Climate Change Risk in Bangladesh
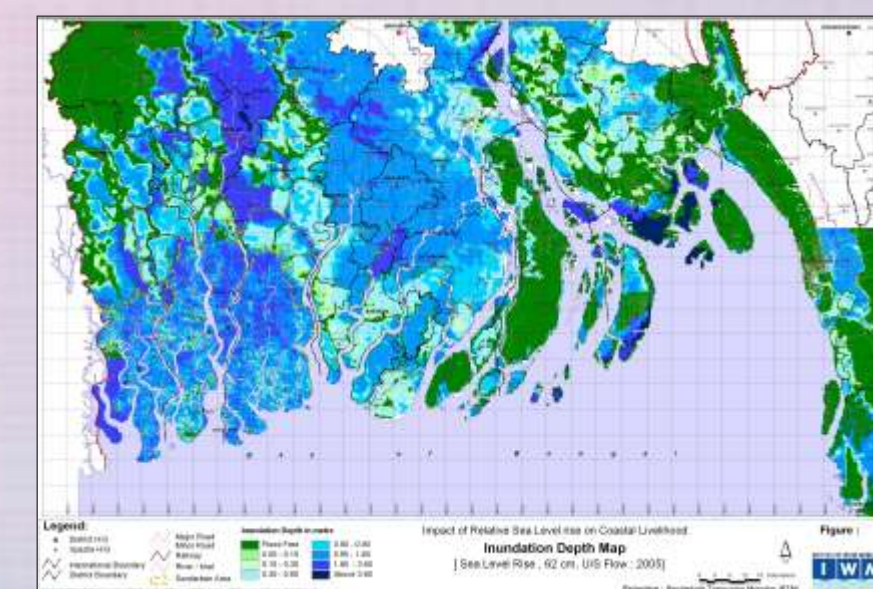
CEGIS RESEARCH PROJECTS

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

CEGIS performs integrated environmental analysis using technology such as geographic information system (GIS), remote sensing (RS), databases and information technology (IT). It provides solutions to issues and problems in the sectors of water, land, agriculture, fisheries, environment, engineering, power, energy, transportation, etc., and recommends technical options based on local realities that are feasible from the socio-economic and institutional point of view.

INVESTIGATING THE IMPACT OF RELATIVE SEA-LEVEL RISE ON COASTAL COMMUNITIES AND THEIR LIVELIHOODS IN BANGLADESH

CEGIS has carried out a study "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 it was funded by Department of Environment Food and Rural Affairs (DEFRA), UK. This study considered the climate change induced global sea level rise (SLR), changes in intensity of cyclones and precipitation for both low and high GHG 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 SLR and their spatial distribution based on impact modelling.

Inundation for A2 scenario 62 cm SLR
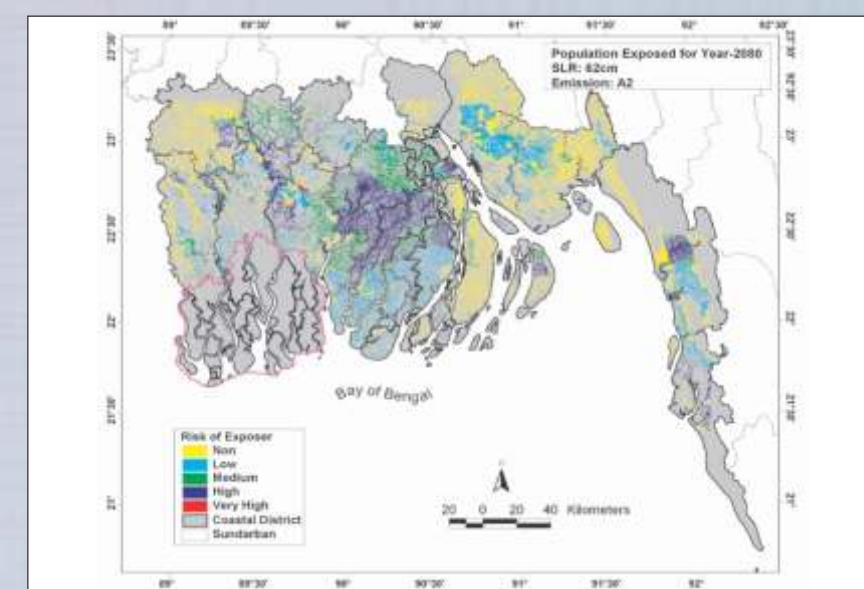
Exposed population for 62 cm SLR
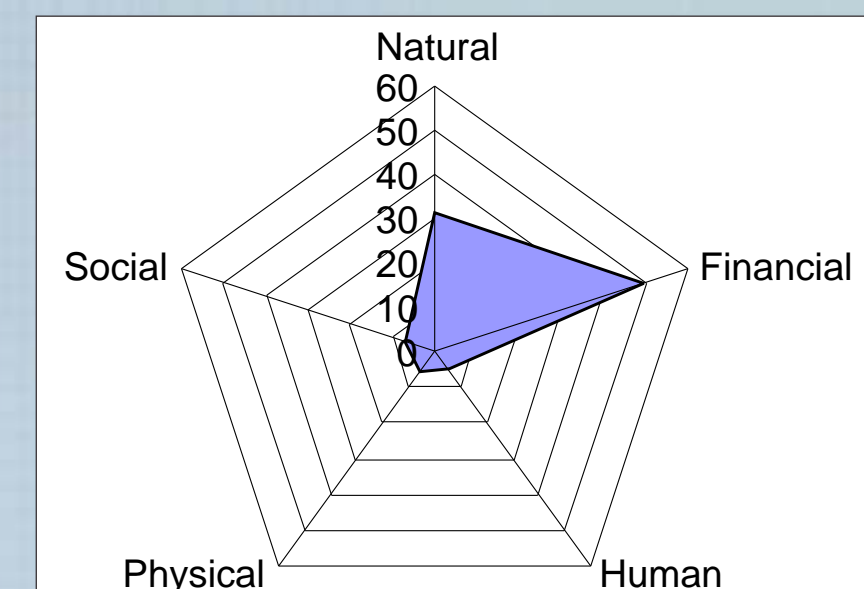
Effect on Farmer's assets due to high tidal flooding

IMPACT OF CLIMATE AND SEA LEVEL CHANGE IN PART OF THE INDIAN SUB-CONTINENT (CLASIC)

A collaborative research project 'Impact of CLimate And Sea level change in part of the Indian sub-Continent (CLASIC)' was carried out during 2003-2007. The partners of the project were the 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. One of the key purposes of the project was to investigate the implications of climate change on water resources and flooding in the GBM (the Ganges, the Brahmaputra and the Meghna) basin 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. 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. A model named 'Global Water AVailability Assessment (GWAVA)', developed by the Centre for Ecology & Hydrology of UK 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. The project has been funded by DFID.

IMPACT OF CLIMATE CHANGE ON RIVER EROSION

Impact of climate change on river erosion has been 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 the Brahmaputra river, which implies that increase in discharge enhance erosion. It has been estimated that upto year 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 the Brahmaputra-Jamuna river banks.

ECONOMIC MODELING OF CLIMATE CHANGE ADAPTATION NEEDS FOR PHYSICAL INFRASTRUCTURES IN BANGLADESH (PHASE-II)

CEGIS has conducted this study to compare the expected economic damage with coast of adaptation to SLR which is funded by Comprehensive Disaster management Programme (CDMP). In this regard, the expected damage to agriculture in the coast due to SLR has been estimated.

Under this study, economic model has been developed, incorporating the risk-based framework combining date on hazard (e.g. SLR) and considering the damage to standing crop due to overtopping of polders as key vulnerability indicator to estimate the risk.
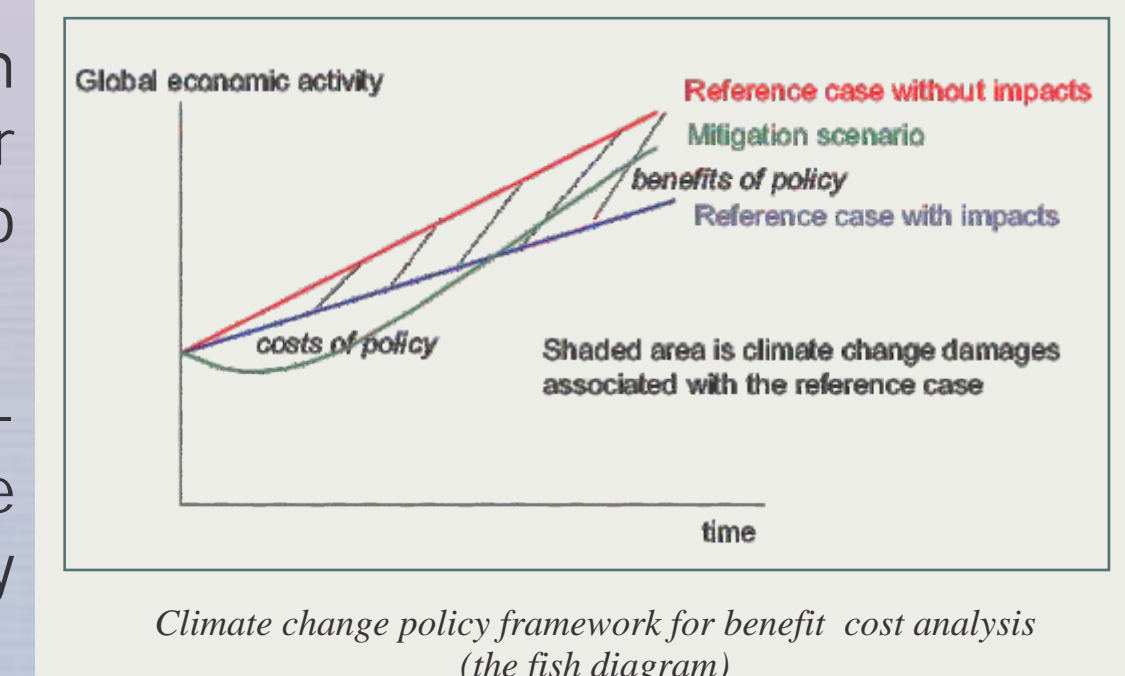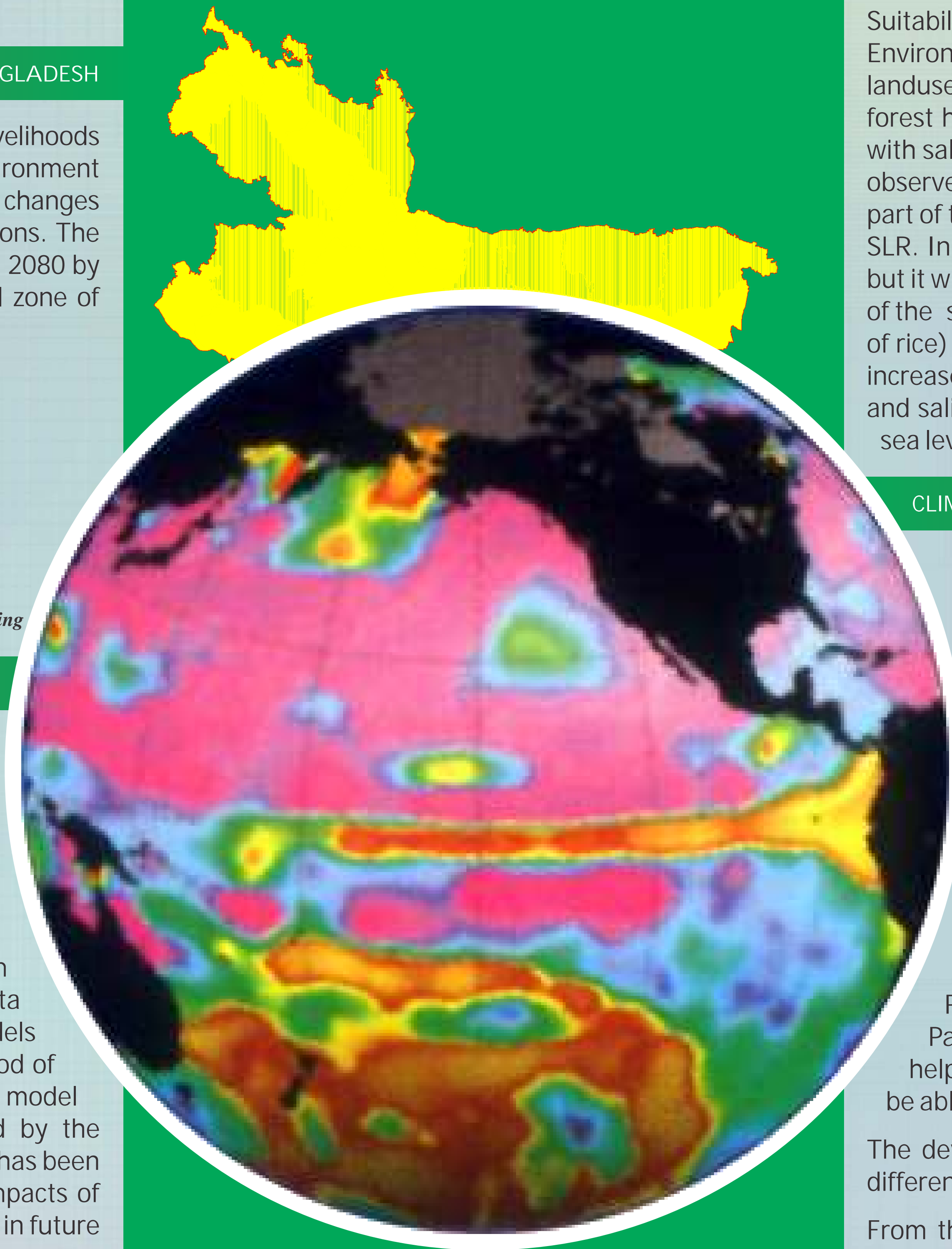
*Climate change policy framework for benefit cost analysis (the fish diagram)*

IMPACTS OF SEA LEVEL RISE ON LANDUSE SUITABILITY AND ADAPTATION OPTIONS IN SOUTHWEST REGION OF BANGLADESH'

CEGIS has carried out a research project '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 the Sundarbans mangrove forest has been analysed under different SLR scenarios. Relation of landuse with salinity, inundation, and sedimentation conditions has been studied. It is observed that the Sundri (a species of plant) suitable areas in the northern part of the Sundarbans will reduce drastically from 80% to 50% due to 88 cm SLR. In the base condition, the "Suitable" area for Transplanted *Aman* (*T.Aman*) was about 84% but it will reduce to only 12 % under 88 cm SLR scenario. The *T.Aman* is found suitable in 90% area of the studied area. It reduces to about 40 % area with SLR. On the other hand, the Boro (a variety of rice) suitable area will decrease from 46% to 6%. Bagda(a variety of shrimp) suitable areas will increase 12% due to SLR of 32 cm, but it will decrease at SLR 88 cm due to excessive flood depths and salinity. The "Suitable" area for Golda (a variety of shrimp) 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
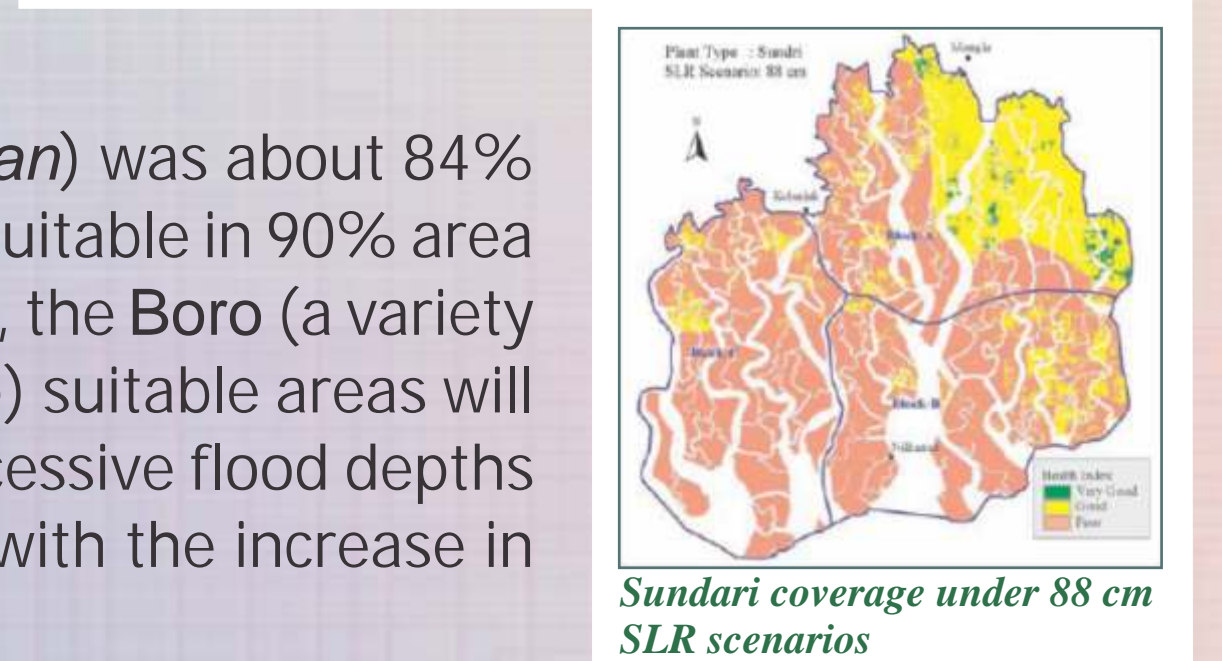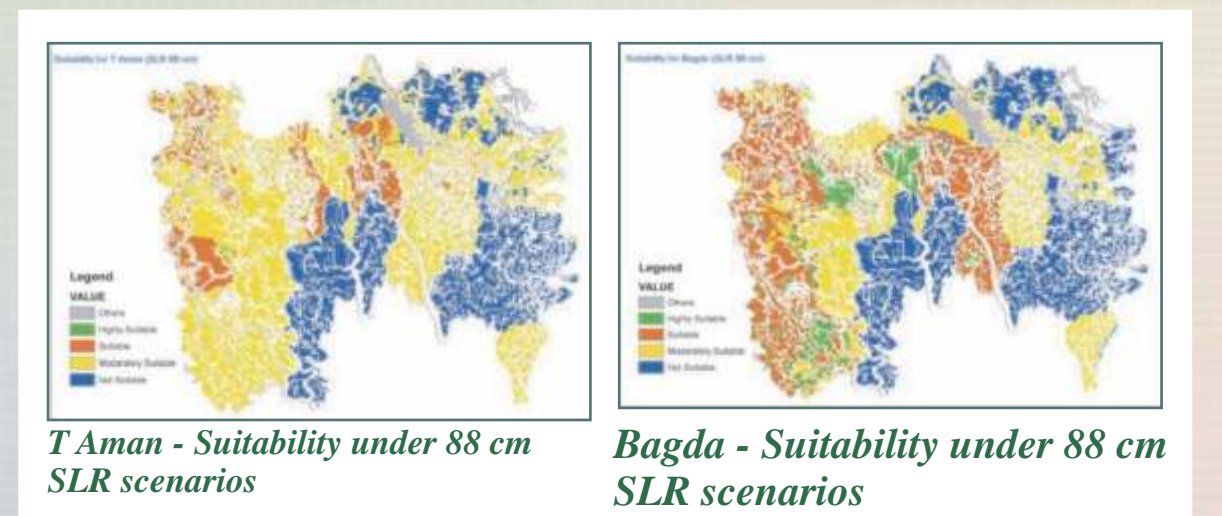
CLIMATE CHANGE DATABASE

A Climate Change Database was developed for the Climate Change Cell, Department of Environment. Climate Change Database focus on original climate related data that is relevant for policy-makers, planners and researchers of different aspects of climate change such as impact, adaptation, risk management in Bangladesh. The Database has became part of Climate Change web portal. This initiative was funded by UNDP.
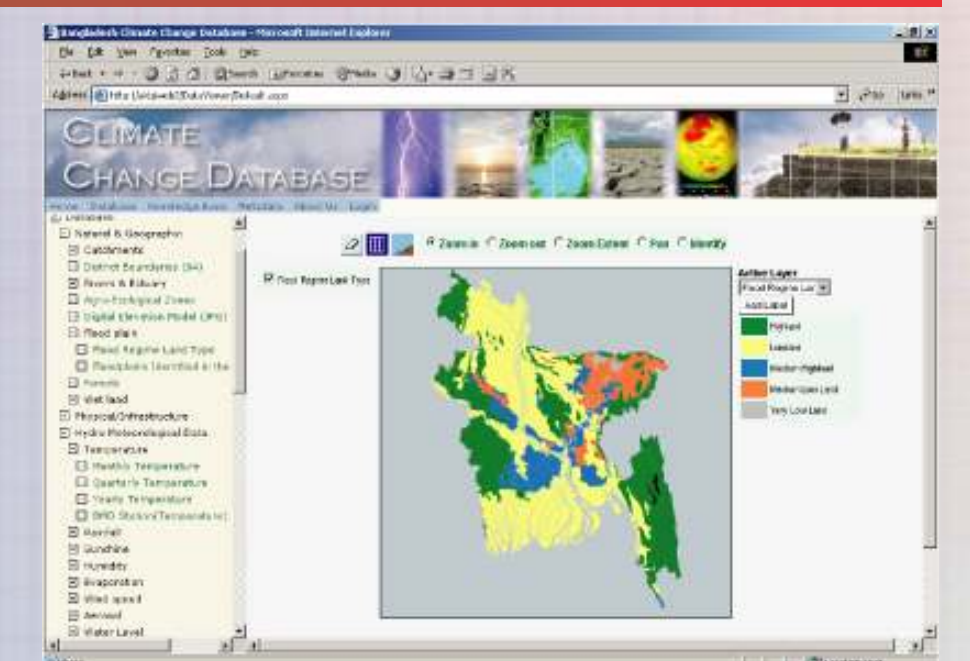
ADAPTIVE CROP AGRICULTURE INCLUDING INNOVATIVE FARMING PRACTICES IN THE COASTAL ZONE OF BANGLADESH

CEGIS has conducted a study on "Adaptive Crop Agriculture Including Innovative Farming Practices in the Coastal Zone of Bangladesh" in Satkhira District, a coastal area, in partnership with Bangladesh Rice Research Institute, Bangladesh Agriculture Research Institute, Bangladesh Agriculture Research Council and Bangladesh Unnayan Parishad with a aim 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 developed CROPSUIT model was used to estimate the physical suitability of land for different types of land uses or crop cultivation.

From the predicted yield of different crops with different climate change scenarios it was evident that in case of rice under GFDL50 and GFDL70 irrigated scenarios 3.98% and 7.84% yield increase for *Boro* rice respectively were noted. For *T.Aman* rice yield reductions of 11.30% and 2.68% were predicted under GFDL50 and GFDL70 irrigated scenario respectively.


IET rice variety planted in the high salinity area

Experimental field of selected rice variety planted in high salinity area

SECONDARY IMPACTS OF CLIMATE CHANGE IN BANGLADESH

DFID Bangladesh conducted a study "ORCHID (Opportunities and Risks of Climate Change and Disasters): Piloting Climate Risk Screening" in 2006. Mr Ahmadul Hasan, Natural Resource Management Specialist of CEGIS contributes to this study as a principle researcher. The approach combines the related concerns of disaster risk reduction and adaptation to future climate change. The study findings:

- There will be 54% and 63% increase in monsoon flooding by 2050s with SRES A2 and SRES B1 scenarios respectively.
- About 18% of *Rabi* and 9% of *Kharif* crops are highly vulnerable to drought and this adverse effect will increase over time due to climate change.
- Due to SLR, inundated areas may increase up to 3% (2030s) and 6% (2050s).
- Cyclone High Risk Areas of 8900 sq km will increase by 35% and 40% in 2020s and 2050s respectively and storm surge height will also increase from 15% to 25% (2020s) and 32% (2050s) due to increases in temperature.
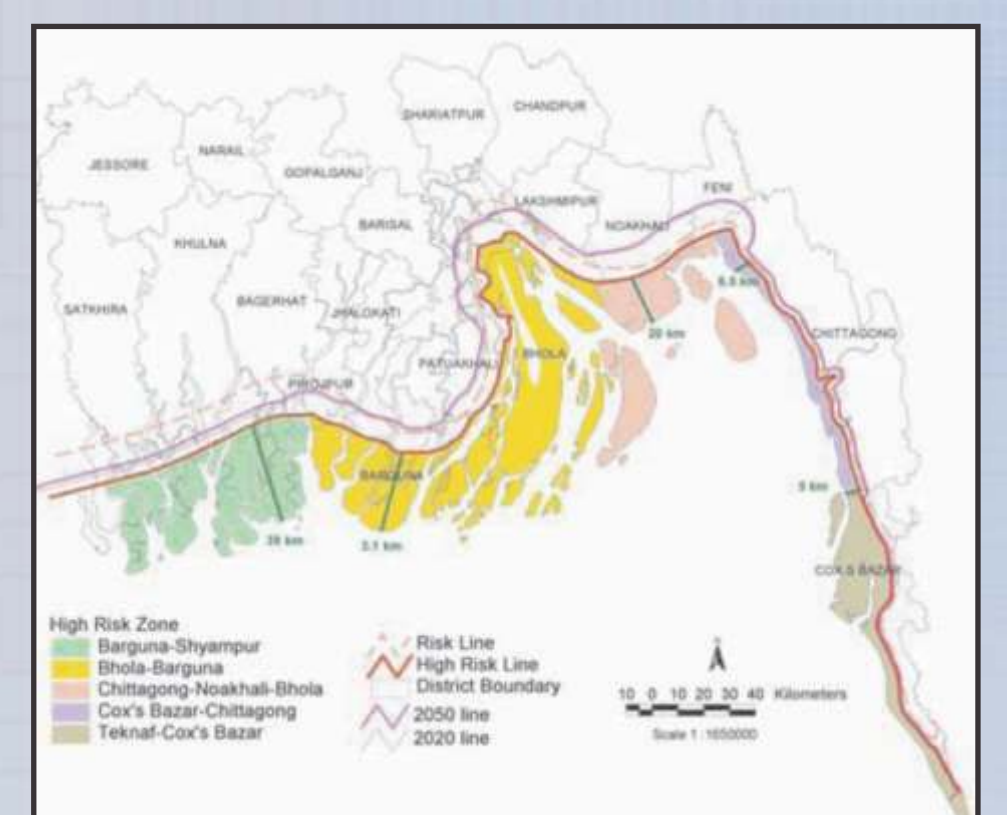
Increase in area and percentage of total area affected by flood
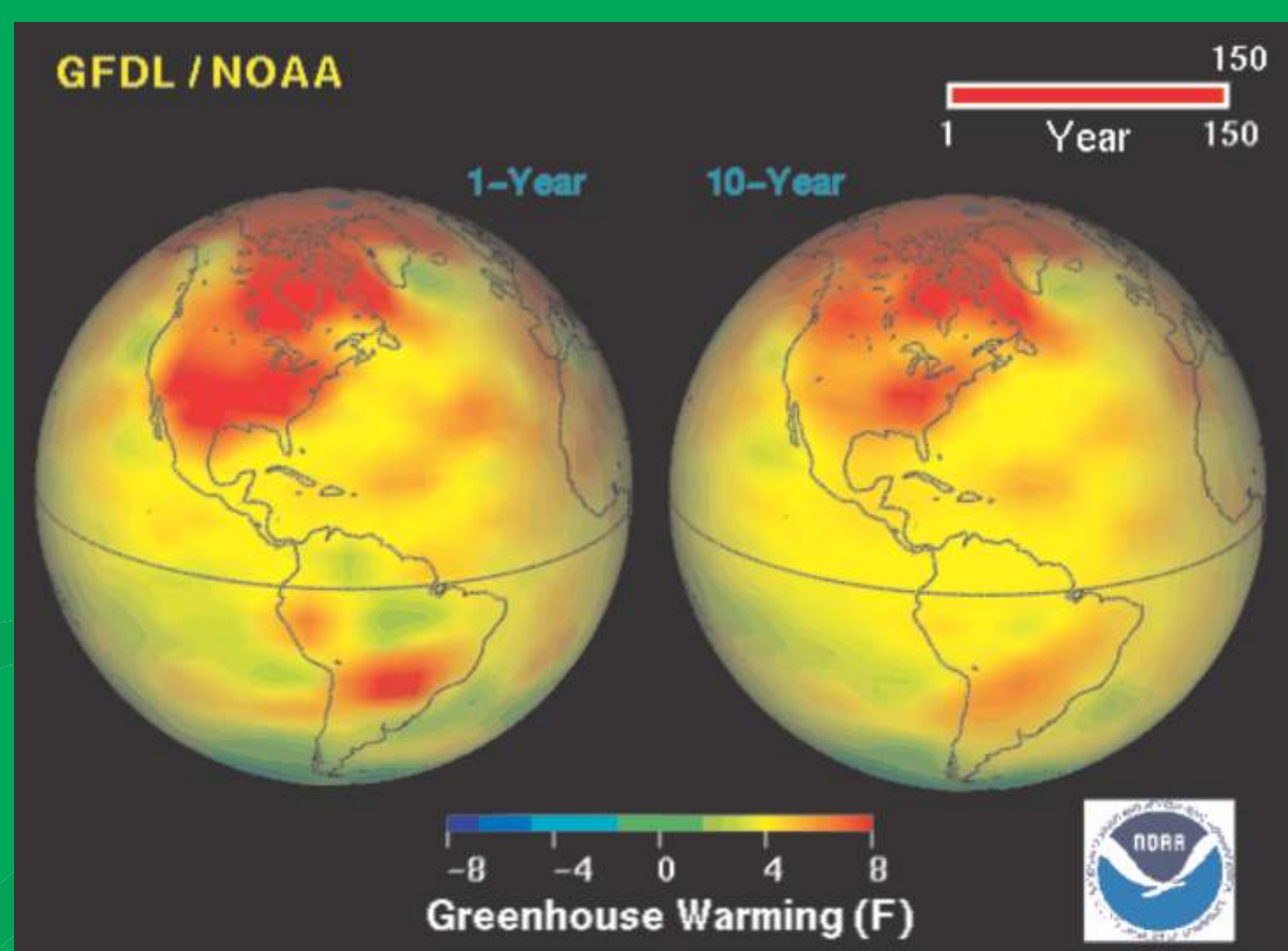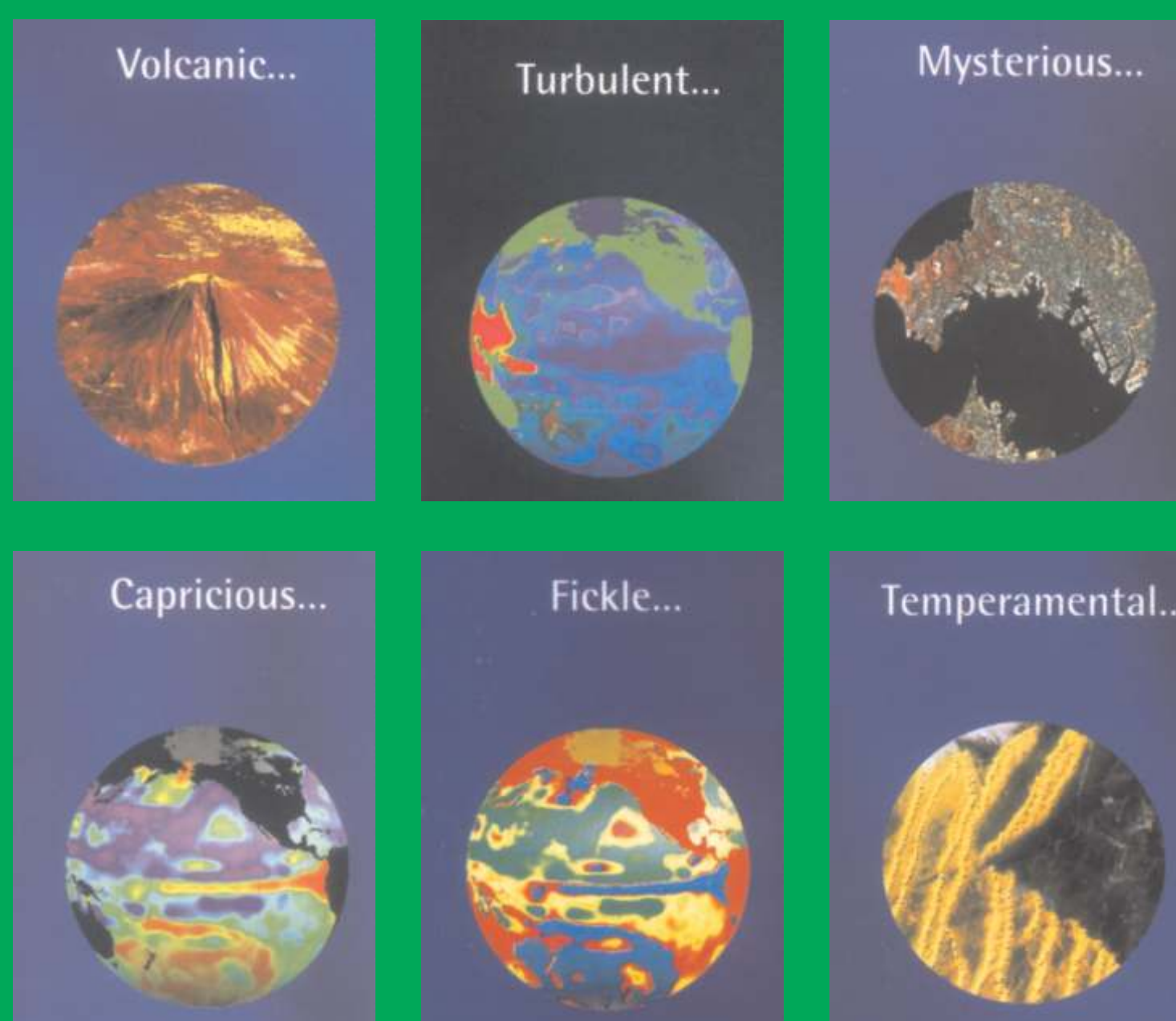
Research and Development

Research & Development is an integral part of the activities of CEGIS which expects to serve as a center of excellence in its fields of activity. In order to perform its activities in an effective manner, the capacity of the professionals at CEGIS needs to be enhanced in certain areas. In doing so CEGIS ensures that its professionals are among the foremost in their fields of expertise in terms of concepts, methods and technology.

Volcanic... Turbulent... Mysterious... Capricious... Fickle... Temperamental...

GFDL / NOAA   1-Year   10-Year

Greenhouse Warming (F)   -8 -4 0 4 8