

# EFFECT OF CLIMATE CHANGE ON AGRO-ECOSYSTEM AND RICE PRODUCTION IN COASTAL REGION OF BANGLADESH



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# Bangladesh: country profile

Population	152 million
Population density	1098 per km <sup>2</sup>
Total area	14.845 million hectare
Cultivable land	52%
Cropping intensity	181%
Contribution of agriculture sector to GDP	20.60%
Manpower in agriculture	62%

**It is the largest delta in the world, formed by the Ganges, the Brahmaputra, and the Meghna river system**



**South Asia**

# Bangladesh agriculture

*Rice is the main crop covers 70% land and grows year round*

## Cropping seasons

- ❖ Rabi: 16 October to 15 March (**Boro-rice**, wheat, potato, corn and winter vegetables)
- ❖ Kharif-1: 16 March to 15 July (**Aus-rice**, pulses, oilseeds, summer vegetables)
- ❖ Kharif-2: 16 July to 15 October (**Aman-rice**, jute, summer vegetables)

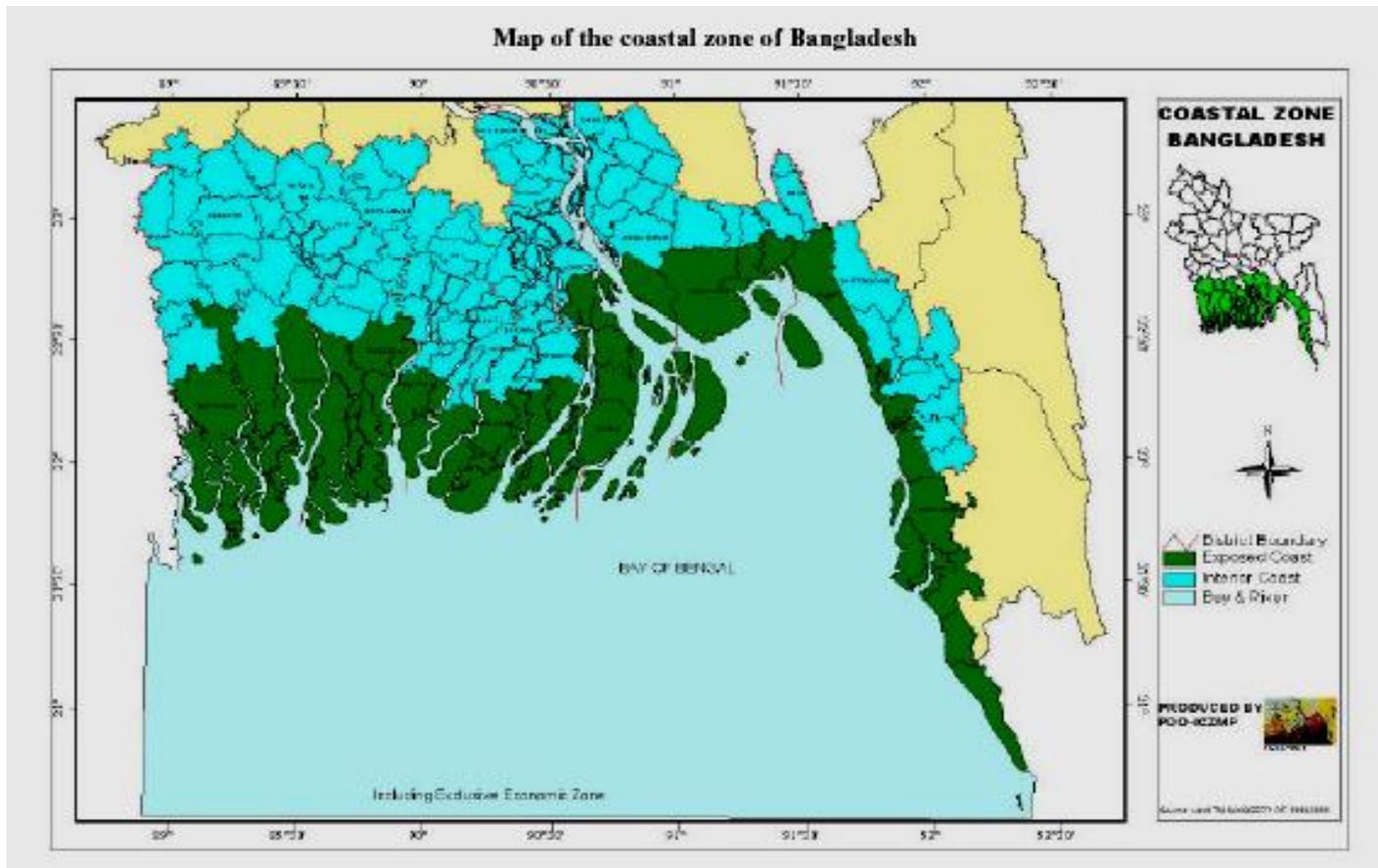
# Coastal Region of Bangladesh

- One fifth of the landmass and one seventh of the total population .
- Cover over 30% of the total cultivable lands.
- Various natural hazards causing damages of lives, properties as well as economy in recent years.
- Climate change affecting the crop production and productivity.
- The soils are poor in organic matter content (<1% to 1.5%).
- In saline affected highlands, local transplanted *aman* rice (July-November) is the dominant crop.

***Most vulnerable area to climate change***

# Objectives

Identify the adverse impacts of climate change on the agro-ecosystem and rice productivity in the coastal region of Bangladesh.



### **Technological factors**

- Modern variety
- Agronomic management
- Soil management
- Crop protection
- Others



### **Non-technological factors**

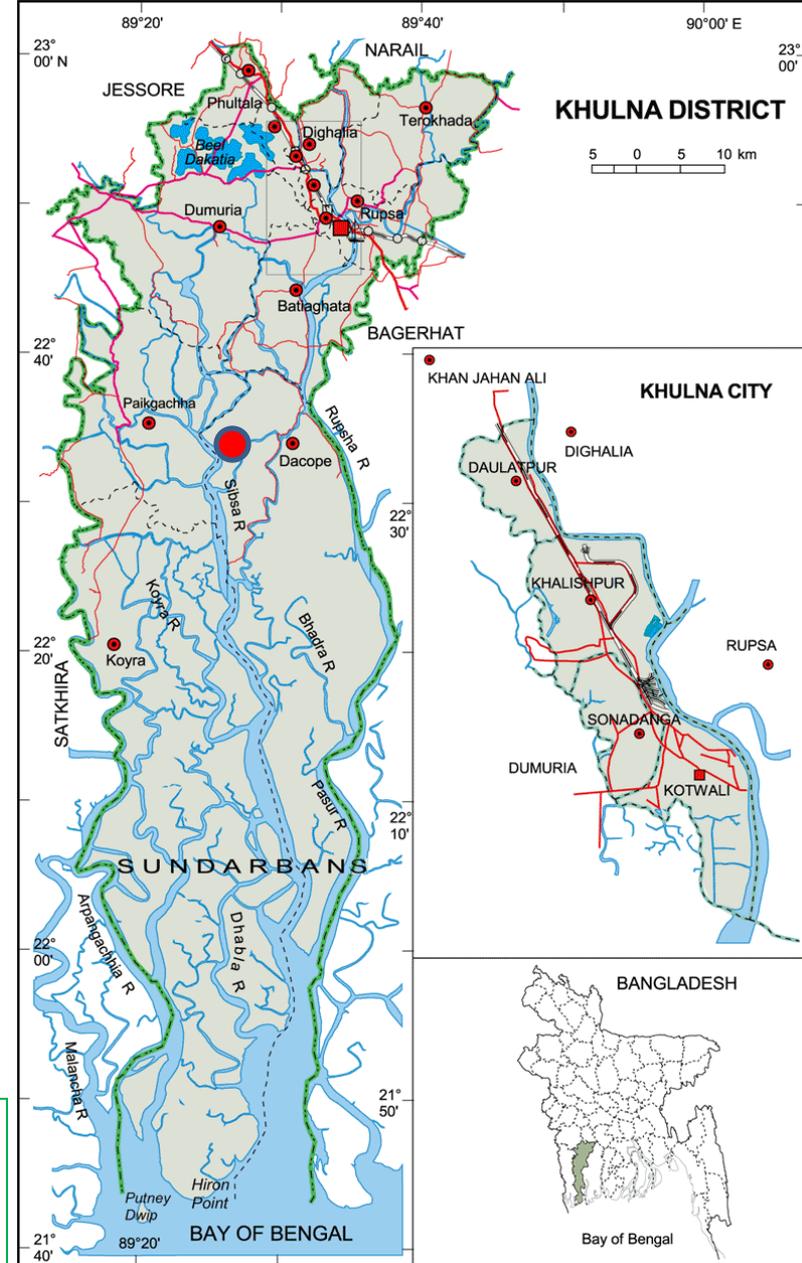
- Weather parameters
- Climate variability and change
- Others



**Crop  
Productivity**

# Study Area and Climate

- Temperature: Maximum – 35.1; Minimum - 12.1 °C.
- Annual rainfall - 1955 mm.
- Most rains occur during the monsoon (June–September) and little in winter (November–February).
- This region is subject to devastating cyclones, originating over the Bay of Bengal.



## Dataset

- **Climate:** 1960 to 2009.
- **Crop yield:** 1996-1997 to 2008-2009
- **Salinity:** 1990-2009

Study area

## DTR and SPI

- DTR: difference between the mean monthly maximum and minimum temperatures ( $T_{\max} - T_{\min}$ ).
- SPI:  $(X_i - X) / \sigma$ , SPI,  $X_i$ ,  $X$  and  $\sigma$  are standardized precipitation index;  $i^{\text{th}}$  year precipitation, long term mean of precipitation and standard deviation of mean, respectively.

## Rice Productivity Index (RPI)

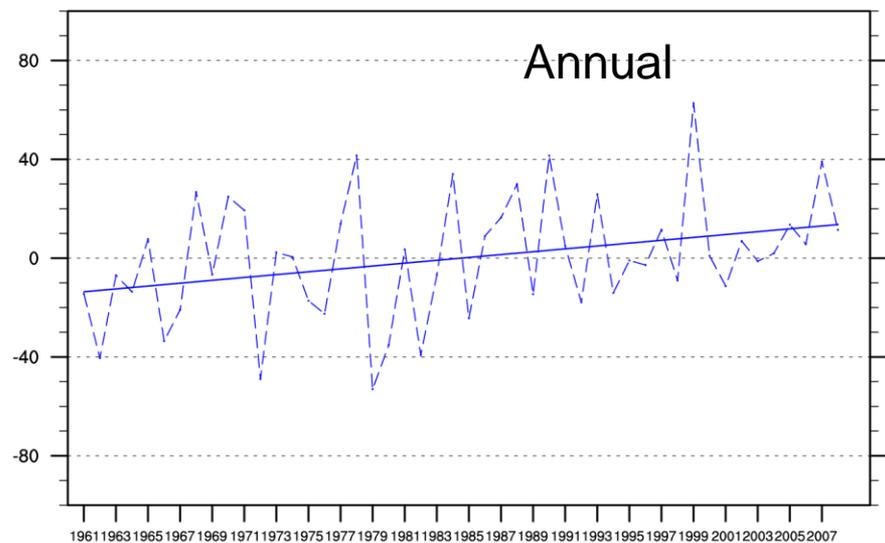
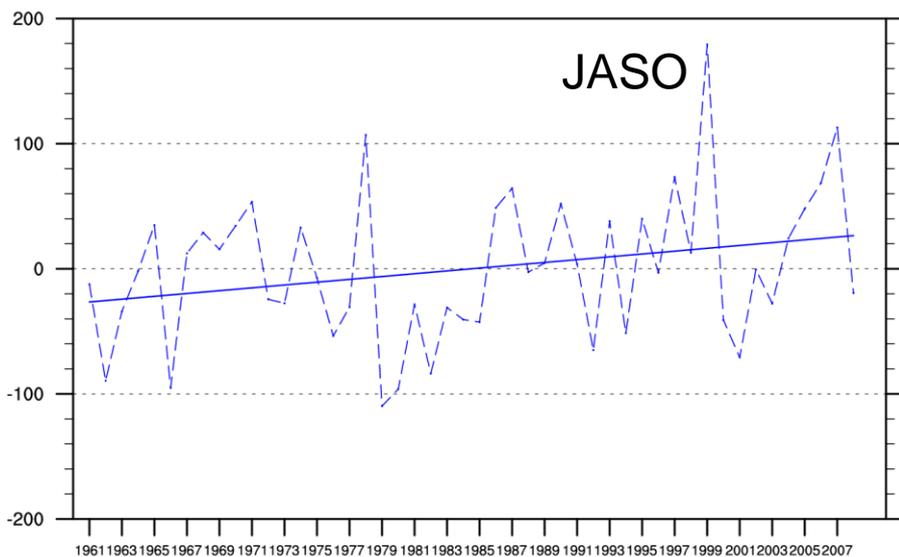
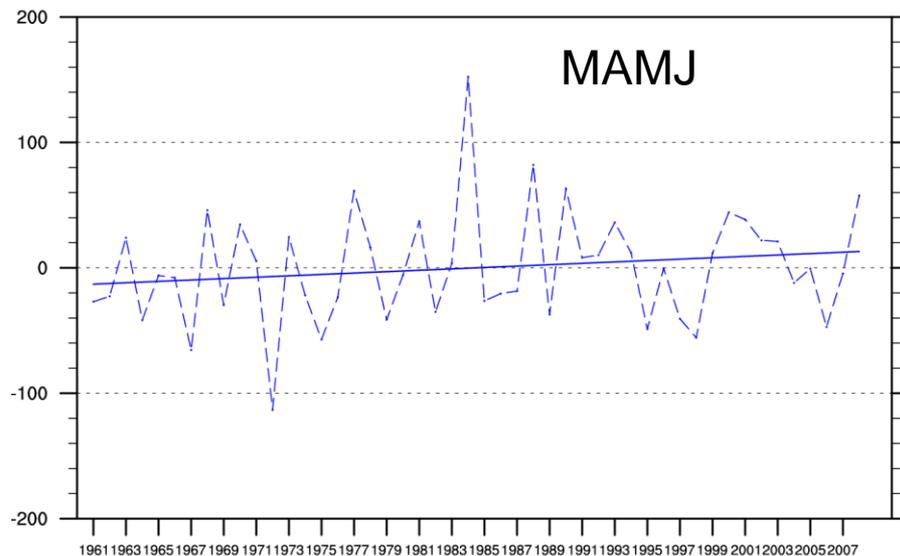
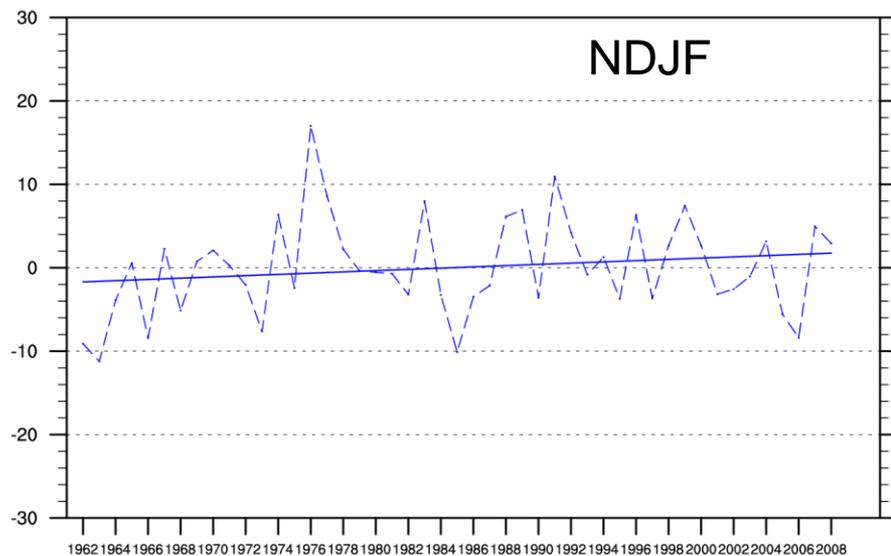
- The rice productivity index (RPI) was taken as the percentage of the technological trend productivity to the actual productivity. The normalized RPI for the  $i$ th year is

$$RPI_i = \frac{(P_i - TPI_i)}{TPI_i} 100$$

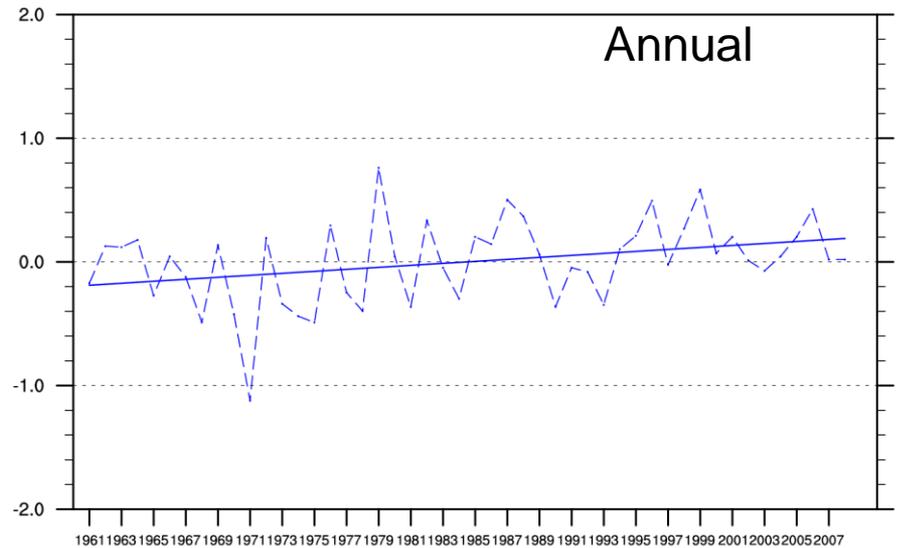
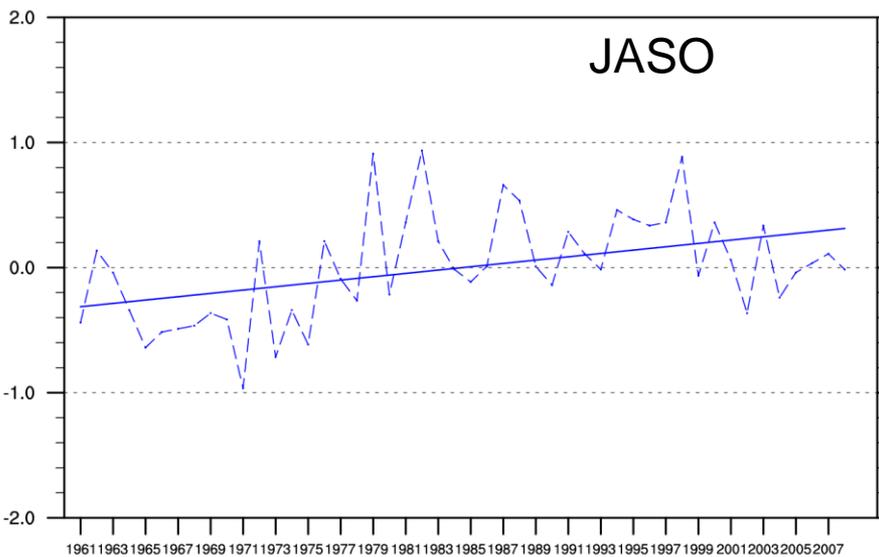
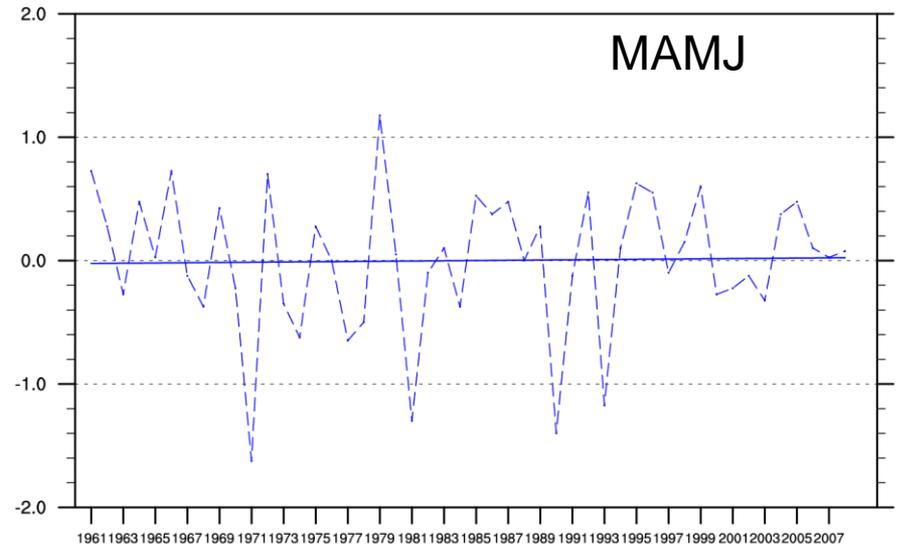
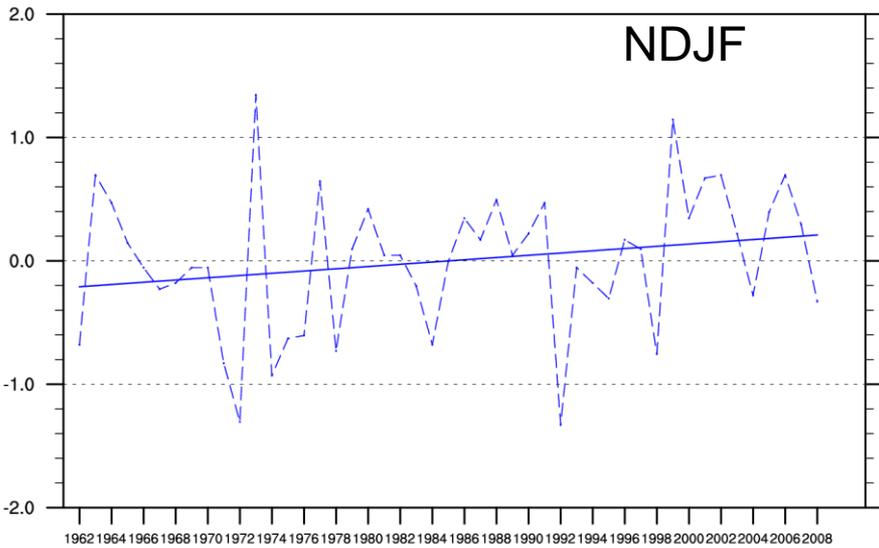
where  $RPI_i$  is crop productivity index of rice for the  $i$ th year,  $P_i$  is the actual productivity for the  $i$ th year and  $TPI_i$  is the technological trend productivity for the  $i$ th year.

# Findings

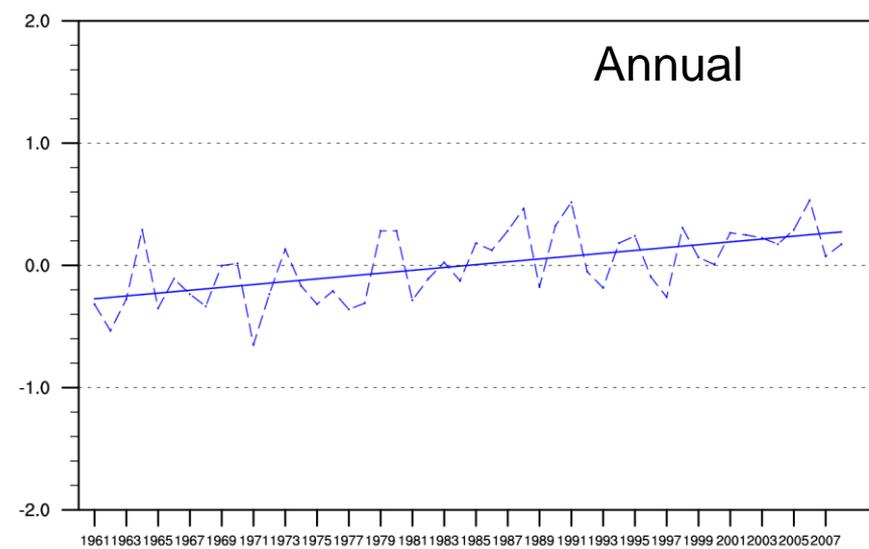
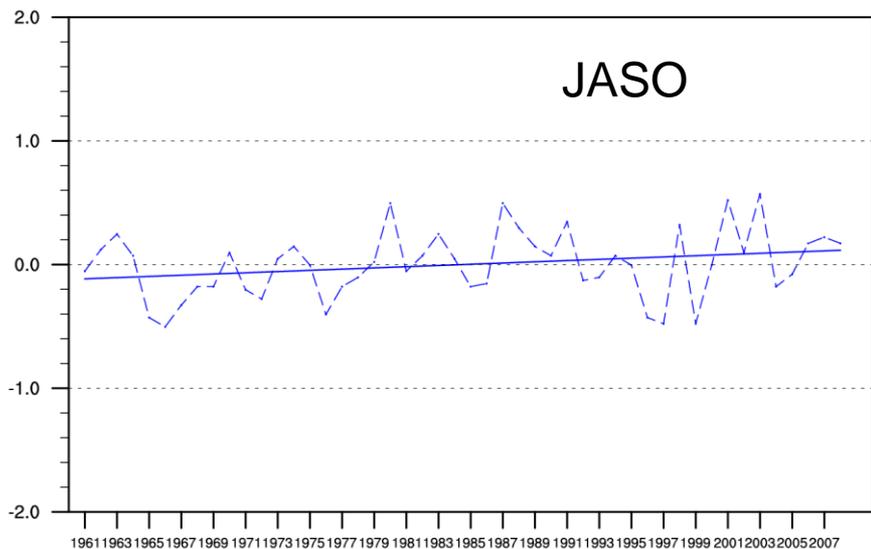
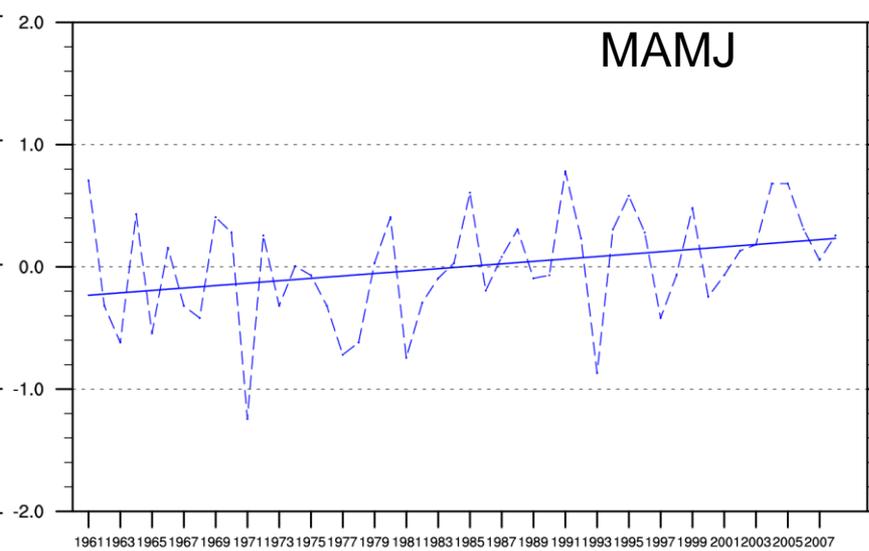
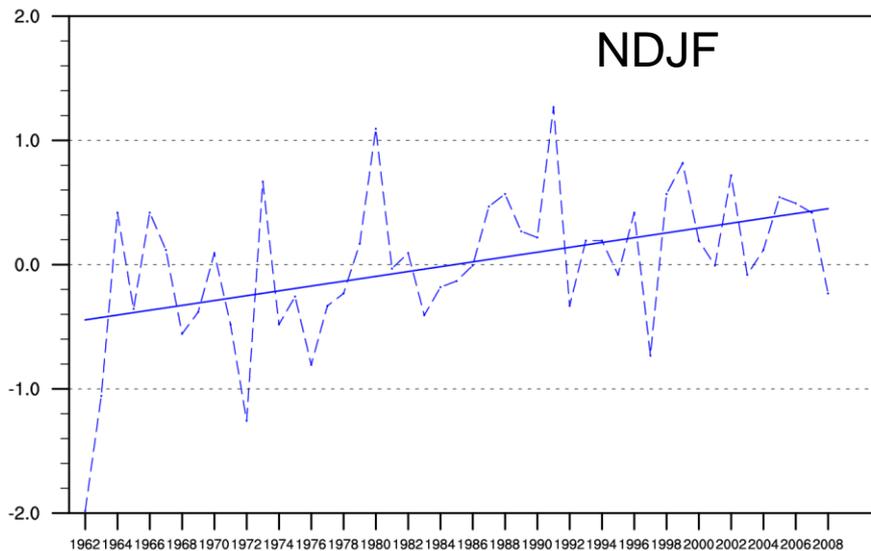
## Trend of Precipitation Anomalies (1960-2009)



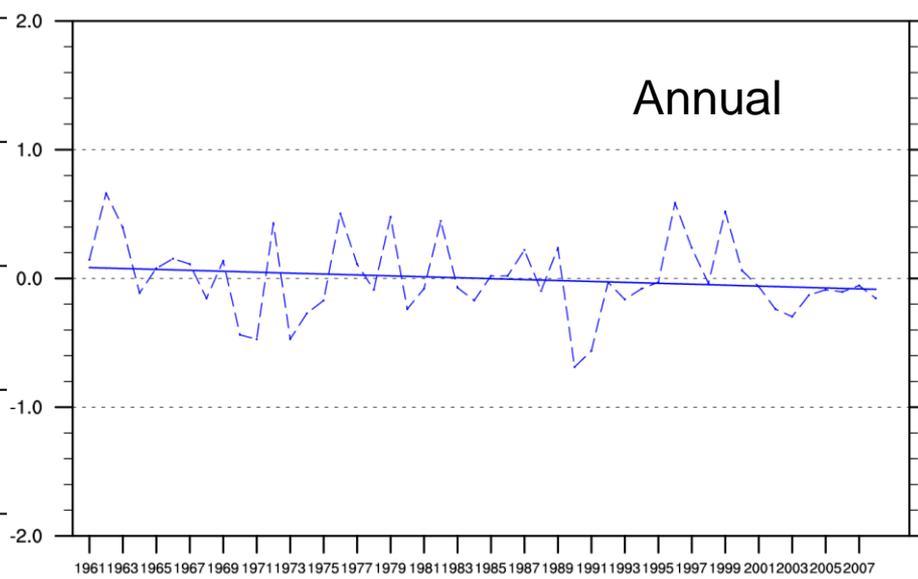
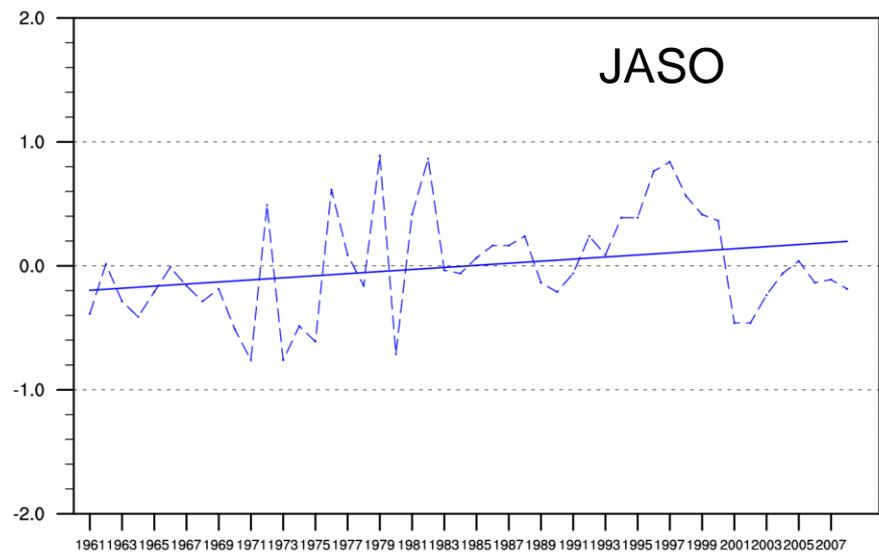
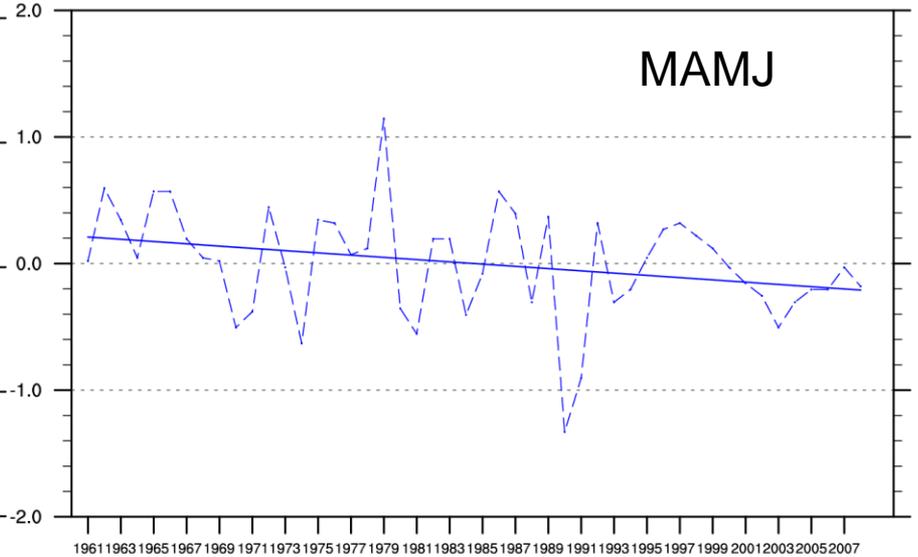
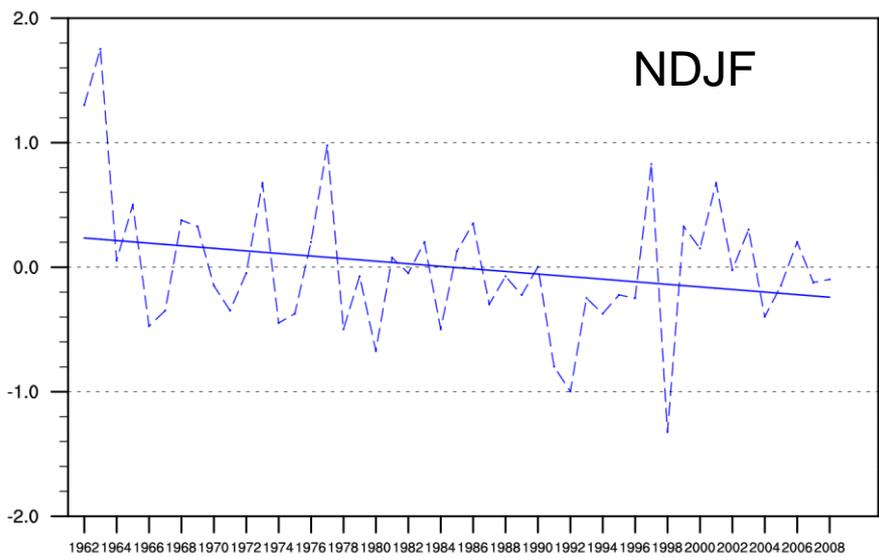
# Trend of Maximum Temperature Anomalies (1960-2009)



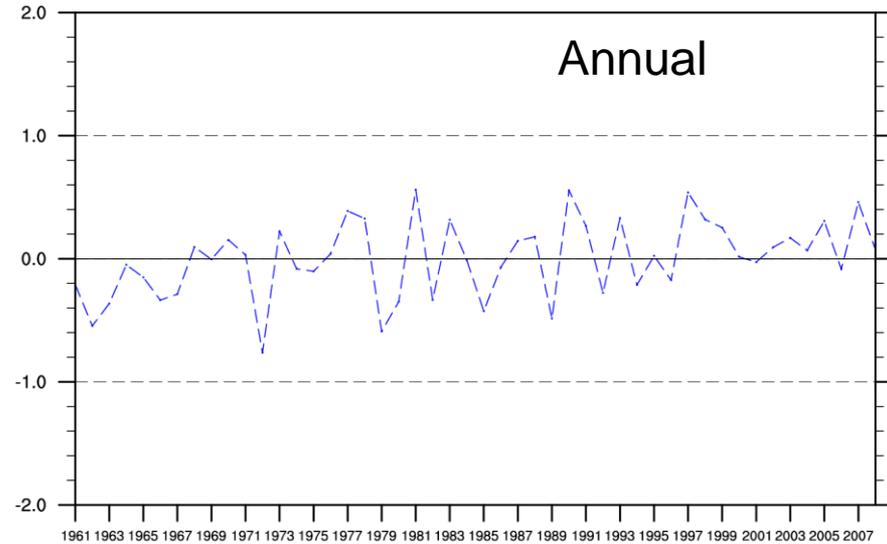
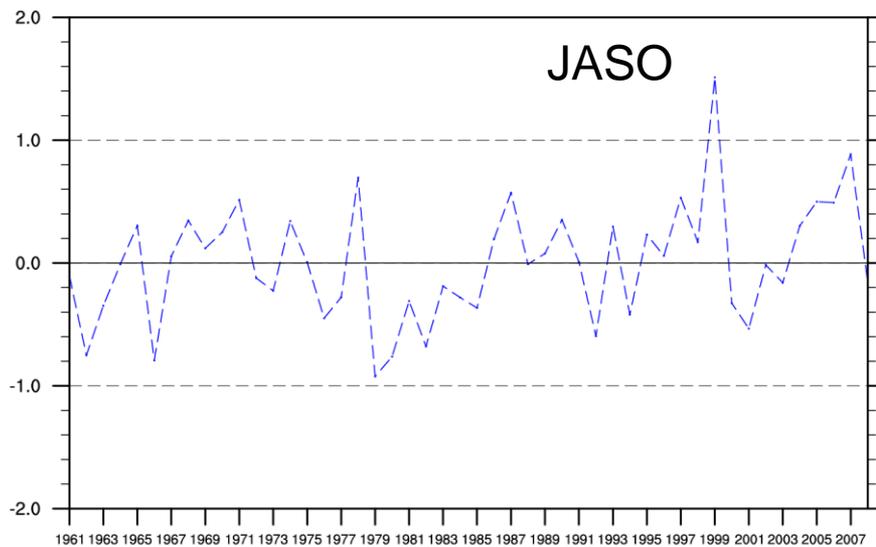
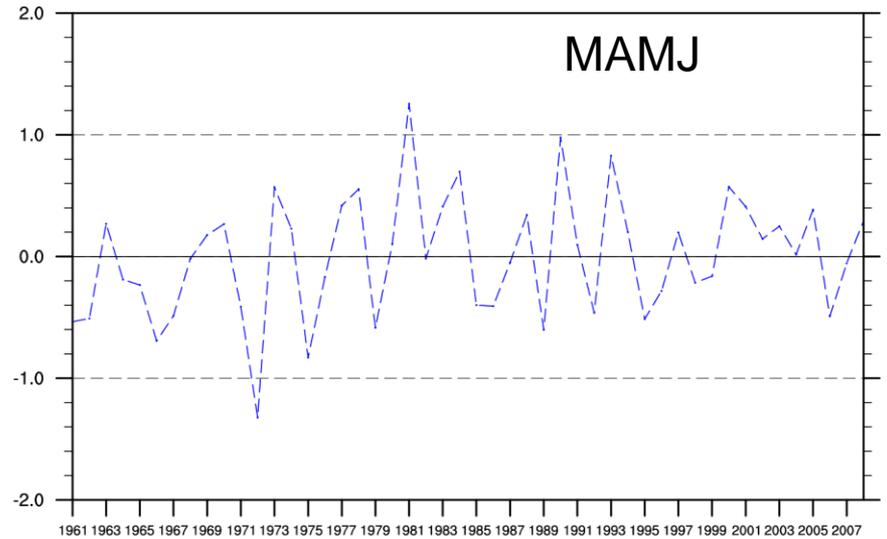
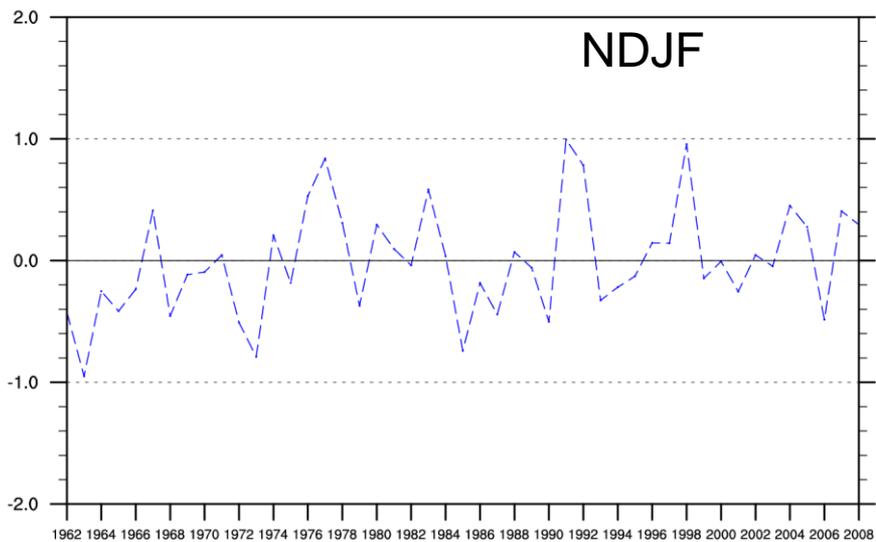
# Trend of Minimum Temperature Anomalies (1960-2009)



# Trend of DTR (1960-2009)



# Seasonal variation of dry and wet conditions corresponding SPI

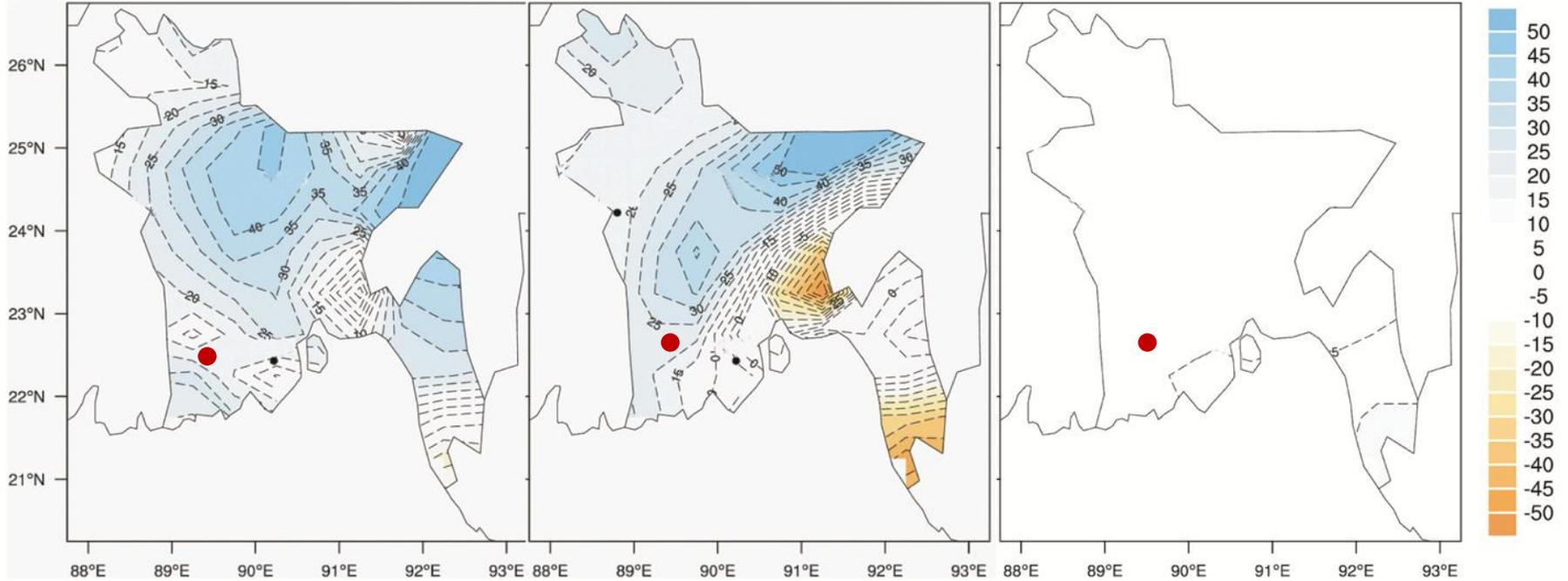


# Precipitation: (1960-1969)-(2000-2009)

March to June

July to October

November to February

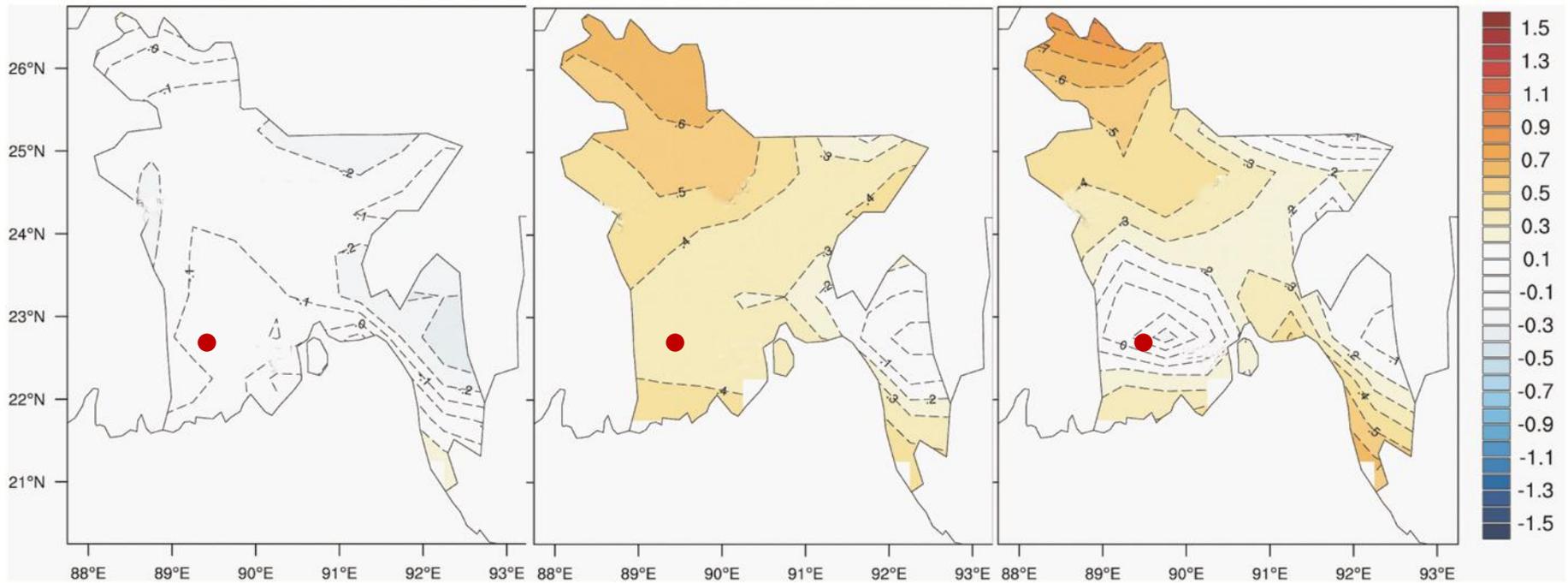


# Maximum Temperature Change: (1960-1969)-(2000-2009)

March to June

July to October

November to February

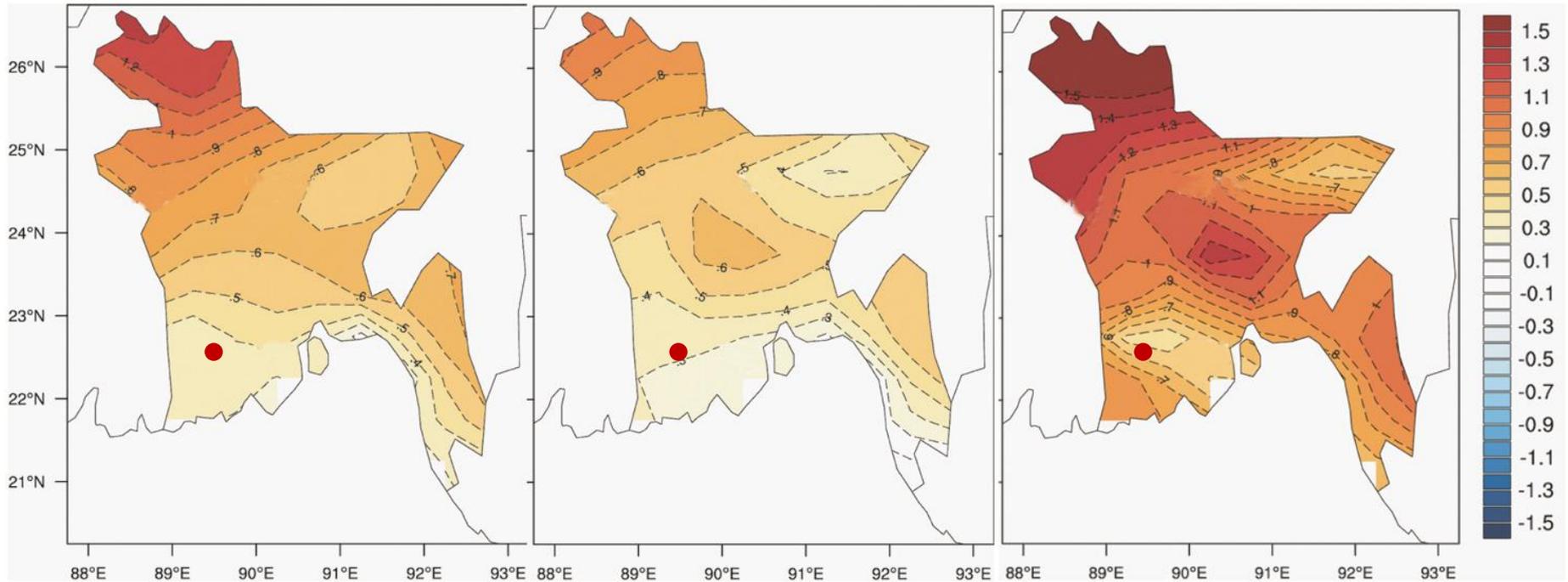


# Minimum Temperature Change: (1960-1969)-(2000-2009)

March to June

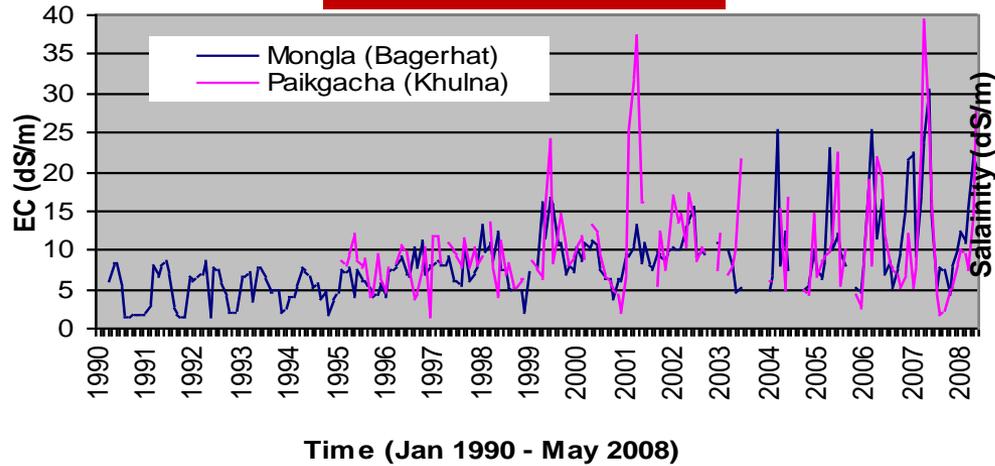
July to October

November to February

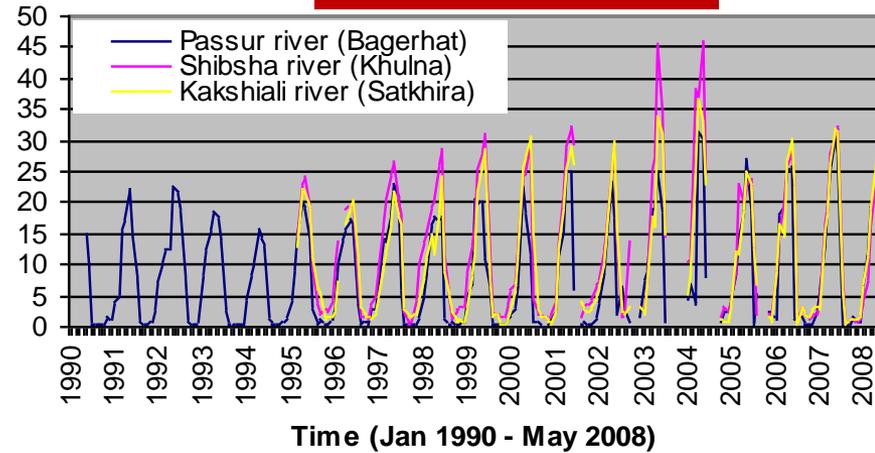


# Degradation of Agro-ecosystem

## Soil salinity



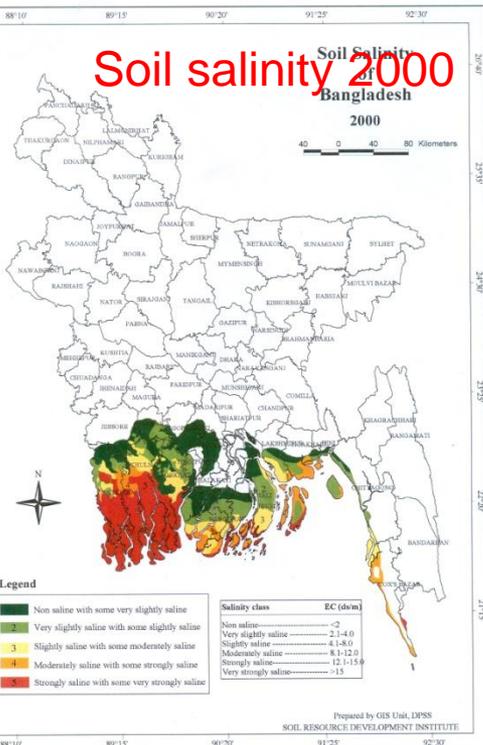
## Water salinity



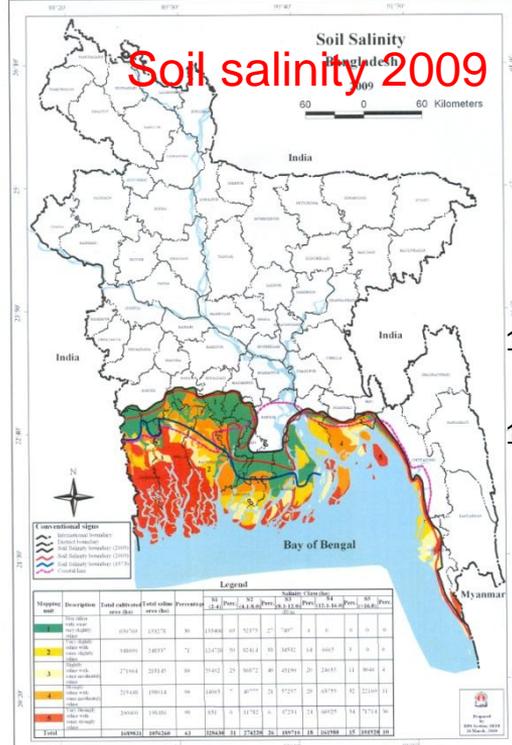
Time (Jan 1990 - May 2008)

Time (Jan 1990 - May 2008)

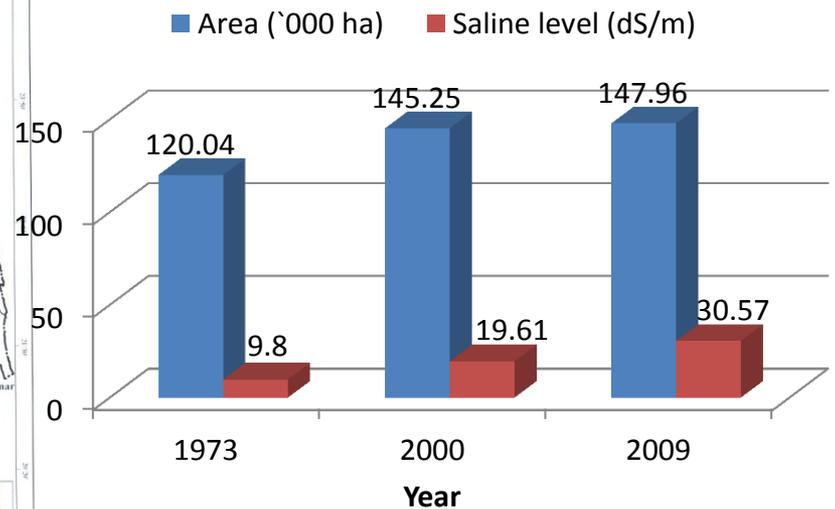
## Soil salinity 2000



## Soil salinity 2009

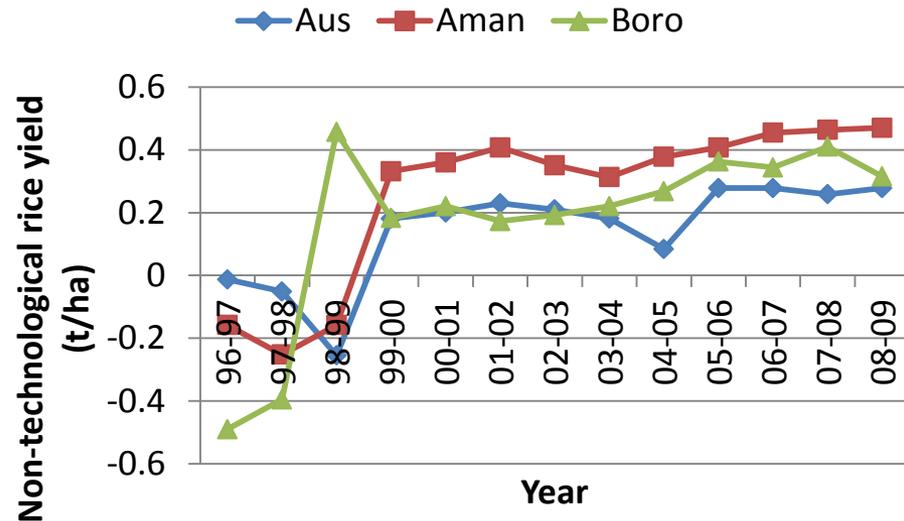
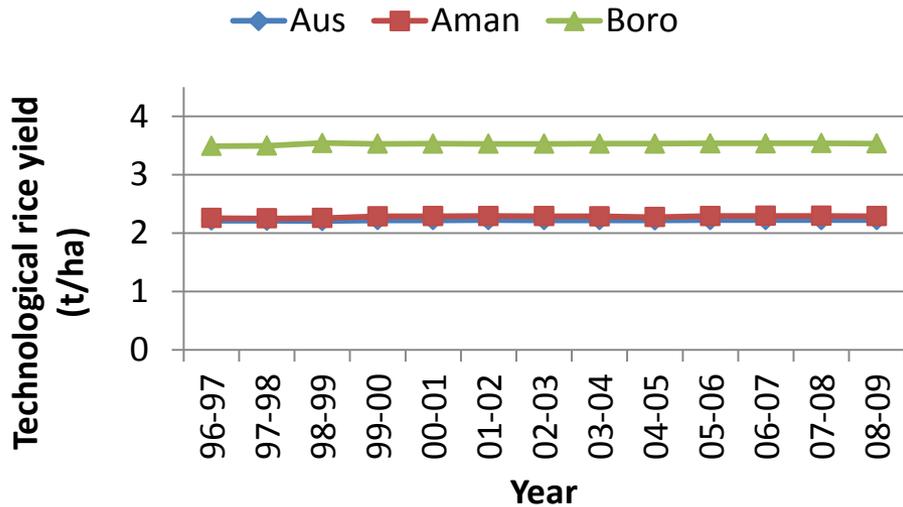
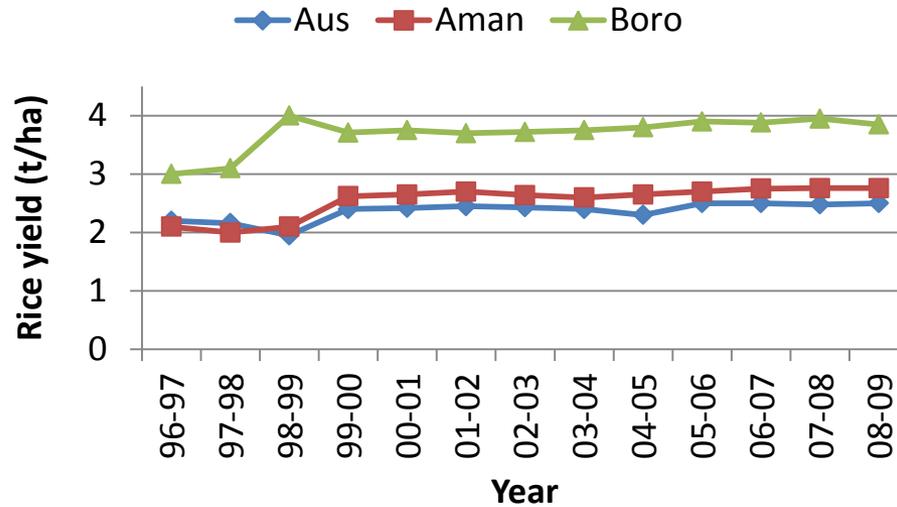


## Increasing trend of salinity in coastal region

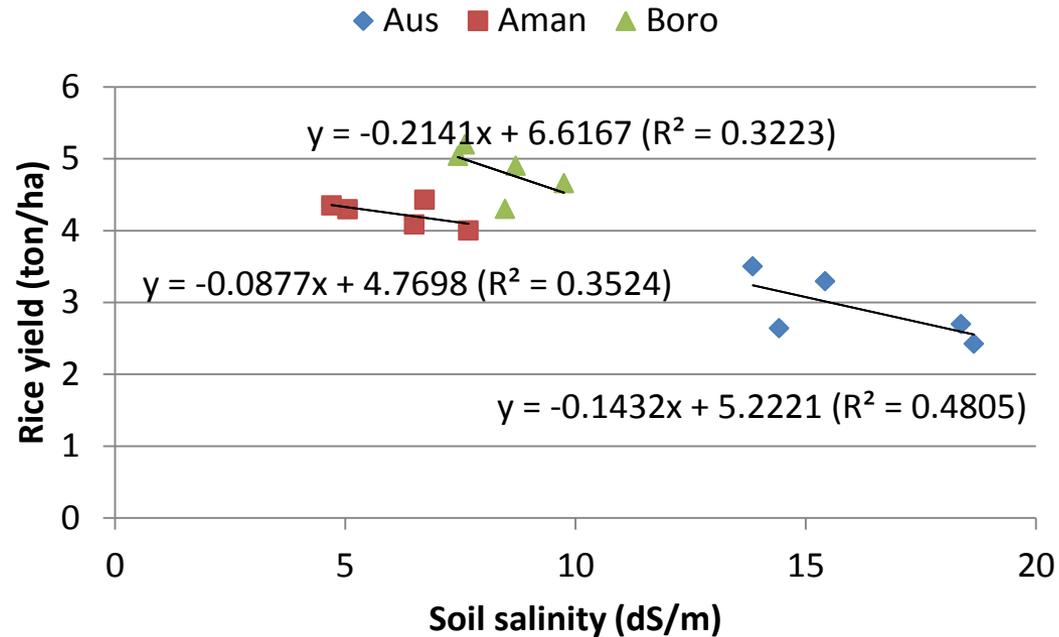


# Rice Productivity

## Technological VS Non-Technological variation of rice yield



# Rice yield VS soil salinity



# Rice productivity VS SPI and DTR

Season	Regression equation	R <sup>2</sup>	SE
Aus	$RPI = 27.630 + SPI_i(-8.532) + DTR_i(-54.512)$	0.19	4.697
Aman	$RPI = 21.178 + SPI_i(-20.172) + DTR_i(-34.498)$	0.34	4.643
Boro	$RPI = 13.603 + SPI_i(-10.803) + DTR_i(-7.139)$	0.04	4.66

## Conclusions

- Monsoon rainfall, maximum and minimum temperatures showed increasing trend. However, the increment rate was higher in case of minimum temperature than maximum.
- The SPI indicated frequent drought in recent years.
- Agro-ecosystem in coastal region has been degraded due to climate change along with sea level rise, high salinity, high intensity of cyclones and other natural hazards.
- The soil salinity level was increased by 23.3% over 4 decades.
- In recent years, rice productivity is not increasing over time as it was observed 5 years back.
- Negative relationships were found between rice yield and soil salinity and climate change.
- It indicates that non-technological factors such as climate change, increase in salinity and natural hazards play a vital role in rice production despite technological development.

# What is needed?

- **Warning system for the farmers to make decision**
- **Improve agro-ecosystem by green agriculture to combat climate change**
- **Appropriate soil and crop management techniques**
- **Saline tolerant and high value crop varieties**
- **Practice IPM**
- **Research and extension services to be enhanced**
- **National and international collaboration**

*Let us work together*





# Thank you

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