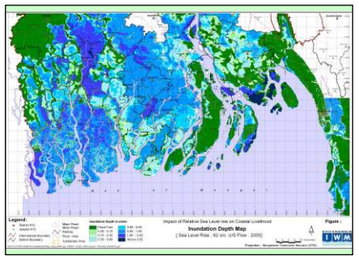
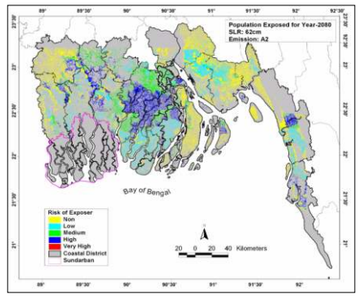
Investigating the Impact of Relative Sea-Level Rise on Coastal Communities and their Livelihoods in Bangladesh

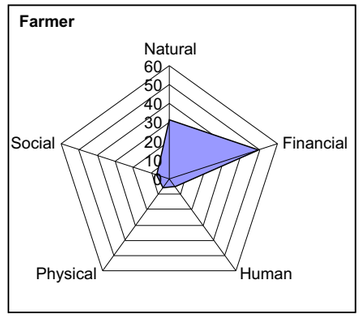
CEGIS has carried out a study entitled "Investigating the impact of relative sea level rise on coastal communities and their livelihoods in Bangladesh" in collaboration with Institute of Water Modelling (IWM) and funded by UK Department of Environment Food and Rural Affairs (DEFRA). This study considered the climate change induced global sea level rise, changes in intensity of cyclones and precipitation for both low and high greenhouse gas emission scenarios according to the 3rd IPCC predictions. The impact analysis of coastal communities and their livelihoods has been done for the projected year 2020, 2050 and 2080 by application of state of the art mathematical model. The study assessed about number of people in the coastal zone of Bangladesh affected by varying degrees of relative sea-level rise and their spatial distribution based on impact modelling.



Inundation for A2 scenario 62cm SLR



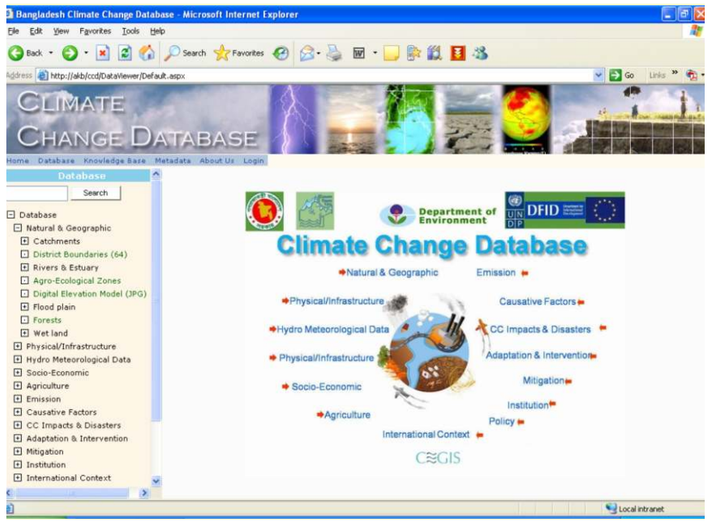
Exposed population for 62 cm sea level rise



Effect on Farmer's assets due to high tidal flooding

Climate Change Database

'Climate Change Database' was prepared for 'Climate Change Cell' under Department of Environment funded by UNDP. Climate Change Database focus on original climate related data that is relevant for policy maker, planner and researcher on climate change, climate change impact, adaptation to climate change and climate risk management in Bangladesh. The database also become part of the Climate Change web portal, which is accessible through the Internet.



Center for Environmental and Geographic Information Services (CEGIS), from its beginning, is engaged in research projects on climate change issues in Bangladesh focusing on the physical phenomena and their impacts on communities and livelihoods. A brief outline of these research projects are given here.

Impact of CLimate And Sea level change in part of the Indian sub-Continent (CLASIC)

A collaborative research project entitled 'Impact of CLimate And Sea level change in part of the Indian sub-Continent (CLASIC)' was carried out during 2003-2007. The partners are Centre for Ecology & Hydrology, UK, Proudman Oceanographic Laboratory, Liverpool, UK, Hadley Centre, Meteorological Office, UK, Institute of Water & Flood Management (IWFM), BUET, Dhaka and Center for Environmental and Geographic Information Services (CEGIS), Dhaka. The project has been funded by the Department for International Development (DFID), UK. One of the purposes of the project was to investigate the implications of climate change on water resources and flooding in the basins of the Ganges, the Brahmaputra and the Meghna with particular reference to Bangladesh. The other purpose was to examine the possible impacts of climate change upon cyclonic storm surges in the Bay of Bengal, which affect low-lying coastal regions of Bangladesh. Data on future climate have been obtained from four global climate models (GCMs) and two regional climate models (RCMs) for the baseline period of 1979-1999 and two future periods of 2015-2035 and 2040-2060 have been used in the study. A model named 'Global Water AVailability Assessment (GWAVA)', developed by the CEH and the British Geological Survey has been used to simulate surface water runoff in the GBM basin. Predicted impacts of climate change on river flows indicate possibility of substantial changes in future river flows in Bangladesh.

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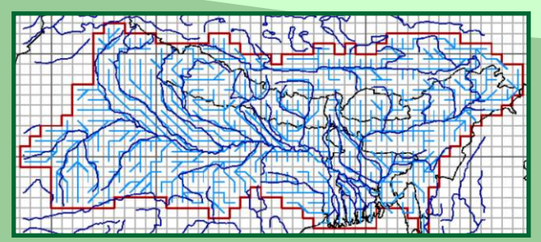
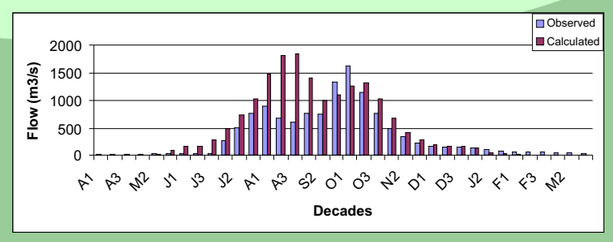
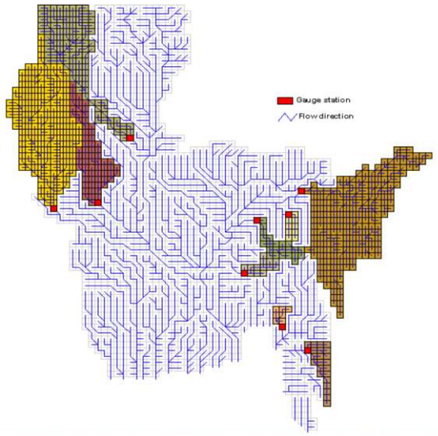


Figure: Coarse grid model drainage network for Ganges, Brahmaputra and Meghna basins.



Comparison of observed and computed flows for decade average discharges in Mahananda sub-catchments



Fine grid model drainage network, and calibration catchments, gauge stations and boundary conditions

Adaptive Crop Agriculture Including Innovative Farming Practices in the Coastal Zone of Bangladesh

CEGIS has conducted a study on the "Adaptive Crop Agriculture Including Innovative Farming Practices in the Coastal Zone of Bangladesh" in Satkhira District in partnership with BRRI, BARI, BARC and BUP. The main objective of the study was to find out suitable adaptation measures that have the potential to help farmers adapt to climate changes and to identify suitable varieties of crops that would be able to adapt to climate change. The CROPSUIT model developed by CEGIS was used to estimate the physical suitability of land for different types of land uses or crop cultivation. Different types of rice crops and non-rice crops were selected for field-testing. From field experiments it was found that introduction of high yielding salt tolerant variety BRRI dhan47 could produce sustainable grain yield in the coastal regions. It was also observed that there was no salinity impact on rice production due to high rainfall during monsoon season. But in the later part, when the rainfall ceases, it was assumed that soil salinity might increase and go beyond the safe limit of rice crop (4 dS/m). So, salt tolerant T. Aman varieties like BR23, BRRI dhan40 and BRRI dhan41 may be the solution to overcome salinity impact at the later stage. Tomato, Okra and Aroid were grown successfully under improved management practices with raised bed and mulch in the medium saline soils of Satkhira. The existing cropping pattern of Fallow-T.Aman (Local)-Fallow or Fallow-T.Aman (Local)-Boro (Local/HYV) may be replaced with the pattern of Kharif I- T. Aman-Boro or Kharif I-T.Aman-Rabi.

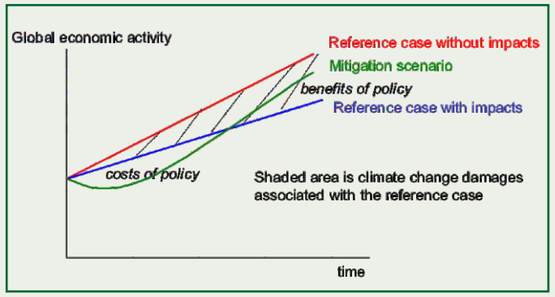
IET rice variety planted in the high salinity area

Experimental field of selected rice varity planted in high salinity area

Economic Modeling of Climate Change Adaptation Needs for Physical Infrastructures In Bangladesh (Phase-II)

CEGIS has conducted this study funded by Comprehensive Disaster management Programme (CDMP). There are 138 polders in the coastal zone of Bangladesh to protect the crops from the tidal inundation. But these polders will be at risk of overtopping due to SLR resulting in damage to agriculture due to inundation. The objective of this study is to compare the expected economic damage with cost of adaptation to sea level rise. In this regard, the expected damage to agriculture in the coast due to sea level rise has been estimated. One physical adaptation model developed by IWM has been used and one economic model has been developed.

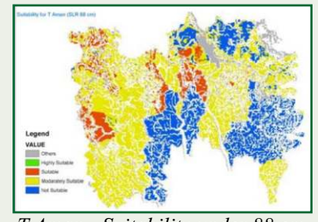
Raising the embankment has been considered as an adaptation option and the cost of this option has been compared with expected benefit i.e. saving the expected damage. It has been calculated that the net investment cost for raising the embankment will be around Tk. 34,828 million (US$ 500 million approximately). Annual benefit that can be expected from this adaptation will be Tk 574 million/year upto 2050 and Tk. 1,148 million/year onwards upto 2080. It has been found that the incremental B/C ratio of raising embankment will be 2.17 and IRR will be 28%.



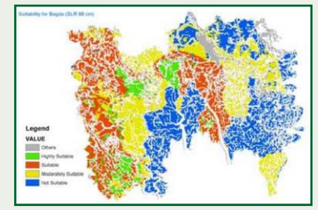
Climate change policy framework for benefit cost analysis (the fish diagram)

Impacts of Sea Level Rise on Landuse Suitability and Adaptation Options in Southwest region of Bangladesh'

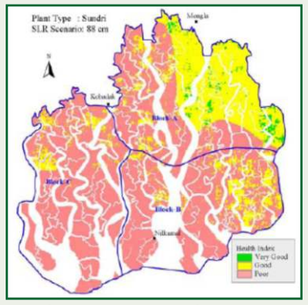
The coastal area of Bangladesh is vulnerable to the impact of sea level rise. Due to sea level rise, potential hazards like salinity intrusion, sedimentation, drainage congestion etc. may occur severely. Thus landuse pattern and suitability will be changed. Focusing on these issues, CEGIS has carried out a research project entitled 'Impact of Sea Level Rise on Landuse Suitability and Adaptation Options' financed by UNDP under the Ministry of Environment and Forests, Government of Bangladesh. Under this project, landuse suitability for agriculture, fisheries and Sundarban mangrove forest has been analyzed under different sea level rise scenarios. Relation of landuse with salinity, inundation, and sedimentation conditions has been studied. It is observed that the Sundri suitable areas in the northern part of Sundarban will reduce drastically from 80% to 50% due to 88 cm SLR. In the base condition, the "Suitable" area for T. Aman was about 84% but it will reduce to only 12 percent under 88 cm SLR scenario. T. Aman is found suitable in 90% area in all three districts. It reduces to about 40 percent area with sea level rise. On the other hand, the Boro suitable area will decrease from 46% to 6%. Bagda suitable areas will increase 12% due to sea level rise of 32 cm., but it will decrease at SLR 88cm due to excessive flood depths and salinity. The "Suitable" area for Golda will decrease with the increase in sea level, as the lower salinities are preferable for Golda.



T Aman - Suitability under 88 cm SLR scenarios



Bagda - Suitability under 88 cm SLR scenarios



Sundari coverage under 88 cm SLR scenarios

Impact of Climate Change on River Erosion

Impact of climate change on river erosion has be studied under CLASIC project. River erosion has a close relation with peak discharge. Observing the historical data from 1973 to 1999 a clear indication and direct relationship between peak discharge and erosion can be found. This type of relationship has been established for Brahmaputra river, which implies that increase in discharge enhance erosion. From figure 1 it can be seen that upto 2000 the average erosion was about 3,300 hectares (RTi & EGIS, 2000) whereas recently conducted erosion prediction study (CEGIS, 2008) envisages that about 2,188 hectares of land were eroded in the Brahmaputra-Jamuna river banks in 2007.

The worst scenario has been found using CCSRNIESB2 model for the year 2050. According to this model peak discharge will be increased by 10%. The 10% increment in discharge will cause the increase in erosion at around 20% on an average if the existing condition and relationships prevails for Brahmaputra - Jamuna river banks.