could be increased

threefold to 80,000 ha with annual production of 2.46 million tonnes. This needs timely supply of HYV and hybrid seeds, farmers' training, credit and improvement in marketing.

Spices

Among spices, the most important is chilli, which is mostly grown in *char* lands of Noakhali, Lakshmipur and Bhola. Other important spices grown are onion and garlic. In some pockets of Noakhali, Feni and Chittagong, coriander is grown. At present major spices are grown in about 17,700 ha of land with annual production of about 92,000t. By improving extension services, the spice area can be increased to about 28,000 ha and production up to 168,000t.

Productivity enhancement through exploring possibilities and potentials are summarized as follows:

Fruits

- Collection of fruit tree germplasm from public and private sources for promotion;
- Zoning for suitable underutilized fruit production and marketing;
- Improvement of coconut orchard and commercialization of cultivation.

Vegetables and spices

- Mapping of potential vegetables and spices suitable for cultivation in various agro-climatic situations;
- Identifying, improvement of innovative practices and up-scaling of indigenous and NARS technologies;
- Up-scaling of betel leaf cultivation in the south central and southeastern zone;
- Promotion of leafy vegetables.

6.2.3 Agro-forestry

In the southern region, agro-forestry is administered by the Forest Department (FD) and NGOs. In the development vocabulary, this is known as social forestry, as the community is engaged as the main stakeholder. Species planted in the social forestry program are selected on the basis of

- suitability of species to the specific plantation site;
- preference of social forestry group members; and
- silvicultural characteristics of the species.

The region is highly suitable for forestry. Agro-forestry is at its initial stage, though homestead plantations, strip plantations and mangrove forestry in the accreted land have significantly progressed. Community forestry in Boyer Char (Noakhali) through the CDSP is an example of good practice. The FD implemented the program with assistance from local NGO and WMGs. A benefit sharing arrangement has been agreed between all the parties involved (Table 6.4). This can be replicated in other areas in the region.

Table 6.4: Benefit sharing (%)

Stakeholder	Woodlot and agro forestry on lands under control of FD	Strip plantation on lands owned by public or statutory body other than FD	Social forestry in the forest land by the local community	Social forestry on land of government, semi-government or autonomous organizations invested by the local community
Forest Department	45	10	25	10
Participants	45	55	75	75
Tree Farming Fund	10	10		
Land owning agency		20		10
Local UP		5		5

Source: CDSP

6.3 Fisheries

Fisheries resources in Bangladesh are of three types on the basis of water salinity, such as, freshwater (salinity $0 < 0.5$ ppt), brackish water in the estuary and the coast ($0.5-29$ ppt), and saline water of the sea (salinity >29 ppt). Along with very productive sweet water, brackish water is suitable for diversified fisheries and aquaculture production of fin and shell fishes and *Ilish* resources.

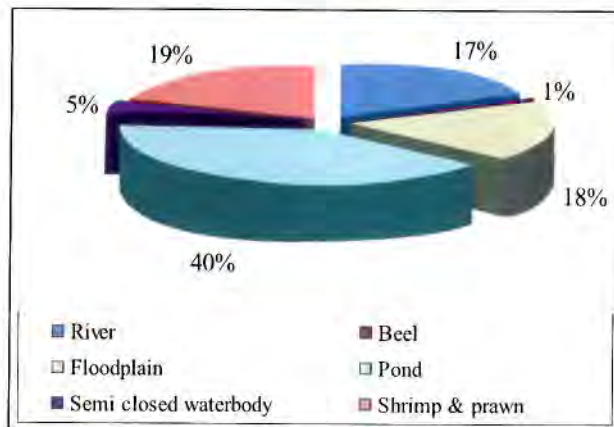


Figure 6.5: Fisheries resources by source

Brackish water shrimp farming grew very fast covering an area of 217,000 ha in 2008 from the 51,812 ha in 1984. The expansion took place in the southwest region due to favorable geo-physical conditions, availability of shrimp PLs and management technology. But the productivity is very low, but levels could be doubled or even tripled through improved technology, better scientific management and more investments.

Annual production/catch of fisheries resources from major inland waters in the region amounts to about 0.71 million tonnes (DoF). Ponds are the single largest source (40%) of fish (Figure 6.5). Average yield per ha in ponds is 2.77t, which is much lower than that of Mymensingh (6.63t), Comilla (4.22t) and Rajshahi (3.63t). Use of ponds exclusively for domestic purpose has changed over the period as potable water is more and more accessible with extension of tube wells, particularly in Barisal region and Lakshmipur. This means that more ponds can be brought under productive use.

Ilish contributes about 13 percent of the annual fish production/catch of the country. Total

catch of *Ilish* in 2009-10 was estimated at 0.31 million tonnes. This resource is dwindling fast because of overfishing, lack of enforcement of conservation regulations, morphological changes in the estuary and different forms of encroachments and pollution. There is high potential for productivity enhancement, which requires the following:

- Community based cage and pen culture;
- Community based open water stocking and biological management;
- Enhanced productivity of pond culture;
- Enforcing zoning and productivity enhancement of shrimp;
- Establishing and maintaining fish sanctuaries.

6.3.1 Cage/pen culture

Productivity enhancement through cage/pen culture exists in the region, particularly in the south-central area. At the moment, this practice is negligible. Expansion of cage/pen culture through community mobilization will be a viable source of employment in villages along the rivers (Figure 6.6).

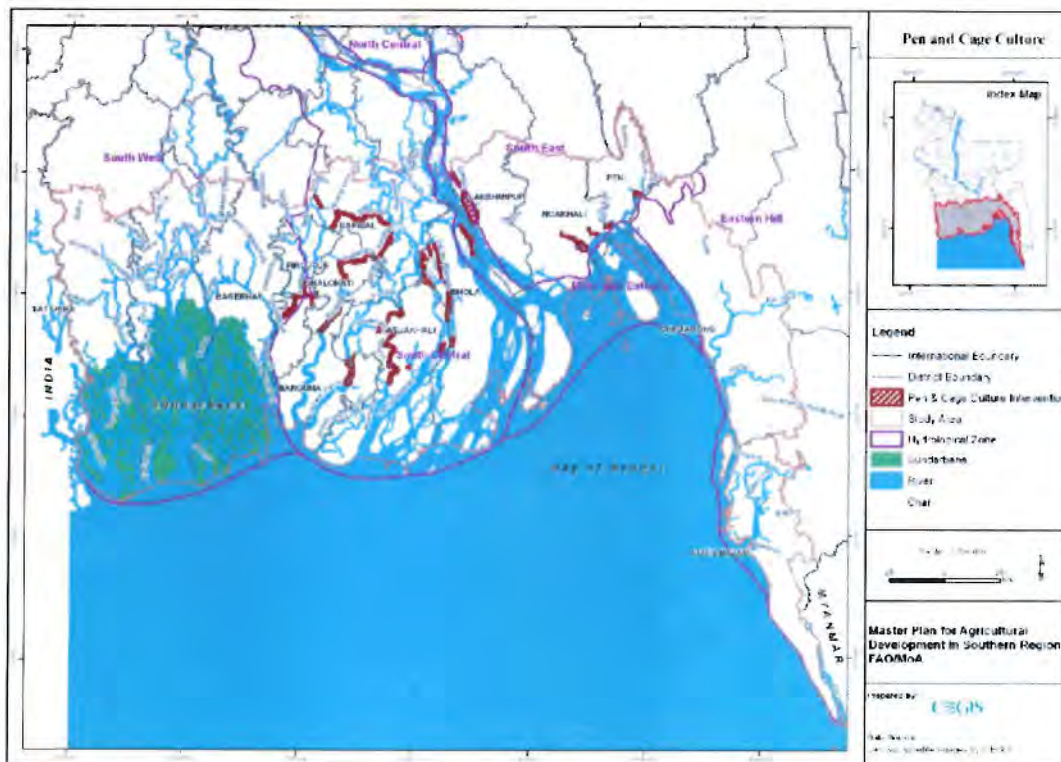


Figure 6.6: Potential areas for cage and pen culture

Cage/pen culture potential also exists in seasonally water-logged areas of Noakhali and Lakshmipur. Total area suitable for cage/pen culture in the southern region is estimated at 7,900 ha and the productive potential stands at 118,500 tonnes.

6.3.2 Shrimp culture

Currently the southern region has 0.21 million ha of shrimp/prawn *ghers*, mostly located in Satkhira, Khulna, Bagerhat and Cox's Bazar districts. Although shrimp area and production have increased significantly in recent decades, there has been negligible or no improvement in yield. For example, average yield per hectare of shrimp (*bagda*) is only 302 kg and that of prawn (*golda*) is 555 kg. This is much lower than the *bagda* yield level of over 1,800 kg/ha as demonstrated by farmers in the southwest region supported by the World Fish Center (WorldFish Center, 2011).

While it is necessary to restrict unplanned expansion of shrimp culture in areas where the potential is low, it is also important to promote it in areas where the suitability is high. Suitability criteria are summarized as follows:

- proximity of *ghers* from the intake canal or channel;
- land type preference, F2 first and F1 second;
- land (plot) to be selected from an area where water goes up to 1.2-1.5 meter in high tide;
- soil pH for *golda* and *bagda* shrimp should be 6.5 – 7.4;
- surface water salinity for *golda* and *bagda* shrimp should be 0 – 0.5 ppt and 15 – 25 ppt Respectively;
- *ghers* in which salinity goes down to 0 ppt in the rainy season or up to 50 ppt due to evaporation in the dry season are not suitable;
- *Doash* soil is favorable (fine particles of less than 0.002 mm mixed with sand particles of 2.0-0.05 mm);
- acid sulfate soil, red soil with stones, black soil and *bele-doash* are not suitable.

The southwest region (greater Khulna district) can be especially addressed for planned *bagda* culture where the land and water conditions are favorable and yield potentials are high.

6.3.3 Marine fishery

Marine fishery is a very important and potentially resourceful sector, contributing 517,282 tonnes (18%) out of total production/catch of 2,899,198 tonnes in the country. There are 41 shrimp trawlers and 124 fish trawlers involved in the marine area with 2,496 tonnes of shrimp and 31,686 tonnes of fin fish catch (total 34,182t). Using mechanized and non-mechanized fishing boats, artisanal fishers harvested 50,096 tonnes of shrimp and 464,690 tonnes of fin fishes (total 483,100t) in 2009-10 (DoF, 2011). About 270,000 fisher families are directly or indirectly depended on marine fishery for their livelihoods.

Marine fisheries resources are mainly capture-based fisheries extended along the coastline to 200 nautical miles. Through the fixation of the marine boundary with Myanmar, Bangladesh has access to vast areas in the Bay of Bengal, enabling its reach to exclusive economic zone (EEZ) with wider coverage.

In the Bay of Bengal, there are 36 species of shrimp and approximately 475 species of fin fish. These are mainly captured based fisheries. Protection and conservation strategies are needed as the prime means to develop and increase the volume of the harvest. This requires the following:

- Stock assessment of pelagic and demersal fisheries resources, as well as harvesting policy and guideline following the MCS;
- Modernization of boat, gear and communication system of the artisanal fishers to ensure their safety.

6.4 Livestock

Basically four factors contribute to low productivity and unutilized potential of livestock resources in the region. These are:

- loss due to the lack of disease control and prevention, malnutrition and under feeding;
- lack of appropriate breeds;
- lack of poor husbandry practices due to inadequate farmers' knowledge and information; and
- natural calamities, tidal surges, and intrusion of salinity.

Lack of feed and fodder in the region is acute. Animals are normally emaciated and productivity is low because of malnutrition. The level of animal malnutrition is high in Barisal region. No grazing land is available in this area. Animals seasonally get some grazing opportunities after harvesting of crops. Feed resources mainly come from crop residues and cereal byproducts.

The region has a wide coverage of land, river and canal and vast accreted area, which can be utilized for livestock rearing.

The density of sheep, goat and duck in Noakhali, Bhola and Patuakhali is high and can be further expanded. In some parts of Patuakhali; goose farming is found profitable.

Satkhira seems to have the highest number of cattle and small and medium dairy and poultry farms, which indicates that Satkhira district is suitable for livestock production.

Chittagong district is another potential area for investment in the dairy chapter. Already there are 1,783 small and medium dairy farms at the farmers' level. Everyday about 200,000 liters of milk is produced in coastal upazilas of Chittagong, such as, Mirsarai, Sitakundo, Anowara and Bashkhali. Farmers sell their products mostly to sweetmeat shops. Establishing a milk processing plant in Chittagong will greatly enhance the potential.

At the household level, backyard poultry is a common phenomenon and can be further promoted and expanded. This will help in enhancing income of poor women who usually look after poultry.

Productive potentials are summarized as follows:

- community livestock, dairy and poultry development, replication and up-scaling;
- up-scaling of dairy farming in Satkhira;
- promotion of HYV fodder cultivation;
- strengthening health care;

- establishing AI service center in each union; and
- establishing improved buffalo farm;

6.5 Water Resources

Water resources management is a big challenge. The most critical of this are alternating flood and water scarcity during the wet and the dry seasons, ever-expanding water need, river sedimentation and bank erosion.

Inadequate supply of surface water for irrigation is a serious problem throughout the southern region except Barisal. The shortage also occurs because many internal *khals* are silted up and water during high tide does not reach the land or the amount of water reaching is not enough for lifting.

Groundwater is not available and suitable everywhere for crop production. In some places like northern part of Barisal, Khulna, Bagerhat and Satkhira, groundwater is used for irrigation in small scale. But in other areas, there is no scope for groundwater irrigation because of the salinity problem. In the southern part of Patuakhali, a large area remains fallow in the dry season because of lack of irrigation infrastructure.

There is huge potential of augmenting water resources by reactivating silted-up rivers through re-excavation. In Barisal region, dry season irrigation can be greatly facilitated using surface water, which remains fresh almost round the year. In other areas, particularly in the northern part of Khulna region and in the Chittagong region, groundwater irrigation can be selectively exploited from the shallow aquifer. Potential areas for intervention are summarized as follows:

- Excavation/re-excavation of silted and dried up canals, construction of water control structures and construction of pump houses;
- Surface water conservation through construction of rubber dam / cross-dam / regulator, etc for development of irrigation;
- Excavation of reservoir/ pond for water conservation for surface water irrigation development;
- Restoration of severely waterlogged areas in Noakhali mainland
- Improving drainage, water logging and flood management through capital dredging of silted and dried up rivers
- Community driven and managed tidal river management (TRM) in severely waterlogged areas in the southwest region;
- Integrated on farm water management;
- Promotion of solar energy for operating irrigation equipment;
- Rehabilitation and improvement of Muhuri, Bhola and Barisal Irrigation Project;
- O&M by community based institutions;
- Emergency public fund for disaster management;
- Legal framework for implementation of institutional arrangements;
- Repair and rehabilitation of damaged polders;

- Redesigning and new construction of climate resilient polders;
- Accelerating land accretion through construction of cross-dam;
- Sustainable use of accreted land resources;
- Creation of rain water harvesting facility.

6.6 Nutrition and Food Security

6.6.1 Poverty and malnutrition

Access at all times to sufficient, safe and nutritious food to meet the dietary needs and food preferences for an active and healthy life is at the heart of food security and nutrition. Poverty and malnutrition are closely linked in that chronic energy deficiency is directly related to the ability to involve in income generation activities and learning capacity. Declining poverty rates in Bangladesh have been accompanied by a significant increase in purchasing power, increasing access to basic foods. Despite decline in poverty, equally strong progress is not seen in nutritional outcomes. Malnutrition is an underlying cause of childhood illness and maternal mortality. Bangladesh has achieved a slow but sustained reduction in prevalence of underweight and stunting. However prevalence of malnutrition is still alarming. Bangladesh is placed in the bottom 25% of the Global Hunger Index and that signifies its vulnerability in the context of recent food price hikes. Chronic energy deficiency, protein-energy malnutrition, low birth-weight and micronutrient deficiency are critical issues faced by Bangladesh (Planning Commission, 2011). Poverty reduction should be coupled with integrated nutrition interventions, that can help increase nutrition awareness and behaviour change across all income groups and also instill a sense of community responsibility to undertake relevant actions for improving household/community food and nutrition security.

6.6.2 Development strategies

Efforts to reduce malnutrition must be based on a clear understanding of the role of poverty as a cause and a consequence of malnutrition. Poverty affects men and women differently. To combat it, a different approach is needed. Moreover as poverty in the region is predominantly rural, agriculture-based strategies are important for improving household food security and nutritional status. These measures include shifting toward production of high-value crops for boosting income, enhancing agricultural biodiversity, increasing consumption of indigenous food plants and bio-fortified crops.

A widely used conceptual framework published by UNICEF in 1990 identifies three main underlying determinants of nutritional status: availability and access to food, the quality of feeding and care giving practices, and the health of the surrounding environment and access to health care services. Each of these determinants is a necessary condition to good nutrition, food security and health outcomes. Household production for own consumption is the most fundamental and direct pathway by which increased production translates into greater food availability and food security. Increased production of fruits, vegetables, and animal source foods (dairy, egg, fish and meat) can raise access to energy, protein, and fat, but can also greatly improve the quality and micronutrient content of diets.

Finally, agricultural growth itself represents an indirect pathway to better nutrition through its contribution to macroeconomic growth and higher levels of national income, which can support nutritional improvements by reducing poverty.

Homestead and nutrition education programmes that have been in operation for last two decades need to be scaled up. Future agricultural intervention programmes should include explicit objectives of improving nutritional status with a focus on addressing child malnutrition. Child stunting should be addressed through strengthening linkage between complementary feeding requirements/practices and agricultural production. The most sustainable and cost effective way to improve complementary feeding of children in poor rural households is by ensuring availability and access of nutritionally appropriate foods at household and community levels.

6.6.3 Development potential

Agriculture

Increasing production and availability of nutritious food is key to ensuring food security. This means that there should be all out efforts to

- increase cropping intensity and productivity to promote the production of basic staples for meeting the energy needs;
- promote mixed fruit orchards and intercropping for increasing production of horticulture foods that can provide dietary micronutrients, anti oxidants and to intensify the process of crop diversification to make available more energy and protein foods at low cost, e.g. maize, sorghum, millets, etc;
- encourage intercropping in order to produce more non staple food crops;
- increase production and consumption of fish by developing capture fisheries, fish seed multiplication farms to supply more fish fry and marine fish production from the Bay of Bengal;
- increase production of fish feed for fish fry and pisciculture;
- encourage development of biotechnology in animal and plant breeding and facilitate exchanges of new advances in biotechnology related to nutrition;
- capacity building for promoting post harvest handling, processing, preservation and storage with a focus on preserving micronutrient rich foods;
- prepare national food balance sheet.

Nutrition education, advocacy and community participation

This is to provide formal and non-formal nutrition education to people at all levels about effective nutrition, especially for vulnerable groups, that is, children, adolescent girls, women and the elderly. Diet-based strategies are the most promising approach for a sustainable control of macro/micronutrient deficiencies. There is need for increasing dietary diversification through consumption of a broad variety of foods, preferably from home gardens, fisheries and small livestock production. Mass media nutrition awareness campaigns and intensive nutrition education should be implemented to support and educate farmers to increase production of dark-green leafy

vegetables, yellow and orange fruits, poultry, egg, fish and milk in their homesteads. Emphasis should be given to

- Educate decision makers in the family to change the method of food distribution in the family to meet specific requirements of vulnerable members, especially during pregnancy and lactation. Adolescent girls, young children and the elderly should receive more nutritious food according to their need.
- Teach all people about the proper preparation and feeding of weaning foods made from locally available foodstuffs.
- Motivate the people to modify their food habits to increase their intake of non-rice foods.
- Introduce formal and non-formal nutrition education at all levels. A nutrition component should be included in the curricula of primary, secondary and tertiary levels.
- Primary training on family nutrition to women participating in mothers' club, non-monetized food distribution programs and others women's development activities.
- Develop effective audio-visual materials and manuals on nutrition for use in education and training. Use of community radio for nutrition education will be very effective.

Community development and social welfare

This is to support diversification of rural economy, promote investment in human resource development and make appropriate technology available to provide integrated production and employment.

- Increase rural people's participation in the development process and their enjoyment of a share of development for physical, social and economical benefit.
- Encourage simple and appropriate technologies for home food processing and preservation.
- Encourage integrated homestead farming for the production of vegetable, fruit, fish, milk, meat, egg, fish feed and fertilizer for income generation.

6.7 Market and Supply Chain

Most of the rural markets have developed in an *ad hoc* manner. As such, facilities, infrastructure, management and operations are haphazard and rarely meet the changing needs of market users.

Some growth centers have been improved by the LGED. A survey of rural markets done by the Department of Agricultural Marketing (DAM) found that growth centers/market places are mostly of primary/retail character (Table 6.5).

Despite the marketing system being fragmented, it is highly competitive. A study by DAM analyzed the cost of marketing and concluded that for the five main spice crops, producers get about 65 percent of the consumer price, with the remaining 35 percent being shared by others in the value chain (5% by traders, 20% by wholesalers/*aratars* and 10% by retailers). Naturally enough, marketing margins will be higher for perishable products like fruits and vegetables, especially at times of gluts when producer prices fall by much more than consumer prices, as producers compete

to sell in a saturated market, but consumers cannot respond by increasing consumption to equal the excess supply.

Table 6.5: Markets in selected coastal districts

District	Type of market			Total	
	Primary/ retail	Assembly/ wholesale	Wholesale cum retail	2000	1985
Barisal	196	13	23	232	181
Bhola	134	7	27	168	104
Patuakhali	247	13	34	294	71
Lakshmipur	118	9	61	158	88
Noakhali	145	12	62	219	218
Total	840	54	177	1,071	662
Percentage	78	5	17	100	

Source: DAM, 2000

In the fishery sub-sector, the degree of consumer price share can vary considerably according to the type of fishery and location. The Fishery Sector Review (2003) concluded that, in remote coastal villages, artisanal fishermen after deducting *dadan* loan repayments get only 25 percent of the final retail price. In contrast, a pond owner selling directly in a village market may get 80 to 90 percent of the retail price. Analysis of the margins and costs involved in marketing of *Ilish* from fisherman in Chittagong to *paiker* - to *aratder* - to retailer in Dhaka shows the fisherman getting 50 percent of the final retail price; but the margin net of costs for the wholesaler is 5 percent, *aratder* 6 percent and retailer 5 percent.

The region has localized seasonal surpluses in some commodities of perishable nature, such as fish and milk. Development of agro-processing facilities and market infrastructure can prevent post-harvest loss and enhance farmers' income. Agro-processing industries are presently at a nascent stage of development. Most of the technologies and facilities for handling, storage, processing and packaging are sub-standard and outdated and cater primarily to the local market. There also exists considerable under-utilization of capacity (Planning Commission, 2011).

There is no organized milk marketing network in the region. Normally farmers sell their products in the local market. In Sadar and Tala upazila of Satkhira district, Milk Vita and BRAC have established milk collection centers and chilling points.

There is not a single meat processing plant in the southern region. With increasing urbanization, demand for milk, meat and egg are also increasing, and so also the potential for processing plants and marketing systems.

Poor transport system and network is another constraint. This requires investment in developing and upgrading road and water transport systems. This includes enhancement of capacity to handle larger volume of freight traffic, as well as improvement in safety standards.

Development potential in regard to processing is summarized below.

Crops and agro-forestry

- Soybean oil extraction plant in Noakhali and coconut oil extraction plant in Khulna and Noakhali;
- Value addition to farm produce and processed products by environmental and user friendly post harvest technologies and byproduct utilization;
- Developing refrigerated and/or non-refrigerated storage technology for preservation of potato, sweet potato, aroids, onion, spices and fresh vegetables;
- Developing refrigerated storage technology for fresh cut vegetables and fruit cobbles;
- Developing processing and preservation technologies for fruits, vegetables and spices;
- Establishment of fruit processing plants for guava, hog plum and chalta;

Fisheries

- Support to establishment of shrimp and fish processing and preservation plants in the private sector in Khulna, Satkhira, Barisal, Bhola, Noakhali and Cox's Bazar;
- Support to environment friendly quality fish drying plants in Noakhali, Khulna and Cox's Bazar;
- Support to establishment of modern hatcheries in the private sector;

Livestock

- Expansion of Milk Vita activities in Bhola, Chittagong and Khulna region. Other milk processors need to be encouraged with special incentives;
- Meat processing plant can be established in Chittagong, Noakhali, Khulna, Barisal and Bhola;
- There is scope for establishment and expansion of feed mills in Chittagong, Noakhali and Khulna;
- Promotion of private veterinary health care practices through training professionals and para-professionals;

Transport

- Building and improving road and river transport network with good cargo facility;
- Developing and upgrading carrying and handling capacity of freight traffic between growth centers and inland ports;
- Improving safety standards for transporting agricultural commodities.

6.8 Land Zoning

Land is used for multiple purposes: housing, infrastructures, crops, fisheries, forestry, salt-production, industries, tourism, conservation of critical ecosystems, etc. Land use in the southern region has undergone major changes in past decades. Major features in this respect are:

- Rapid urbanization: conversion of agricultural land into areas for housing and other infrastructures;
- Shrimp culture: change of land use from crops to *bagda* farming;
- Afforestation in *chars* and newly accreted land.

Government policy documents highlight the importance of optimizing land use and land zoning for integrated planning of resource management. The Coastal Zone Policy 2005 describes that "actions shall be initiated to develop land use planning as an instrument of control of unplanned and indiscriminate use of land resources" and "zoning regulations would be formulated and enforced in due course" (WARPO, 2006). An indicative land zoning has emerged out of the ICZM process that identified the following zones (Table 6.6).

Table 6.6: Indicative land zoning

Zone	District	Upazila / Thana (in city corporation areas)
Shrimp (brackish water)	Khulna	Batiaghata, Paikgachha
	Satkhira	Sadar, Assasuni, Kaliganj, Debhata
	Bagerhat	Sadar, Rampal, Morrelganj
Prawn (sweet water)	Khulna	Dumuria, Phultala
	Bagerhat	Fakirhat, Mollahat, Chitalmari
Salt-shrimp	Cox's Bazar	Chakaria, Moheshkhali, Kutubdia, Pekua
	Chittagong	Bashkhali
Forest	Chittagong	Fatikehhari
	Cox's Bazar	Ramu, Teknaf, Ukhiya
Urban	Chittagong	Port, Double Mooring, Hathazari, Pahartali, Bakalia, Panchlaish, Patenga, Halishahar, Kotowali, Baizid Bostami, Sitakunda, Karnaphuli
	Khulna	Kotowali, Rupsa, Dighalia, Khalishpur, Sonadanga, Daulatpur, Khanjahan Ali
	Barisal	Sadar
	Bagerhat	Mongla
Tourism	Cox's Bazar	Sadar
	Patuakhali	Kolapara (Kuakata)
Agriculture	Khulna	Terokhada
	Satkhira	Tala, Kolaroa
	Bagerhat	Kochua
	Pirojpur	Entire district
	Barisal	Entire district except Sadar
	Patuakhali	Entire district
	Jhalokati	Entire district
	Barguna	Entire district
	Bhola	Entire district
	Feni	Entire district
	Lakshmipur	Entire district
	Noakhali	Entire district
	Chittagong	Mirsarai, Chandgaon, Boalkhali, Lohagara, Rangunia, Patiya, Anowara, Chandanish, Satkania, Raozan, Sandwip

Source: PDO-ICZMP, WARPO

In the past decades, land use pattern has changed significantly in the Khulna region with the advent of *bagda* shrimp farming. This has led to social contention and conflict in many areas. The yield level has also remained very low. Poor technology, poor management practices and farming in areas not suitable for shrimp culture have all contributed to this. For Khulna region, zoning for shrimp culture is important. This should be based on suitability conditioned by bio-physical characteristics of the land, current practices, emerging trends, long term market behavior, etc (Figure 6.7). Farmers can not be forced to follow what to do or what not to do. But their activities in particular areas can be regulated and streamlined through measures of incentive and disincentive.

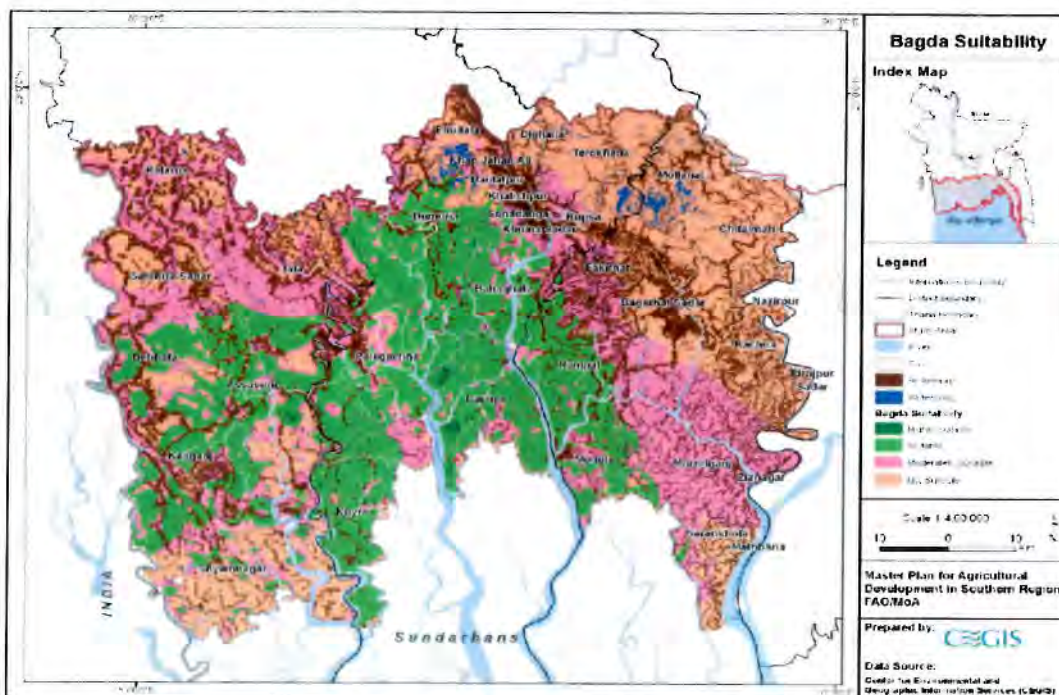


Figure 6.7: Bagda suitability map

6.9 Sub-regional Perspective

6.9.1 Khulna

Fifteen years after construction of coastal embankments, water logging began to emerge in the polders of upper part of the southwest region. As water logging gradually turned severe, its solution became a popular demand. As the authorities paid no heed to their grievances, people took the initiative to organize and mobilize the community and devised plans for solving the problem. From their own experience and observation, people identified polders as the main cause for water logging and began to present their arguments for breaching or cutting away polders to allow unrestricted tidal flow to solve the problem. Their logic was that if tidal flows can be made free, the navigability of the rivers will be restored, *beels* will be free from water logging, alluvial soil will accumulate inside *beels* and, as a result, the bed level of *beels* will rise. The first manifestation of this logic was seen in the *Beel Vaina* in September 1990 when the polder of the *Beel Dakatia* was breached at four

places. This concept is called Tidal River Management (TRM). Later, TRM has been practiced in the *Beel Kedaria* and the *Beel Khuksia*.

The main objective of the TRM is to keep the river functional and make the area free from drainage congestion and water logging. Another objective is to raise the associated *beels* through sediment management in the TRM *beel* areas. The process of natural sedimentation is uneven and scattered. In some places more sedimentation will take place while in some other places the sedimentation will be less, especially at the furthest end of the TRM basin.

On the basis of the TRM option, waterlogged area and areas susceptible to water logging can be converted into tidal basins on rotational basis with modification of existing structures and allow sedimentation in a planned way (Figure 6.8). This means deposition will be in a certain site or sites by a specific tidal channel or channels. Later deposition site will be shifted to other sites according to the topography of the area. This is a non-regulator/ non-structural type of solution.

Planning and design requirements of the TRM are:

- Suitable *beels* and depressions should have sediment caring capacity;
- There should be defined drainage network;
- Proper connectivity of *beel* area with drainage channels;
- Stopping tidal flow penetration towards upland;
- Establishment of designed drainage condition of river;
- Scope of compartmentalization in the TRM *beel*.

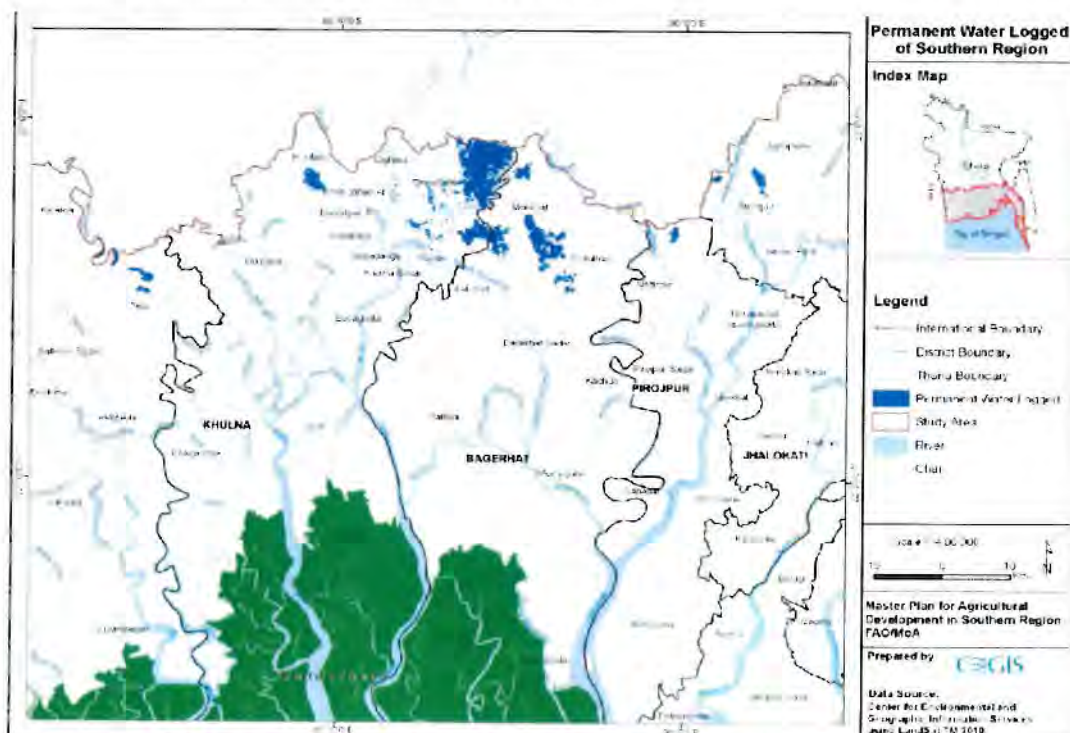


Figure 6.8: Waterlogged area suitable for TRM

TRM is a continuous process. Necessary conditions for successful TRM process are:

- Construction of a 2nd TRM should start immediately after operation of the 1st TRM, otherwise connected rivers will be silted up;
- No time gap in between successive TRM *beels*;
- Landowners should have enough motivation to accept and cooperate.

6.9.2 Barisal

Barisal region is rich in open water resources. It has a huge network of rivers that flow round the year. Surface water salinity is negligible, which provides an excellent opportunity for irrigation. This opportunity may be harvested for growing crops, particularly in the Kharif-I and Rabi seasons. Cropping intensity is low in Barisal compared to other regions of the country. Also vast areas remain fallow. A dominant cropping pattern is Fallow-T.Aman-Fallow. Agricultural productivity in this area may be expanded and accelerated by concentrating on surface water irrigation.

In Barisal region, 78 percent of the area is suitable or moderately suitable for T.Aus, though the present coverage is low. On the other hand, huge amount of land can be brought under Boro rice cultivation using surface water for irrigation (Figure 6.9).

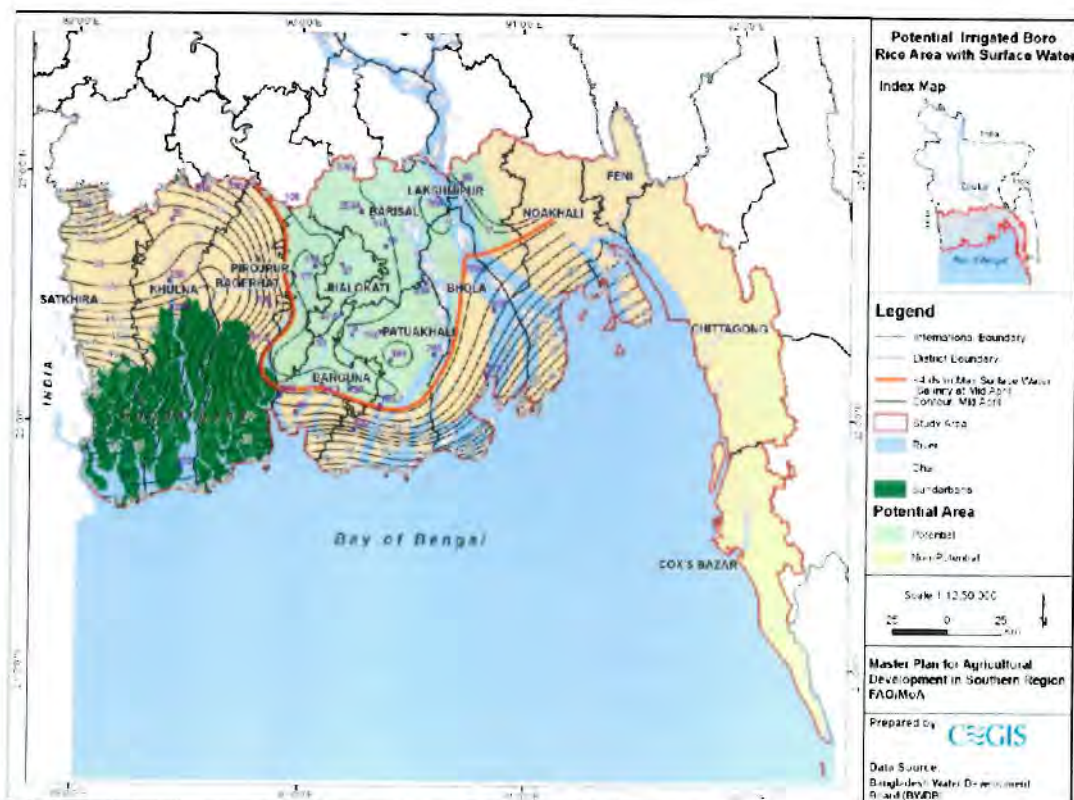


Figure 6.9: Boro suitable area with surface water irrigation

6.9.3 Noakhali

Land reclamation

The Meghna estuary has a very high potential for land accretion. Two cross-dams (no. 1 and 2) built in 1959 and 1964 respectively by the BWDB, had helped in reclaiming a huge land mass and the coastline of Noakhali has moved further southward. In the accreted land, BWDB developed several polders, other protective infrastructures and settled thousands of landless families through the Land Reclamation Project (LRP) and the Char Development and settlement Project (CDSP) since 1979 (Figure 6.10). Urir Char-Noakhali cross-dam with a length of 3.3 km is being envisaged to accelerate the process of land accretion in the *Meghna* estuary and to reclaim *char* land for human settlement and agricultural development.

When land will be accreted, the shoreline will be shifted toward the south keeping inlands safe from tidal surge. The need for bank protection will be reduced. Through plantation in the accreted area, a biological protection against cyclone and tidal overflow can be developed. An estimated 10,000 ha of reclaimed land will be available for productive use.

Drainage improvement

Greater Noakhali region has been suffering from acute drainage congestion for a long time. Water logging resulted from shifting of the Meghna river to the south accelerated by construction of two cross-dams. Due to land accretion, drainage channels have become lengthy. Eventually water surface slope decreased and the drainage flow was reduced. Unplanned infrastructures also impeded the natural drainage.

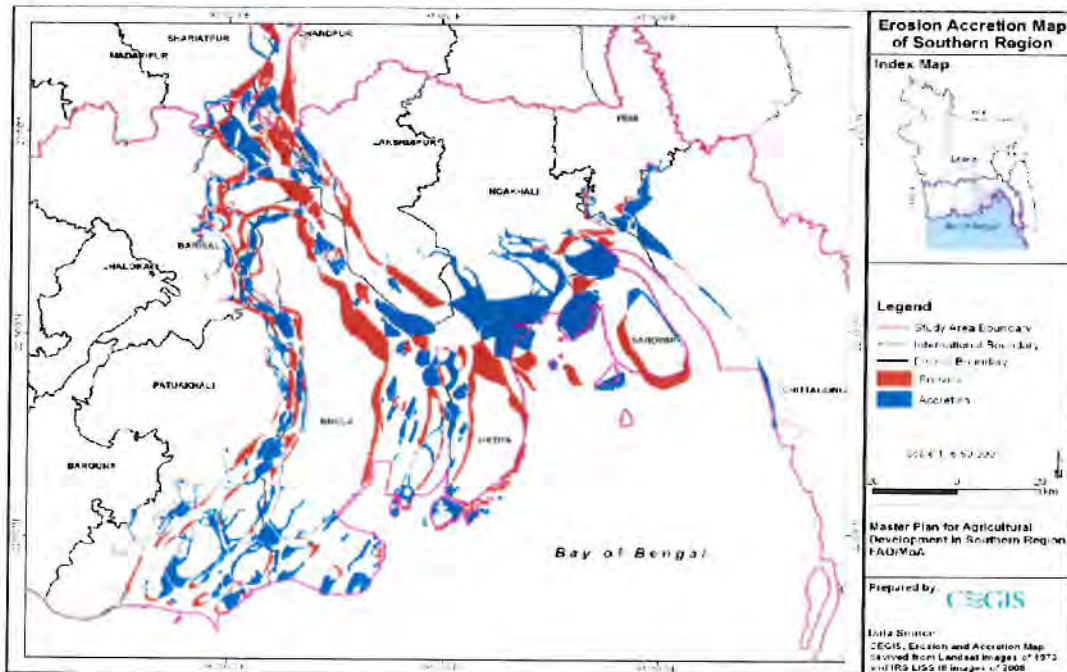


Figure 6.10: Land accretion in the Meghna estuary

The Noakhali Khal had been the main drainage route for monsoon runoff from 160 km² floodplain area. At the downstream, the flow is directed from north to south following the Algir Khal and Bamni outfall. Noakhali Khal does not drain to Bamni outfall until a certain level of high water is reached; rather the major portion of catchment runoff is draining towards Wapda Khal and Rahmatkhali regulator. Due to this reason, drainage of monsoon water is extremely slow causing drainage congestion. Besides, the flow direction is from south to north because of adverse bed slope, which is supposed to be in the reverse direction.

The Borrowpit Khal is connected with Noakhali Khal at its upstream end and drains monsoon water flow to the Bamni regulator. Currently the conveyance of the *khal* is not at its design condition.

Two 15 vent regulators were constructed to enhance the drainage of the Noakhali area and also to restrict large scale sedimentation from the Meghna estuary towards inward *khals*. But the second regulator collapsed in October 2010. A new regulator is needed for smooth drainage and also for arresting sedimentation of the Bamni drainage channel.

Along with the siltation of the Noakhali Khal, the absence of well-managed internal drainage network has been causing water logging in Noakhali urban area. Linkage of local *khals* and floodplains is needed to the Noakhali Khal to improve drainage condition of Noakhali town. Some *khals* need immediate re-excavation for drainage improvement (Table 6.7).

Table 6.7: Khals needing immediate re-excavation

Item	Khal	Average width (m)	Length (km)
Excavation of major khal	Noakhali Khal	45	40
	Borrowpit Khal	20	8
Excavation of secondary khal	Debipur Khal	20	12
	Datterhat Khal	15	9
	Ramjanbibi Khal	18	8.5
	Kalamunshi Khal	20	20
	Gabua Khal	20	18
	Chomuhani Khal	20	13
Protective work	Reconstruction of Bamni regulator		1

PRIORITIZATION AND INVESTMENT NEED

7.1 Programmes

This Master Plan ultimately boils down to a set of Programmes and activities across all branches of agriculture and other related fields. Based on field study, regional consultations and interaction with various stakeholders, a list of interventions have been identified under 26 programmes across 10 thematic areas as follows:

- Crops, horticulture and agro-forestry
- Fisheries
- Livestock
- Nutrition
- Water management
- Polder management
- Drainage improvement
- Agri-business
- Agricultural credit
- Capacity building

7.2 Prioritization Criteria

Based on problems and potentials, programmes and interventions have been identified. All interventions are important. However, all the activities cannot be implemented in one go. As there are constraints of resource and capacity, the proposed interventions need some prioritization. The following criteria have been used for prioritization.

- Urgency of the program
 - people's desire
 - government's interest
 - response to climate change threat
- Number of beneficiaries

Priorities are grouped into four categories in line with the criteria used in the CIP (Government of Bangladesh, 2011). These are:

- **Top:** Interventions will provide immediate benefits to large sections of the population and already there is GoB commitment.
- **High:** Interventions where efforts will benefit the people and has regional and area-based importance and need to be implemented immediately.
- **Medium:** Important interventions where implementation are needed in future.

- **Low:** Interventions where implementation depends on the availability of resources.

Most of the programmes and interventions need early implementation. However, Top and High priority interventions should commence immediately.

7.3 Approaches to Prioritization

A three-pronged strategy has been adopted in the prioritization exercise. A preliminary list of interventions was prepared incorporating activities from each component and program. Firstly, a sense of direction was found through discussion with officials of relevant agencies over a number of meetings. Secondly, opinions were sought from all stakeholders in regional consultations that were organized in Barisal, Khulna, Chittagong and Noakhali in January-March 2012. Each consultation was attended by 40-60 participants from different GoB agencies, NARS institutes, private sector, academia, local government, CBOs, farmers and the civil society. In each consultation, participants were grouped into following thematic areas:

- crop, horticulture, agro-forestry and nutrition;
- fisheries;
- livestock;
- agro-business; and
- water management and irrigation

Each group held brain-storming sessions and their collective opinions on respective sectoral interventions were documented.

Thirdly, the study team after scrutinizing and reviewing all the opinions received from GoB agencies and regional consultations prepared a harmonized list.

7.4 Period of Implementation

Based on identified programmes and interventions, relevant Ministries/Departments and agencies will prepare project document for implementation within the Master Plan period. Based on need and availability of resources, implementation periods may be categorized as

- Short Term (ST): Implementation requires 1-3 years.
- Medium Term (MT): Implementation requires 1-6 years.
- Long Term (LT): Implementation requires 1-10 years and beyond.

7.5 Investment Need

Resources are indeed required for implementation of programmes. This has been estimated separately for each intervention and has been spread over the entire period of implementation. Direct financial costs have been considered. Economic analysis of particular activities, if necessary, may follow later by concerned implementing agency when it goes for detailed conceptualization and feasibility.

Investment needs have been estimated using appropriate unit, say, per ha (for crop related activities), or size (for small scale dairy farm), or per km (for repair of embankment), or per m³ (for river dredging). Investment need of ongoing or already proposed interventions were directly

derived from the CIP, while estimates for newly proposed interventions were made in consultation with officials of relevant agencies.

Total investment need is estimated at 578,026 million taka (57,802.6 crore taka), which is equivalent to about US\$ 7,225 million. Component wise investment need has been presented in Figure 7.1.

Among the interventions, 24 have been marked as 'Top' priority, which account for 258,673 million BDT while 37 are identified as 'High' priority that would require 265,955 million BDT (Tables 7.1, 7.2, 7.3, 7.4 and 7.5).

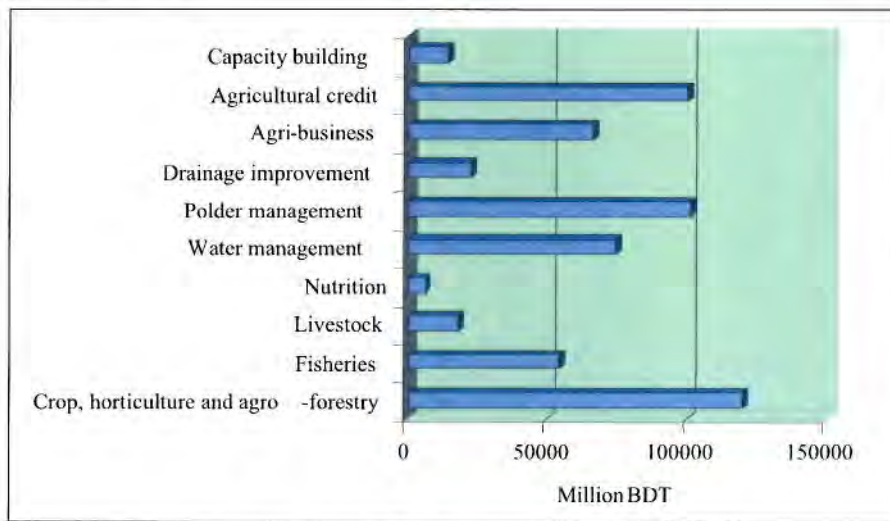


Figure 7.1: Investment need

Table 7.1: Interventions and investment need by priority

Priority	No. of interventions	Investment need (million)	
		BDT	US\$
Top	24	258,673	3,196
High	37	265,955	2,778
Medium	19	46,795	1,169
Low	5	6,603	83
Total	85	578,026	7,225

Numbers may not add to totals due to rounding

It may be mentioned that components are interdependent. One component cannot be taken in isolation for implementation, as its efficacy depends on implementation of the others. For example, investments in crop, horticulture, fisheries and livestock would positively affect nutrition and, hence, investments particularly targeted to 'nutrition' do not necessarily mean that these are the only ones for nutrition. Similarly, absence of investments in water and polder management, as well as

credit, would render the whole plan redundant. Therefore a holistic approach to the Master Plan is needed rather than negotiation at the programme level.

Some interventions may need one time investment; some interventions need investment for several years, while annual allocation is needed for certain interventions for entire period of the plan (Figure 7.2). It should also be remembered that investment in general of the programmatic areas has already begun.

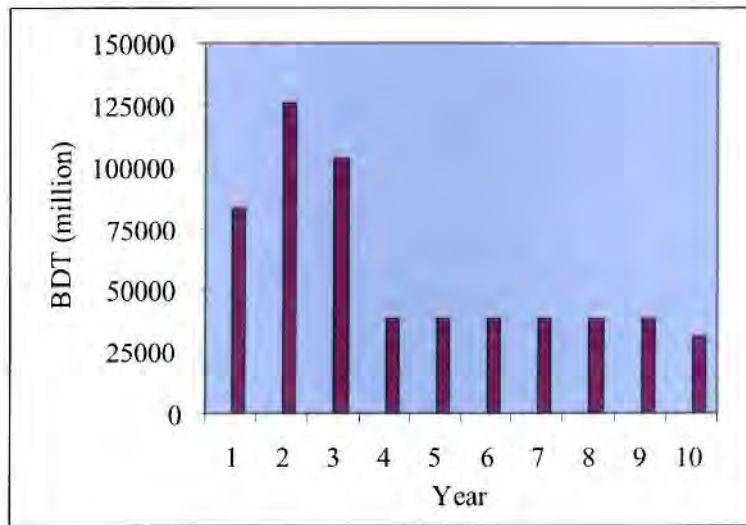


Figure 7.2: Annual investment need

7.6 Financing

Financing of the programmes outlined in the Master Plan is important and challenging. Concerted efforts are required in this direction by bringing all possible sources on board. Financing sources will include, among others, the following:

- Special allocations from the Annual Development Programme (ADP). The ADP will be aligned and harmonized in line with investment needs and priorities of the Master Plan.
- The Development Partners (DP). This is very much expected as the Bangladesh Development Forum also requested for such a Master Plan in 2010. The Economic Relation Division (ERD) will organize consultations with DPs to seek financial assistance from them for priority program areas.
- The private sector needs to take a lead role in the Master Plan, particularly in financing agri-business programmes. The construction of the Padma Bridge will open up opportunities for the private sector to contribute in the national development, particularly in the southern region.

Implementation of an intervention should not start until and unless total financing is guaranteed. It is better to start with fewer interventions and complete them, rather than embarking on too many interventions and leaving them half-done.

Table 7.2 : Distribution of interventions by priority and duration of implementation

Crop, horticulture and agro forestry

Sl No.	Programme	Intervention	Cost (Million BDT)	Cost criteria	Priority	Implementation duration
1	Productivity Enhancement of Rice	i. Increase productivity of T. Aman through improved management practice in non-tidal and non-saline phases	14000	65% area will be increased. Target area: 815 ha. will be achieved by 10 years (extension programme and input support). Tk. 100m/district/year.	T	MT
		ii. Promotion of HYV T. Aus in varied region of the coast	7000	Yield increase target is 65%. Area will be increased by 35% of the potential area (373632 ha) in 10 years; Tk. 100m/district/year	T	ST
		iii. Enhance Boro area where quality surface water is available through improved lifting and distribution system	2370	Boro area 2437000 ha. Of the total area 40% are DL and 60% are LLP. For 10 years.	H	LT
		iv. Production and supply of locally adapted seeds	2000	Lump sum	T	ST
Sub Total			25370			
2	Promotion of potential cropping patterns incorporating diversified new crops	i. Increase cropping intensity with remunerative cropping patterns for varied regions	1110	Of the total area (2056479 ha), 20% area will be considered in 10 years	H	LT
		ii. Establishing rice-cum-fish farming system in suitable areas	550	Potential area 120,000 ha. 70% will be achieved in 10 years	M	MT
		iii. Promote pulse (khesari, mungbean and chickpea, cowpea, oil seeds, sesame, groundnut, etc.) area for non-saline and non-tidal area (NARS varieties)	2000	Existing MHL area 1,692,007 ha. 10% will be achieved (pulses) in 10 years.	T	ST
		iv. Encourage mushrooms cultivation as alternative livelihood for rural women	50	Up scaling of mushroom production in 10% of MHL area (169,200 ha) will be considered. A lump sum amount Tk. 50 million.	M	MT
		v. Mapping of vegetables & species suitable for cultivation in various agro-climatic situations	110	Target area is 278543 ha; of the total target area 30% of HL and 10% of MHL will be covered in 10 years.	H	ST
		vi. Introduction of Beekeeping as alternative livelihood for marginal and landless farmers	50	Bee keeping for 12 ha of land. 25 box/ha. Tk. 3000/box. for 10 years.	M	MT
Sub Total			3870			
3	Technology generation and	i. Area specific crop / variety selection by conducting adaptive trials (NARS)	5000	Adaptive trial of 25 crops for up scaling. for 10 years	H	ST

PRIORITIZATION AND INVESTMENT NEED

Sl No.	Programme	Intervention	Cost (Million BDT)	Cost criteria	Priority	Implementation duration
	R&D strengthening	i. Area specific crop variety selection by conducting adaptive trials (NARS)	5000	Adaptive trial of 25 crops for up scaling; for 10 years	H	ST
		ii. Strengthening R&D of salt tolerant and high yielding potential crop and forage cultivars	2000	Lump sum: Tk. 200 million/year	T	MT
		iii. Submergence tolerant crop variety selection	150	Lump sum; Tk. 150 million	H	LT
		iv. Selection of crop varieties suitable for late planting and heat-tolerant condition	100	Lump sum: Tk. 100 million	L	LT
		v. Developing management package for unfavourable ecosystems with conservation of natural resources	10000	Lump sum: Tk. 1000 million /year	T	MT
		vi. Establishment & strengthening of Research and Extension and private sector linkage for location specific technology development and promotion	200	Lump sum: Tk. 200 million.	H	LT
		vii. Improved management practices for fish and rice culture	5000	Lump sum: Tk:500 million/year	M	MT
		Viii. Lab facility development of NARS institutes in the region	10000	Lump sum	H	LT
		viii. Strengthening on -farm research for technology packaging	3000	Lump sum	H	MT
	Sub Total		35450			
4	Input supply system	i. Production and supply of quality seed of different crops	610	61 ton seed/year; Tk 100/kg; for 10 years.	T	ST
		ii. Delineation of soil fertility problems and nutrient deficient areas in order to promote balanced fertilizer use	10000	Tk 10000 million/year; for 10 years.	H	MT
		iii. Promotion of tillage implements, post harvest loss reduction tools and small farm machinery	10000	Lump sum; farm mechanization cost for 10 years	H	LT
			Sub Total	20610		
5	Promotion of fruit cultivation	i. Mapping of potential fruit species for diversified agro-climatic situations	50	Lump sum: Tk 50 million for survey	H	ST
		ii. Zoning for suitable underutilized fruit production and marketing	150	5 Zones; cost/zone: Tk 30 million	M	ST
		iii. Commercialization of coconut cultivation	5000	Lump sum: Tk 500 m/year	M	LT
		iv. Collection of fruit tree germ plasm from public and private sources for promotion in the southern coastal districts.	500	Lump sum: Tk 50 million/year; for 10 years	L	MT

SI No.	Programme	Intervention	Cost (Million BDT)	Cost criteria	Priority	Implementation duration
		v. Up-scaling of HDP technique for quality mango and boroi cultivation.	1500	Lump sum: Tk 150m/year	M	ST
		vi. Capacity enhancement of Isolated Coconut Garden, Ramu, as coconut germ plasma center	500	Lump sum: Tk 50 million/year; for 10 years	H	MT
		vii. Introduction of proven technologies for fruit production and post harvest management	10000	Lump sum: Tk 1000 million/ye; for 10 years	H	ST
		viii. Expansion of guava cultivation through Ditch and Dyke method in waterlogged areas	200	Lump sum: Tk 20 million/year; for 10 years	H	ST
		ix. Intercropping and improved management practices within coconut plantation	1000	Lump sum: Tk 100 million/year ; for 10 years	M	MT
	Sub Total		18900			
		i. Introduction of proven new crops and management practices against different gradient of salinity: sugar beat, chilli, sweet potato, barley, soybean, QPM, etc. (Rabi crops)	7000	Tk 700 million/year; for 10 years	H	MT
6	Intensification and productivity enhancement of vegetables and spices	ii. Identification of farmers' innovative practices in saline zone and improving those for up scaling	1200	Lump sum: Tk 120 million/year; for 10 years	M	ST
		iii. Expansion of spices (eg. ginger, chillies, turmeric etc.)	2000	Lump sum: Tk 200 million/year	H	LT
		iv. Improved management of betel leaf cultivation	500	Lump sum: Tk 500 million	M	ST
	Sub Total		10700			
7	Popularizing agro-forestry practices	i. Promoting agro forestry and establishment of nursery for fruits and fast growing species	150	Lump sum: Tk 150 million	M	MT
		ii. Introduction of agro forestry and afforestation in char lands and embankments	5000	Lump sum: Tk 5000 million	M	MT
	Sub Total		5150			

Fisheries

SI No.	Programme	Intervention	Cost Million (BDT)	Costing criteria	Priority	Implementation duration
1	Improving management of pond resources for enhancing production of fish	i. Development of upazila wise database of ponds, ditches, closed canals, & other water bodies and capacity building	6000	Survey cost of upazila for one year. Per unit cost of quality seed cost: Tk.500000/upazila/year. For 140 upazila; for 5 years. Training & extension cost for 140 upazila for 10 years. Fish feed for 10 years for 140 upazila.	T	ST

PRIORITIZATION AND INVESTMENT NEED

MUSEUMS AND MONUMENTS DEPARTMENT, DHAKA, BANGLADESH

Sl No.	Programme	Intervention	Cost Million (BDT)	Costing criteria	Priority	Implementation duration
2	Community based Pen and Cage culture	ii. Intensification of fish production by introducing mono-sex tilapia, GIFT tilapia, ThaiKoi, & Pungus of mono culture and mixed culture in the deltaic area including water logged areas of Noakhali & Lakshimpur	5000	5 ha/upazila pond area each for Tealapia, Thai Koind Pungus for demo (total 15 ha); for 10 years; in 140 upazila; of total cost, 50% supported by Govt.	H	MT
		iii. Pilot project for integrated community based flood plain aquaculture (Davidkandi model)	16560	Total flood plain area 115000 ha. 20% will be used for piloting. Govt will support 30% of total cost.	M	LT
		Sub Total	27560			
3	Production and protection of quality broods, stocks, fingerlings, shrimps and prawns	i. Piloting of community based pen & cage culture in selective rivers, their tributaries & semi closed water bodies of Noakhali, Lakshimpur, Pirojpur, Patuakhali and Barisal	650	1 km each for three sites; for 3 years	H	MT
		ii. Promotion of cage/pen culture	10000	10000 farmers/year/50% govt support; Tk 100/m/year	H	LT
		Sub Total	10650			
		i. Establish & maintain community based fish sanctuaries	575	Tk 0.5 million / upazila; 115 upazila; for 10 years.	T	MT
		ii. Community based open water stocking & biological management	2000	Tk. 200 million/upazila, 115 upazila; for 10 years	H	ST
		iii. Stock assessment of pelagic and demersal fisheries resources	1375	Lump sum	H	ST
3	Production and protection of quality broods, stocks, fingerlings, shrimps and prawns	iv. Improvement of quality of brood stocks of native major carps as well as the Chinese exotic carps & raising of inbred free quality fry, fingerlings, juveniles of shrimps & prawn through the development of union based nursery; operated by private sector with technical assistance from DoF (PPP)	3000	Lump sum: 2 ha/upazila; 140 upazila; for 10 years.	T	LT
		v. Upgradation & development of DoF hatcheries & fish seed multiplication farms	2500	25 hatcheries; Tk 100 million/hatchery	H	ST
		vi. Strengthening & enforcing of Jaka-Hilsha conservation protection & development	4600	46 upazilas to be covered; for 10 years	H	LT
		vii. Establishing crab hatchery for the promotion crab fattening	100	Lump sum Tk 100 million	H	MT
Sub Total	14150					

SI No.	Programme	Intervention	Cost Million (BDT)	Costing criteria	Priority	Implementation duration
4	Enforcing land zoning and productivity enhancement of shrimp	i. Identification of underutilized shrimp ghers & enhancing the production of shrimp and prawn by introducing shrimp/prawn, shrimp/prawn with paddy, shrimp & brackish water fin fish after paddy ii. Piloting of semi intensive shrimp culture with target production of 1200 -1500kg/ha in the selective areas of Khulna, Satkhira, Bagerhat & Cox's Bazar district	200	34 upazila to be covered; Tk 60 million/year. for 10 years	L	MT
	Sub Total		2000	15 upazila for piloting; for 10 years.	T	MT

Livestock

SI No.	Programme	Intervention	Cost Million (BDT)	Costing criteria	Priority	Implementation duration
1	Community based dairy development	i. Community livestock and dairy development in the southern region, replication and up scaling of dairy farming in Satkhira (Tala model) ii. Promotion of HYV fodder cultivation iii. Strengthening health care(HC) iv. Establishing AI service center in each union	2975	Farm size: 5 cattle; Tk. 850000/farm; 140 upazila, 1 farm/upazila; for 10 years ; govt support 50% Lump sum Tk. 3000 million	T	ST
	Sub Total		12275	Lump sum; 100% Govt. support; Tk. 500m/year. 3 AI centers/union; 50% support by the govt.	H	MT
2	Establishment of commercial buffalo and sheep farms	i. Establishing improved buffalo farm ii. Upgradation of local buffalo and sheep breeds	5000	200000 (buffalo); Tk. 50000/unt; Govt support: 50% Lump sum Tk. 1000 million	H	LT
	Sub Total		6000		M	LT

Nutrition

SI No.	Programme	Intervention	Cost Million (BDT)	Costing criteria	Priority	Implementation duration
1	Synergizing homestead farming with nutrition education	i. Promoting integrated homestead agriculture (vegetables, fruits, pond fish culture, poultry, duck & dairy). ii. Incorporate nutrition component in agricultural BCC and IEC activities at different level for mass communication (audio visual, printing media etc)	6000	2 demo/village; total 10000 demo in 5000 villages; Tk. 10000/demo/year, for 10 years. 10 video documentary for each of 25 million	T	ST
	Sub Total		6250		H	LT

PRIORITIZATION AND INVESTMENT NEED

Water Management

Sl No.	Programme	Intervention	Cost Million BDT	Costing criteria	Priority	Implementation duration
1	Surface water augmentation	i. Excavation of silted and dried up canals and fish migratory routes, construction of water control structures, construction of irrigation canals and pump houses.	31170	Canal length: 3117000m; width: 50 m; depth: 2m; Tk 100/cubic meter	T	MT
		ii. Surface water conservation through construction of rubber dam / cross dam / regulator, etc for development of irrigation	5000	Lump sum: Tk 5000 million	L	MT
		iii. Excavation of reservoir/ pond for water conservation for surface water irrigation development.	5000	Lump sum: Tk 5000 million	M	MT
		Sub Total	41170			
2	Enhance Irrigation potentials	i. Integrated on farm water management including double lifting, infrastructure development	30000	Lump sum	H	LT
		ii. Promotion of solar energy for operating irrigation equipment.	560	Lump sum demo for 200 units	M	MT
		iii. Rehabilitation and improvement of Muhuri, Bhola and Barisal Irrigation Project	2525	Cost/ha: Tk 10000	M	ST
		i. Exploration of groundwater aquifer for high value non-rice crops in suitable areas	500		M	ST
Sub Total	33585					

Drainage improvement

Sl No.	Programme	Intervention	Cost Million BDT	Costing criteria	Priority	Implementation duration
1	Restoration of degraded land	i. Restoration of severely waterlogged areas in Noakhali mainland	2509	Lump sum: Tk 2109 million	T	MT
		ii. Improving drainage, water logging and flood management through capital dredging of silted up rivers in southwest region	20000	Length: 200 km; width: 200m; depth: 2m; Tk 250/Cubic meter	H	LT
		iii. Community driven and managed TRM in selected beels	100	Tk 10 million/2500 ha beel; for 10 beels.	T	LT
		Sub Total	22609			

Polder Management

SI No.	Programme	Intervention	Cost (Million BDT)	Costing criteria	Priority	Implementation duration
1	Ensure community managed polder development	i. O&M by community based institutions.	2780	Tk 2m x 139 polders X 10 yrs	T	MT
		ii. Emergency public fund for disaster management	13620	Tk 5 m x50 polders X 10 yrs	T	LT
		iii. Legal framework for implementation of institutional arrangements	50	Lump sum	T	ST
	Sub total		16450			
2	Construction of climate resilient polders	i. Repair and rehabilitation of damaged polders	284	5.9 m /km breach, for 48 km	T	MT
		ii. Coastal embankment improvement with climate resilient structures	83700	0.124m/ha, for 675000 ha of most vulnerable polders	H	LT
	Sub total		83984			
3	Promotion of land accretion process	i. Noakhali -Urr Char Cross -Dam	803	Dam 3 km Yr1 : 250 m Yr2 : 391 m Yr3 : 162 m	L	MT
		ii. Sustainable use of accreted land resources	90	Tk. 0.18 m/ha/yr for 5000 ha annually	H	LT
	Sub Total		893			

Agri-business

SI No.	Programme	Intervention	Cost Million BDT	Costing criteria	Priority	Implementation duration
1	Enhance capacity building	i. Establishment of market infrastructure with value chain management addressing processing, postharvest management and grading	40000	Market infrastructure at upazila, union and growth centers	T	MT
		ii. Training and awareness building of all types of stakeholder	5000	Lump sum	H	LT
	Sub Total		45000			

PRIORITIZATION AND INVESTMENT NEED

Agri-business (continued)

SI No.	Programme	Intervention	Cost Million BDT	Costing criteria	Priority	Implementation duration
2	Processing centre	i. Enhancement of milk, meat, fish, fruits and vegetable processing center ii. Establishment of independent quality control certification laboratory	20000 200	1 medium sized beef processing unit of 100 cattle/day can process 500 goats/day can process. Cost of one unit of chicken processing plant Plant capacity 10000 lit/day. 2 insulated milk tankers (2500 lit capacity) 2 nos. Insulated milk delivery van 5000 lit capacity. lump sum	H H	LT ST
	Sub Total		20200			
3	Salt production	Salt productivity enhancement through improved management practice	500	Lump sum for demo	M	MT
	Sub Total		500			
4	Fish drying	i. Promotion of community based fish dryer	500	Lump sum for demo	H	LT
	Sub Total		500			

Agrikultural Credit

SI No.	Programme	Intervention	Cost (Million BDT)	Costing criteria	Priority	Implementation duration
1	Special farm credit	i. Establishing a revolving credit fund for farmers and small & medium entrepreneurs with maximum 3 % service charge	100000	Lump sum	T	LT
	Sub Total		100000			

Capacity Building

Sl.No.	Programme	Intervention	Cost (Million BDT)	Costing criteria	Implementation duration
1	Strengthening of public sector agencies and local government institutions	i. Human resource development of the Public sector Extension agencies and Technology providers including recruitment of field level staffs. ii. Training and capacity building of the members of Local Government bodies, community organizations, Agri-business entrepreneurs and farmers on technology modules	5000	Lump sum	MT
	Sub Total		14000	Lump sum	LT

Table 7.3: List of top and high priority interventions

A. Top priority interventions

SI No	Thematic area	Intervention	Investment need (million BDT)
1	Crop, horticulture and Agro - forestry	i. Increase productivity of T. Aman through improved management practice in non-tidal and non-saline phases	14000
		ii. Promotion of HYV T. Aus in varied region of the coast	7000
		iii. Production and supply of locally adapted seeds	2000
		iv. Promote pulse (khesari, mungbean and chickpea, cowpea, oil seeds: sesame, groundnut, etc.) Area for non-saline and non-tidal area (NARS varieties)	2000
		v. Strengthening R&D of salt tolerant and high yielding potential crop and forage cultivars	2000
		vi. Developing management package for unfavourable ecosystems with conservation of natural resources	10000
		vii. Production and supply of quality seed of different crops	610
2	Fisheries	viii. Development of upazila wise database of ponds, ditches, closed canals, & other water bodies and capacity building	6000
		ix. Establish & maintain community based fish sanctuaries	575
		x. Improvement of quality of brood stocks of native major carps as well as the Chinese exotic carps & raising of inbred free quality fry, fingerlings, juveniles of shrimps & prawn through the development of union based nursery; operated by private sector with technical assistance from DoF (PPP)	3000
		xi. Piloting of semi intensive shrimp culture with target production of 1200 -1500kg/ha in the selective areas of Khulna, Satkhira, Bagerhat & Cox's Bazar district	2000
3	Livestock	xii. Community livestock and dairy development in the southern region, replication and up scaling of dairy farming in Satkhira (Tala model)	2975
		xiii. Strengthening health care (HC)	5000
4	Nutrition	xiv. Promoting integrated homestead agriculture (vegetables, fruits, pond fish culture, poultry, duck & dairy).	6000
5	Water management	xv. Excavation/ re-excavation of silted and dried up canals and fish migratory routes, construction of water control structures, construction of irrigation canals and pump houses.	31170
6	Drainage improvement	xvi. Restoration of severely waterlogged areas in Noakhali mainland	2509
		xvii. Community driven and managed TRM in selected beels.	100
7	Polder management	xviii. O&M by community based institutions.	2780
		xix. Emergency public fund for disaster management.	13620
		xx. Legal framework for implementation of institutional arrangements.	50
		xxi. Repair and rehabilitation of damaged polders	284
8	Agri-business	xii. Establishment of market infrastructure with value chain management addressing processing, postharvest management and grading	40000
9	Agricultural credit	xiii. Establishing a revolving credit fund for farmers and small & medium entrepreneurs with maximum 3 % service charge	100000
10	Capacity building	xiv. Human resource development of the Public sector Extension agencies and Technology providers including recruitment of field level staffs.	5000
Total			258673

B. High priority interventions

Sl No	Thematic area	Intervention	Investment need (million BDT)
1	Crop, horticulture and agro forestry	i. Enhance Boro area where quality surface water is available through improved lifting and distribution system	2370
		ii. Increase cropping intensity with remunerative cropping patterns for varied regions.	1110
		iii. Mapping of vegetables & species suitable for cultivation in various agro-climatic situations	110
		iv. Area specific crop / variety selection by conducting adaptive trials (NARS)	5000
		v. Submergence tolerant crop variety selection	150
		vi. Establishment & strengthening of Research and Extension and private sector linkage for location specific technology development and promotion	200
		vii. Lab facility development of NARS institutes in the region	10000
		viii. Strengthening on-farm research for technology packaging	3000
		ix. Delineation of soil fertility problems and nutrient deficient areas in order to promote balanced fertilizer use	10000
		x. Promotion of tillage implements, post harvest loss reduction tools and small farm machinery	10000
		xi. Mapping of potential fruit species for diversified agro-climatic situations	50
		xii. Capacity enhancement of Isolated Coconut Garden, Ramu, as coconut germ plasm center	500
		xiii. Introduction of proven technologies for fruit production and post harvest management	10000
		xiv. Expansion of guava cultivation through Ditch and Dyke method in waterlogged areas	200
		xv. Introduction of proven new crops and management practices against different gradient of salinity: sugar beat, chilli, sweet potato, barley, soybean, QPM, etc. (Rabi crops)	7000
		2	Fisheries
xvii. Intensification of fish production by introducing mono-sex tilapia, GIFT tilapia Thai -Koi, & Pungus of mono culture and mixed culture in the deltaic area including water logged areas of Noakhali & Lakshmipur	5000		
xviii. Piloting of community based pen & cage culture in selective rivers, their tributaries & semi closed water bodies of Noakhali, Lakshmipur, Pirojpur, Patuakhali and Barisal	650		
xix. Promotion of cage/pen culture	10000		
xx. Community based open water stocking & biological management	2000		
xxi. Stock assessment of pelagic and demersal fisheries resources	1375		
xxii. Upgradation & development of DoF hatcheries & fish seed multiplication farms	2500		
xxiii. Strengthening & enforcing of Jatka-Hilsha conservation, protection & development	4600		
3	Livestock	xxiv. Establishing crab hatchery for the promotion crab fattening	100
		xxv. Promotion of HYV fodder cultivation	1000
		xxvi. Establishing AI service center in each union	3300
		xxvii. Establishing improved buffalo farm	5000

PRIORITIZATION AND INVESTMENT NEED

4	Nutrition	i. Incorporate nutrition component in agricultural BCC and IEC activities at different level for mass communication (audio visual, printing media etc).	250
5	Water management	ii. Integrated on farm water management including double lifting, infrastructure development	30000
6	Drainage improvement	iii. Improving drainage, water logging and flood management through capital dredging of silted up rivers in southwest region	20000
7	Polder management	iv. Coastal embankment improvement with climate resilient structures	83700
		v. Sustainable use of accreted land resources	90
8	Agri-business	vi. Training and awareness building of all types of stakeholder	5000
		vii. Enhancement of milk, meat, fish, fruits and vegetable processing center	20000
		viii. Establishment of independent quality control certification laboratory	200
		ix. Promotion of community based fish dryer	500
9	Agricultural credit	---	---
10	Capacity building	x. Training and capacity building of the members of Local Government bodies, community organizations, Agri-business entrepreneurs and farmers on technology modules	9000
Total			265,955

Of the total 85 interventions 24 are short duration (ST) amounting to BDT 57,745 million and 33 interventions are medium term (MT) amounting to BDT 161,931 million. Long term interventions require the largest amount of BDT 358,350 million (Figure 7.3).

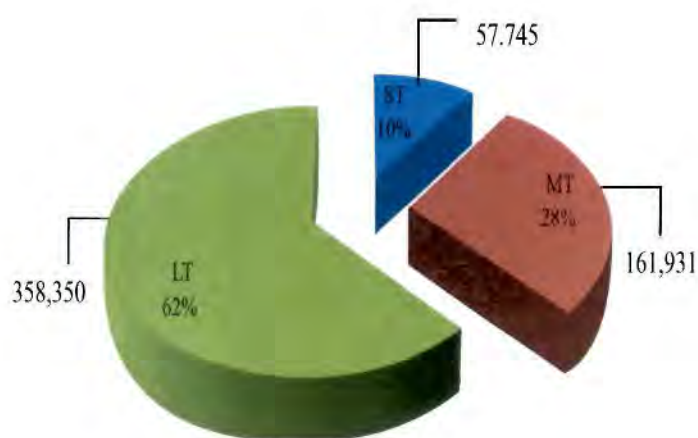


Figure 7.3: Investment (BDT in million) by duration of implementation.

Table: 7.4: Programme location**Crops, Horticulture & Agro-forestry**

Sl No.	Programme	Cost (Million BDT)	Programme location
1	Productivity enhancement of rice	25370	Greater Barisal and Noakhali region
2	Promotion of potential cropping patterns with adjustment of diversified new crops	3870	Greater Noakhali, Greater Barisal, Some places of Khulna region
3	Technology generation and R&D strengthening	35450	Entire Southern region
4	Inputs supply system	20610	Entire Southern region
5	Promotion of fruit cultivation	18900	Greater Barisal, Chittagong and Noakhali
6	Intensification and productivity enhancement of winter and summer vegetables	10700	Greater Barisal and sole places of Khulna region
7	Popularization of agro-forestry practices	5150	Entire Southern region
	Sub total	120050	

Fisheries

Sl No.	Programme	Cost (Million BDT)	Programme location
8	Improve management of pond resources for enhancing production of fishes	27560	Greater Barisal and Noakhali
9	Community based Pen and Cage culture in open water system	10650	Greater Barisal, Lakshimpur and waterlogged inland area of Noakhali
10	Production and protection of quality broods, stocks, fingerlings, shrimps and Prawns	14150	Entire Southern region
11	Enforcing land zoning and productivity enhancement of shrimp	2200	Greater Khulna region and Cox Bazar
	Sub total	54560	

Livestock

Sl No.	Programme	Cost (Million BDT)	Programme location
12	Community based dairy development	12275	Greater Khulna and greater Barisal
13	Establishment of commercial farms of buffalo and sheep in Bhola and Noakhali	6000	Bhola and Noakhali region
	Sub total	18275	

Nutrition

Sl No.	Programme	Cost (Million BDT)	Programme location
14	Synergizing homestead farming with nutrition education	6250	Entire southern region

PRIORITIZATION AND INVESTMENT NEED

Water Management

Sl No.	Programme	Cost (Million BDT)	Programme location
15	Surface water augmentation	41170	Greater Barisal and Khulna
16	Enhance Irrigation potentials	33585	Greater Barisal and Chittagong
Sub total		74755	

Drainage Improvement

Sl No.	Programme	Cost (Million BDT)	Programme location
17	Restoration of degraded land	22609	Entire southern region

Polder Management

Sl No.	Programme	Cost (Million BDT)	Programme location
18	Ensure community managed polder development	16450	Entire southern region
19	Coastal embankment improvement with climate resilient structures	83984	Mainly Khulna region
20	Promotion of land accretion process	893	Meghna estuary
Sub total		101327	

Agri-business

Sl No.	Programme	Cost (Million BDT)	Programme location
21	Enhance capacity building	45000	Entire southern region
22	Processing centre for milk, meat, fish and vegetable	20200	Entire southern region
23	Salt production	500	
24	Fish drying	500	
Sub total		66200	

Agri. Credit

Sl No.	Programme	Cost (Million BDT)	Programme location
23	Special farm credit	100000	Entire Southern region

Capacity Building

Sl No.	Programme	Cost (Million BDT)	Programme location
26	Strengthening of public sector agencies and Local government institutions	14000	Entire Southern region

Grand Total: 578,026 (Million BDT)

Table 7.5: Year-wise investment need

Sl No	Programme	Total cost (million BDT)	Year-wise investment need (million BDT)										
			1	2	3	4	5	6	7	8	9	10	
Crop, Horticulture and Agro -forestry													
1	Productivity Enhancement of Rice	23370	1169	2629	2629	2629	2629	2629	2629	2629	2629	2629	1169
2	Promotion of potential cropping patterns incorporating diversified new crops	3870	194	435	435	435	435	435	435	435	435	435	194
3	Technology generation and R&D strengthening	37450	1872	4213	4213	4213	4213	4213	4213	4213	4213	4213	1872
4	Input supply system	20610	1031	2319	2319	2319	2319	2319	2319	2319	2319	2319	1031
5	Promotion of fruit cultivation	18900	945	2126	2126	2126	2126	2126	2126	2126	2126	2126	945
6	Intensification and productivity enhancement of vegetables and spices	10700	535	1204	1204	1204	1204	1204	1204	1204	1204	1204	535
7	Popularizing agro -forestry practices	5150	258	579	579	579	579	579	579	579	579	579	258
	Sub total	120050	6004	13505	13505	13505	13505	13505	13505	13505	13505	13505	6005
Fisheries													
8	Improving management of pond resources for enhancing production of fish	27560	2756	8268	2067	2067	2067	2067	2067	2067	2067	2067	2067
9	Community based Pen and Cage culture	10650	1065	3195	799	799	799	799	799	799	799	799	799
10	Production and protection of quality broods, stocks, fingerlings, shrimps and Prawns	14150	1415	4245	1061	1061	1061	1061	1061	1061	1061	1061	1061
11	Enforcing land zoning and productivity enhancement of shrimp	2200	220	660	165	165	165	165	165	165	165	165	165
	Sub total	54560	5456	16368	4092	4092	4092	4092	4092	4092	4092	4092	4092
Livestock													
12	Community based dairy development	12275	1227	3682	921	921	921	921	921	921	921	921	921
13	Establishment of commercial buffalo and sheep farms	6000	600	1800	450	450	450	450	450	450	450	450	450
	Sub total	18275	1827	5482	1371	1371	1371	1371	1371	1371	1371	1371	1371
Nutrition													
14	Synergizing homestead farming with nutrition education	6250	425	758	633	633	633	633	633	633	633	633	633
	Sub total	6250	425	758	633	633	633	633	633	633	633	633	633

PRIORITIZATION AND INVESTMENT NEED

SI No	Programme	Total cost (million BDT)	Year-wise investment need (million BDT)										
			1	2	3	4	5	6	7	8	9	10	
Water Management													
15	Surface water augmentation	41170	2059	4117	12351	3234	3234	3234	3234	3234	3234	3234	3234
16	Enhance Irrigation potentials	33585	1679	3358	10075	2639	2639	2639	2639	2639	2639	2639	2639
	Sub total	74755	3738	7475	22426	5873	5873	5873	5873	5873	5873	5873	5873
Drainage Improvement													
17	Restoration of degraded land	22209	1110	2221	6663	1745	1745	1745	1745	1745	1745	1745	1745
	Sub total	22609	1110	2221	6663	1745	1745	1745	1745	1745	1745	1745	1745
Polder Management													
18	Ensure community managed polder development	16450	1645	3290	4935	940	940	940	940	940	940	940	940
19	Construction of climate resilient polders	83984	8398	16797	25195	4799	4799	4799	4799	4799	4799	4799	4799
20	Promotion of land accretion process	893	89	179	268	51	51	51	51	51	51	51	51
	Sub total	101327	10132	20087	30398	5790	5790	5790	5790	5790	5790	5790	5790
Agri-business													
21	Enhance capacity building	45000	2250	4500	13500	3536	3536	3536	3536	3536	3536	3536	3536
22	Processing centre	20200	1010	2020	6060	1587	1587	1587	1587	1587	1587	1587	1587
23	Salt production	500	25	50	150	39	39	39	39	39	39	39	39
24	Fish drying	500	25	50	150	39	39	39	39	39	39	39	39
	Sub total	66200	3310	6620	19860	5201	5201	5201	5201	5201	5201	5201	5201
Agricultural Credit													
25	Special farm credit	100000	50000	50000	--	--	--	--	--	--	--	--	--
	Sub total	100000	50000	50000	--	--	--	--	--	--	--	--	--
Capacity Building													
26	Strengthening of public sector agencies and Local government institutions	14000	1400	2800	4200	800	800	800	800	800	800	800	800
	Sub total	14000	1400	2800	4200	800	800	800	800	800	800	800	800
	Total	578026	83402	125316	103148	39010	39010	39010	39010	39010	39010	39010	31510

IMPLEMENTATION AND MANAGEMENT

8.1 Institutional Framework and Governance

Government mainly deals with two areas: public administration and development. With the passage of time, the role of the government in Bangladesh has undergone significant changes and a host of other institutions have emerged to cater the needs of the people. Development is no more an exclusive domain of the public sector. Under changed circumstances, different formations belonging to the national government, local government, private sector and a wide range of civil society organizations have developed with competing and complementary roles in development. Besides, there are formal and informal functional groups and coalitions of the people at the local level who are increasingly being acknowledged as focus of all development efforts. This has replaced the earlier notion that the people are mere recipients and objects of development services and governance. All these social and institutional entities, however, operate under a nexus of power relations and linkages, which frames the overall institutional environment.

If institutional arrangements work well, people tend to believe that "good governance" prevails. Good governance is defined as harmony between performance of the state and aspiration of the society. Lack of good governance produces disparity, injustice, deprivation and lawlessness in the society in general and for the poor in particular. In order to attain a higher rate of poverty reduction, there is no escape from ensuring good governance (GED, 2005).

However, the governance agenda has suffered from being insufficiently grounded in an understanding of where the governance 'needs' of the poor and of vulnerable groups including women lie. Some service providing agencies are present up to the upazila level and some of these agencies, such as the Department of Agricultural Extension and Health and Family Welfare, have extension staff even below the upazila level. However, the general perception about them is that they are not delivering services to the required extent. Even if they are posted at the union level their mode of operation is still essentially top-down.

The issue of governance has seldom been addressed in conventional development literature, though fruits of development are often lost due to lack of good governance. Women continue to face entrenched barriers and insecurities in deepening their gains achieved in social and economic fronts. Governance weaknesses stand in the way of acceleration in the growth process (GED, 2005).

Local level units of line Ministries/Departments have the mandate and the authority to play certain roles and deliver specific services. This has not been a smooth as expected. The main constraints as envisaged by the government are outlined below.

- Although 'village' is the basic geographic unit in Bangladesh and constitutes the bottom-most entity for identification of development needs in rural areas, there are farmers organizations, CBOs and local NGOs working in the grass root level. It is necessary to motivate the poor farmers to effectively participate in the development process.
- There are a number of government agencies for service delivery at various tiers of local government. But in the absence of effective 'clientele' organization, the delivery structure remains rather inaccessible. In particular, this system often does not reach the poor and the disadvantaged.
- Various efforts to organize the people at the grassroots level through local government bodies also did not succeed.
- The government personnel who were sent to the rural areas to work for the poor largely proved to be inadequately motivated for participatory local level development for various reasons such as inadequate training, incentive structure, logistics, colonial legacy, etc.
- The understanding at different levels of the needs emphasized for effectiveness of "participatory local level planning". The usual emphasis was on the need for "educating the poor" before they could effectively participate (Planning Commission, 1998).

In recent years, a change in the declared strategy of the public authorities is being observed. Community participation in the development process is increasingly being emphasized by the government. Participatory water management has been declared as a major thrust in the SFYP. This approach would be followed in all water sector projects right from the identification up to monitoring and evaluation. The approach is mandatory for all public sector institutions (Planning Commission, 2011).

8.2 Sustainable Polder Management

It is no exaggeration to say that the southern region is a region of polders. Polders are now part of the natural setting in the coastal zone. While these have contributed significantly in enhancing food production, they are now confronting second generation problems, both social and environmental. Any strategy for poverty reduction must address these problems for a durable solution.

There are many problems, while resources are scarce. Resources need to be utilized in a context of competing and often conflicting demand, in a manner that optimizes their utility.

Optimum utilization of polder infrastructures has been affected by failure to take institutional aspects into account. Experiences of the past decades have led the Ministry of Water Resources and the Bangladesh Water Development Board (BWDB) to acknowledge the fact that an appropriate institutional structure for water management is the missing link. Since 2000, this is being adopted in different strategies and approaches. However, most of the institutional interventions have not sustained or are unlikely to keep going because of the *ad hoc* nature of the planning process. In a special project like CDSP, this somehow works. But this is far from being mainstreamed in the sponsoring agency, the BWDB. A sustainable institutional framework is yet to be in place. Against this backdrop, the following aspects need urgent attention.

- a) **People's Participation and Ownership:** Sustainable management of polders can only be convincing and successful if the people, particularly the poor, are able to enhance their livelihoods in harmony with nature. The most contributing elements in a program toward attaining such a difficult goal is to consider the people the motor of development. This needs continuous support from all endogenous and exogenous entities and processes. They together constitute the institutional environment that can promote people's initiatives, ownership and belongingness and encourage participation of all stakeholders to achieve the desired goals in all stages of resource management.

Building people's ownership needs intensive and meaningful engagement of the LGI. UP is the most sustainable LGI that has passed the test of time. Although the UP is used by all GoB agencies for their sectoral purposes and interests, there have been little efforts to empower it and make it functional in every respect. In fact, WMA can function as a taskforce of the UP on water management. Through this, field level institutions will be integrated and mainstreamed in the existing administrative structure and would facilitate devolution of authority to the local level. Lessons learnt from others such as the Netherlands and Vietnam on engagement of local communities in implementation and O&M of polders need to be utilized in the implantation process of the Master Plan.

The concept of Integrated Coastal Zone Management (ICZM) is highly relevant and important in this respect, which offers a means of balancing the competing demands of different users of the same resource and of managing the resources to optimize the benefits that is consistent with the country's goals (MoWR, 2005). ICZM principles work through the local government institutions as a first step towards mainstreaming, adhering to the principles of decentralization. The crux of the problem is to promote community-driven development through enabling participatory local governance and community belongingness and ownership of programs.

- b) **Legal status:** As envisaged in the GPWM, a three-tier structure for the WMOs should be in place, such as, the WMG at the sub-polder/village level, the WMA at the system level and the WMF at the catchments level. The WMOs may be registered with the BWDB or with the Department of Co-operatives to have legal status, as well as to have flexible mode of operation for social and economic development of their members that often transcend water management functions. A legal status would definitely empower field level community institutions.
- c) **Functionality:** The WMOs should aspire and strive to expand their activities and should not remain confined to water management alone. The 'incentive' factor is of critical importance. Social actions and economic activities on a regular basis would keep community institutions going. This means a WMO should not remain confined as a consultative body, but should become functional in a way that brings tangible economic benefits for its members.
- d) **Mandate:** Sometimes it is argued that certain actions are not permissible under the existing mandates and Acts of sponsoring organizations like the BWDB. If this is the case, it is

necessary to amend the mandates and Acts, rather than fitting field level institutions to predetermined domains. For example, registering the WMOs as statutory body under the BWDB, the BWDB Act should be amended.

- e) **Facilitation by BWDB:** The BWDB must not be solely a regulatory body, but should function as a facilitating agency to allow community based institutions to develop, function and prosper.
- f) **Allocation for O&M:** To keep polder infrastructures in good shape, budgetary allocation for O&M should be increased and amounts should be spent prudently. A community based O&M system combining beneficiary contribution and government endowment fund should be in place.
- g) **Allocation for LCS:** The functionality of grassroots institutions like the WMGs is critically dependent on access to common resources and collective actions that bring tangible benefits for the members in the short run. In this context, all possible public resources for maintenance works that require unskilled labor should be earmarked for the WMGs. According to the field level BWDB source, about seven million taka is typically available for annual maintenance work per polder, mostly earthwork, which the WMGs are capable of undertaking. This entire amount should be allocated to local institutions, thus providing some employment benefit and income support to poor farmers of WMG.
- h) **Capacity of BWDB:** The BWDB does not have sufficient in-house capacity to develop, monitor and improve the WMGs and their quality. The BWDB should be allowed to have the optimum level of staffing to monitor and maintain polder infrastructures. This would involve high overhead costs. Some tasks should be transferred to local government and NGOs to keep costs at a reasonable level.
- i) **Coordination mechanism:** A better management of natural resources would require improved cooperation between water sector organizations and other relevant agencies. So, BWDB should maintain close linkage with other Ministries through the Ministry of Water Resources and horizontal linkage with other line departments at the central level, as well as at the field level.
- j) **Conflict resolution:** With respect to common public resources, it is necessary to encourage the people to identify trade-offs among different users for the purpose of conservation and resolution of conflicts. Zoning for appropriate and profitable land use should be done involving all stakeholders. This should be linked with administrative actions in the form of incentives and disincentives to promote or discourage certain activities in certain areas based on suitability and trend. Polders with suitable land for shrimp culture should be designed in compliance with requirements of shrimp culture.

8.3 Other Stakeholders

There is a broad spectrum of civil society organizations (CSO) including NGOs and academia, which plays a vital role in the development process. These stakeholders can provide not only

valuable expertise, but also can function as watchdog in the implementation process.

Among the CSOs, NGOs are the most organized operating at all levels throughout the country. Their main aims are advocacy, social mobilization, human development and poverty alleviation. They mostly work with a target group approach, addressing most of their programs to the poor and women.

There is a wide range of CBOs operating at the grass roots level. Among these are landless groups, women's groups, farmers' cooperatives, fishers' cooperatives, etc. that are organized at the micro level. These are mostly village-based. These are often perceived as extended arm of the NGOs.

The banking system expanded in the rural areas quite rapidly in the 1970s and 1980s. Yet heavy dependence of the rural poor on informal sector moneylenders who charge high interest rates has continued to limit their creative potential to contribute more to national growth (Planning Commission, 1998). During this period, NGOs have emerged as a major source of micro credit that has almost overwhelmed other community development programmes. People often view NGOs as alternative service providers.

The key question remains how to incorporate NGOs in partnerships that go beyond project implementation. The following are few general observations that may be taken into account while further exploring such partnerships.

NGOs are a fact of life in socio-economic development of the country and a widely accepted vehicle to channel contributions of DPs to grassroots development processes. Their focus on social and environmental issues gives them the status of "action groups" than representatives of the public. In other words, they are fundamentally not democratic in the sense of being accountable to a general electorate.

NGOs have slowly changed their working scope and working areas. From "organized philanthropy", they now provide complementary services to government functions, such as primary education and public healthcare.

There is a scope for collaboration between the UPs and NGOs. UP officials would like to share resources mobilized by NGOs, while NGOs want more help from UP officials in implementing their projects (The World Bank, 2002). Nonetheless, there is considerable space for mutually satisfying cooperation.

Private sector

The private sector is gaining more and more space in the economy. While agriculture has always been in the private sector, investments from the organized private sector are critically important. In this way, agriculture can transcend primary production and enter the sphere of value chain and agro-processing. A key pre-requisite is investment in rural infrastructure.

Private investments in non-rice agricultural activities are constrained by a number of factors including the absence of adequate roads, power and finance. Rapid progress will be achieved if investments in these areas are targeted.

Public-Private Partnership (PPP) has been a declared policy of the government. The government recognizes that strong public-private partnership can play a catalytic role in mobilizing additional resources and creating additional capacity which would help implementing public programs. Accordingly the government has put emphasis on PPP to ensure development of infrastructure and utility services by attracting investment and improving the expertise and technology (Planning Commission, 2011).

Private sector organizations and forums will be included in the planning and monitoring process of the Master Plan at the national and local levels.

8.4 Implementation Mechanism

Once the Master Plan is adopted, the Government commits to support its implementation. An essential approach to implementation would be to mainstream it in existing policies and programs of the Government. This necessitates the following:

- Focus shall be given on incorporating the plan (interventions) in ongoing and future programs of relevant Ministries and agencies;
- The Master Plan will be implemented through existing ministries/departments and organizations;
- Existing policies and programs of participating ministries/departments will be harmonized to suit the requirements of the Master Plan;
- Adequate resource will be allocated in the Annual Development Programme (ADP) of all relevant ministries;
- Where more than one ministry/department is involved in the implementation of a particular program, inter-ministerial/department linkage and coordination mechanism will be in place;
- Engaging the local government and co-management, understood as a range of management systems where responsibilities are shared between the government and the communities, will be the mode of management at the local and the district level.

8.5 Public Sector Capacity

As the government agencies are the main anchorage points for implementation of the Master Plan, it is of utmost importance that they have necessary human resources with required background and competence. At the moment, most of these agencies lack adequate extension staff at the field level. The situation is particularly precarious for Department of Livestock Services and Department of Fisheries. Research stations of Bangladesh Agriculture Research Institute (BARI) and Bangladesh Rice Research Insitue BRR1 in Khulna, Barisal and Noakhali are ill equipped with professionals and facilities and they cannot carry out their mandate properly.

It is an imperative to modernise the entire system of research and extension. All vacant posts need to be filled on an urgent basis. It is also necessary to increase the number of extension staff and base them at the union level, so that they can deliver services at the doorstep of farmers. At the

same time, necessary infrastructure and logistic support need to be arranged to facilitate stay and retention of staff in remote areas.

8.6 Institutional Setting

The Master Plan for agricultural development consists of a multi-level and multi-sectoral interventions involving several ministries, departments and other entities including the local government, the CSOs and the private sector. Certain programmes are of very local nature, and some would involve more than one district. Thus, institutionalization of the Master Plan requires a functional mechanism for coordination and interaction between and among the many parties involved at national, district and local levels.

It is recommended that relevant line agencies will implement respective sectoral programs as per existing administrative norms. However, institutional arrangements need to be in place to facilitate coordination among the stakeholders whose activities affect one another.

To coordinate these activities, the Ministry of Agriculture will function as the lead Ministry. An Inter-Ministerial Implementation Committee will be responsible for overall coordination and oversight. To ensure overall coordination of implementation of the Master Plan, the following institutional arrangements will be made:

- a. Inter-Ministerial Implementation Coordination Committee (IMICC): The Minister in charge of the Ministry of Agriculture will be the Chair, while Ministers of the Ministry of Water Resources and Ministry Fisheries & Livestock will be the Co-Chairs. Secretaries of the Ministry of Agriculture, Ministry of Water Resources, Ministry of Fisheries and Livestocks, Ministry of Environment and Forests, Ministry of Food, Ministry of Disaster Management and Relief, Ministry of Land, Local Government Division, Rural Development & Co-operative Division, Economic Relations Division, Member-General Economics Division and Agriculture, Water Resource and Rural Institution Division of the Planning Commission and Chief Executives of all participating departments/organizations/forums will be member.
- b. Inter-Ministerial Implementation Committee (IMIC): The Secretary of the Ministry of Agriculture will be the Chair. Secretaries of the Ministry of Water Resources, Ministry of Fisheries and Livestock, Ministry of Environment and Forests Ministry of Food, Ministry of Disaster Management and Relief, Ministry of Land, Local Government Division, Rural Development & Co-operative Division, Economic Relations Division and Member-General Economics Division and Agriculture, Water Resources and Rural Institution Division of the Planning Commission and chief executives of all participating departments/organizations/forums will be the member.
- c. A District Implementation Committee (DIC) will be in place involving all available Division/District level members of relevant organizations/forums. The Additional Director of the Department of Agricultural Extension covering the district will be the Chair. The committee will implement decisions of IMIC and send feedback. It will periodically review performance of programs.

- d. An Upazila Implementation Committee (UIC) will be set up at the upazila level. The Deputy Director of the Department of Agricultural Extension covering the upazila will be the Chair.
- e. Each participating Department/ organization/ forum will nominate a focal point as operational contact in relation to Master Plan activities and maintain contact with the lead Ministry for liaison and coordination.
- f. Committees at all levels will meet on a regular basis. The minimum meeting frequency will be as follows:
 - IMICC: Annually
 - IMIC: Six-monthly
 - DIC: Six-monthly
 - UIC: Three-monthly

The proposed institutional structure (Figure 8.1) will be formalized through a gazette notification to avoid any ambiguity or confusion, as well as to facilitate smooth functioning of the implementation process.

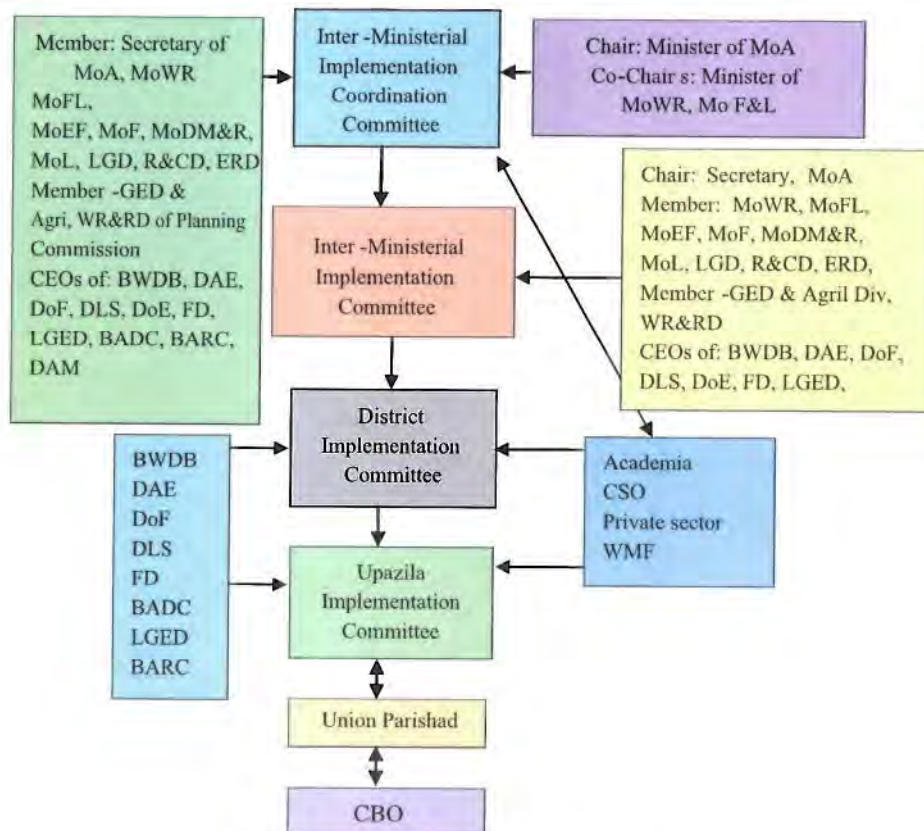


Figure 8.1: Proposed institutional setting

All stakeholders are important and relevant. Their participation in a setting as essential partners will definitely add fortitude and moral fiber in their institutional behavior.

The crux of the matter is to cultivate an administrative culture of working together for a common goal. This would necessitate radical shift of existing orientation and mindset of the people engaged in delivering services. In this backdrop, an institutional set up for the implementation of the Master Plan has been suggested.

8.7 Monitoring

A key to smooth implementation of the Master Plan would essentially require regular and functional monitoring. Committees at the four aforementioned levels will obviously review the progress of implementation and will resolve inter-agency coordination issues at respective spheres; this would also require a system of result-based monitoring. The lead Ministry/agency will prepare appropriate reporting tools and formats and, after endorsement by the IMIC, will use them during the implementation period. The format should be simple and easy to fill up and should include all vital information corresponding to necessary indicators of monitoring. In line with the government policy on ICT, The IMIC should put up a website for public use and should encourage different stakeholders to participate in e-discussion and providing comment.

An independent organization will be contracted to prepare Annual Monitoring Report throughout the plan period. This can be facilitated by the FAO.

A Mid-term Review will be done after three years from the commencement of implementation. A second mid-term review will be done after the sixth year.

The implementation of the Master Plan will be evaluated after the completion of the program after the tenth year.

Reference

Abedin, Zainal (2004). Overview of Water Management in CDSP-II, Technical Report No. 14. CDSP-II. BWDB.

Ahmad, Ishtiaq Uddin, Forestry Development in Coastal Areas, in de Wilde (2011), ed. Moving Coastlines, Emergence and Use of Land in the Ganges-Brahmaputra-Meghna Estuary. UPL.

Ahmad, Mohiuddin (2003). Livelihoods - situation and context, Working Paper WP015. WARPO, Ministry of Water Resources.

Ahmad, Mohiuddin (2003a). NGOs in Coastal Development, Working Paper WP022. WARPO, Ministry of Water Resources.

Ahmad, Mohiuddin (2004). Living in the Coast - People and Livelihoods. PDO-ICZMP, WARPO, Ministry of Water Resources.

Ahmad, Mohiuddin (2005). Living in the Coast - People and Institution. WARPO, Ministry of Water Resources.

Asiatic Society of Bangladesh (2003). Banglapedia, National Encyclopedia of Bangladesh.

BADC (2010). Minor Irrigation Survey Report 2009-10. Ministry of Agriculture.

BADC (2011). Groundwater Assessment, Ministry of Agriculture

BBS (1999). Census of Agriculture 1996. Ministry of Planning.

BBS (2002). Report of the Poverty Monitoring Survey. Ministry of Planning.

BBS (2002a). Provisional Estimates of Gross Regional Products. Ministry of Planning.

BBS (2005). Preliminary Report on Agriculture Sample Survey 2005. Ministry of Planning.

BBS (2007). Population Census 2001, National Series, Volume-1. Ministry of Planning.

BBS (2010). Census of Agriculture 2008. Ministry of Planning.

BBS (2010a). Statistical Yearbook of Bangladesh 2009. Ministry of Planning.

BBS (2011). Population & Housing Census 2011, Preliminary Results. Ministry of Planning, July 2011.

BBS and UNICEF (2010). Progotir Pathey 2009, Monitoring the Situation of Children and Women - Key Findings of the Bangladesh Multiple Indicator Cluster Survey 2009, Preliminary Report.

BSCIC (2003). Salt Field Survey Report in 2002-2003. Salt Industry Development Project, Cox's Bazar.

- BWDB (2008). Guidelines for Integrated Planning for Sustainable Water Resources Management – to be used in existing medium-sized Flood Control and Drainage (FCD) Projects. Ministry of Water Resources.
- CDF and InM (undated), Bangladesh Microfinance Statistics 2008. Dhaka.
- Credit & Development Forum (2006). Microfinance Country Profile. Dhaka.
- DoF (2011). Fisheries Statistical Year Book of Bangladesh 2009-10.
- Frankenberger, Timothy R (2002). A livelihood analysis of shrimp fry collectors in Bangladesh. Tango International Inc, for Department of International Development, Dhaka.
- GED, Planning Commission (2005). Unlocking the Potential - National Strategy for Accelerated Poverty Reduction. Ministry of Planning.
- GED, Planning Commission (2011). SAARC Development Goals, Bangladesh Country report 2011. Ministry of Planning.
- Government of Bangladesh (2011). Bangladesh Country Investment Plan: a road map towards investment in agriculture, food security and nutrition. FPMU, Ministry of Food and Disaster Management.
- IFPRI (2012). Institutional Arrangements for Sustainable Polder Management (draft).
- Integrated Coastal Zone Management Program (2006). State of the Coast 2006. WARPO, Ministry of Water Resources.
- Karim, Zahurul (2009). Climate Change Impact on Agriculture and Food Security in Bangladesh. Ministry of Agriculture/FAO. Dhaka
- Karim, Zahurul, A. Iqbal (2001). Impact of land Degradation in Bangladesh- Changing Scenario in Agricultural Land Use. BARC, Dhaka.
- Karim, Zahurul (1996). Agricultural Vulnerability and Poverty Alleviation in Bangladesh. In Climate Change and World Food Security, T.E. Downing (Ed.), NATO ASI Series, 137. Springer-Verlag, Berlin, Heidelberg.
- Karim, Zahurul, S. G. Hussain, and A. U. Ahmed (1999). Climate Change Vulnerability of Crop Agriculture. Vulnerability and Adaptation to Climate Change for Bangladesh. In Huq. S., Z. Karim, M. Asaduzzaman and F. Mahtab (Eds) pp-39-54, Kluwer Academic Publishers. Dordrecht, The Netherlands.
- Karim, Zahurul, S.G. Hussain and M. Ahmed (1990). Salinity problems and Crop Intensification in the Coastal Regions of Bangladesh. Soils Publication No.33, BARC.
- Karim, Zahurul, and N.A. Akand (1982). Net Irrigation requirement of rice and evapotranspiration of wheat and potato for different locations of Bangladesh. BARC, Soils and Irrigation Publication No.11.

REFERENCE

- Karim, Zahurul, J.M. Shoaib and A. Iqbal (1991). Potentials of increased agricultural productivity in the greater Barisal and Patuakhali coastal regions. *Bangladesh Journal of Soil Science*.
- Leedshill-DeLeuw Engineers (1968). Coastal Embankment Project – Engineering and Economic Evaluation, Volume 1. East Pakistan Water and Power Development Authority.
- Local Government Division (2006). Institutional Studies for Legal Framework of Water Management Organizations – Final Report. Second Small Scale Water Resources Development Sector Project. Local Government Engineering Department, Asian Development Bank, Government of the Netherlands.
- Mahtab, F.U and Z. Karim (1992). Population and Agricultural Land Use towards sustainable food production system in Bangladesh. *J. Of Human Environment*. Sweden, Vol. 21(1).
- PDO-ICZMP (2002). Perceptions of Direct Stakeholders on Coastal Livelihoods, Working Paper WP004. WARPO, Ministry of Water Resources.
- Pearbolte, Bart & Zubair, Md. Hasan. Unprotected Areas, Polder Development and Operation & Maintenance (O&M), in de Wilde (2011), ed. *Moving Coastlines, Emergence and Use of Land in the Ganges-Brahmaputra-Meghna Estuary*. UPL.
- Planning Commission (1991). Fourth Five Year Plan 1990-95. Ministry of Planning.
- Planning Commission (1998). Fifth Five Year Plan 1997-2002. Ministry of Planning.
- Planning Commission (2009). The Millennium Development Goals, Bangladesh Progress Report 2009. Ministry of Planning.
- Planning Commission (2011). Sixth Five Year Plan FY2011-FY2015, Part-2, Sectoral Strategies, Programs and Policies. Ministry of Planning.
- Roy, Prosanta (2001). Coastal Resource Degradation and User-right Abuse in Bangladesh. Paper presented at the conference on Coastal Communities and the Indian Ocean's Future, IIT Madras, Chennai, India, 9-13 October 2001.
- SBCP (2001). Socio-economic Baseline Study on the Impact Zone of the Sundarbans. Urban and Rural Planning Discipline, Khulna University.
- SRDI. Land Resources Database. Ministry of Agriculture.
- UNDP (2011). Global Assessment Report on Disaster Risk Reduction.
- UNFPA (2011). The State of World Population 2011.
- WARPO (2006). Coastal Development Strategy. Ministry of Water Resources.
- World Bank (2002). Taming Leviathan, Reforming Governance in Bangladesh – An Institutional Review. Dhaka.



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