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# Climate Change and Agriculture

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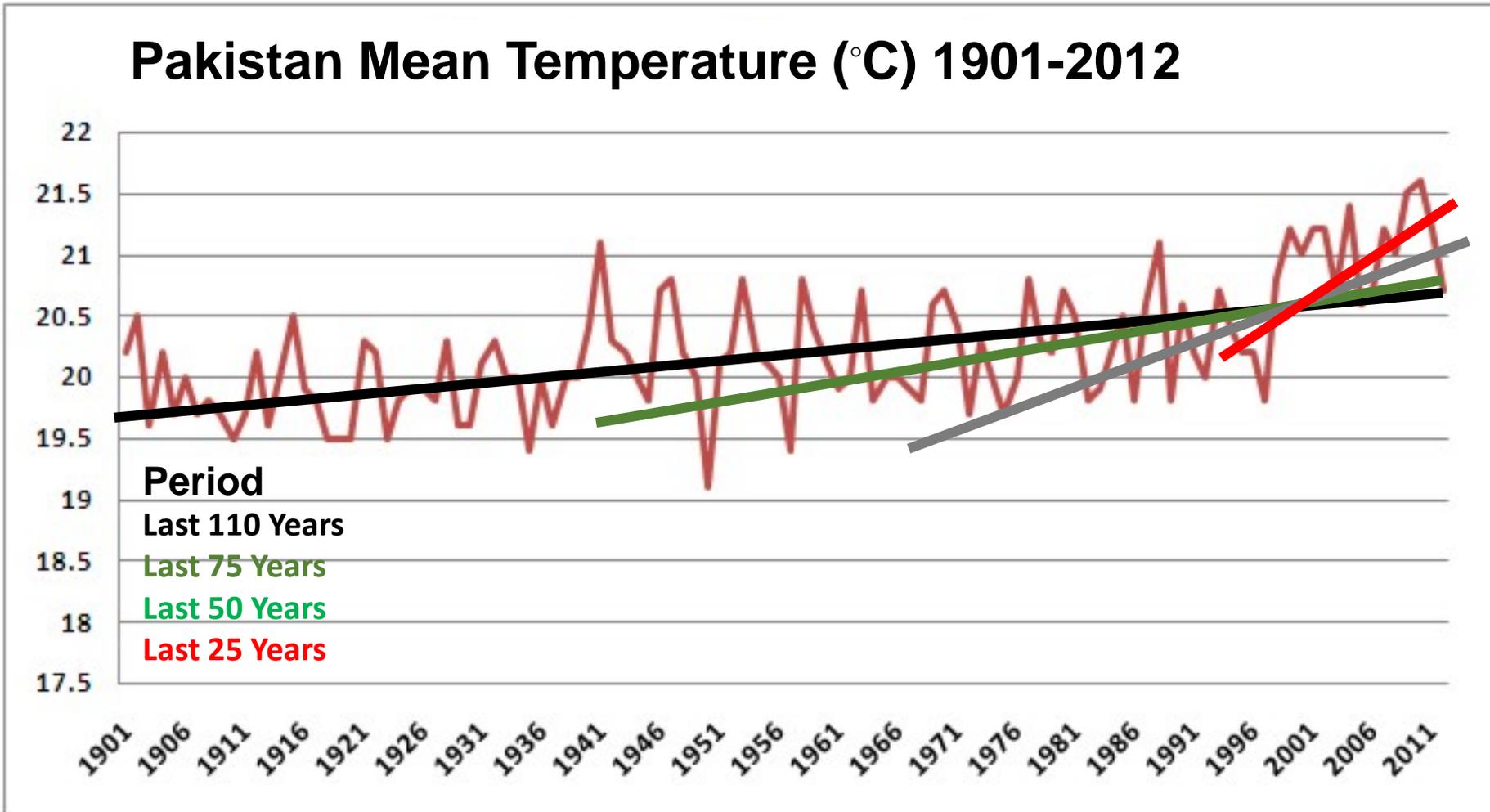
CAREC Institute

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# Sequence of Presentation

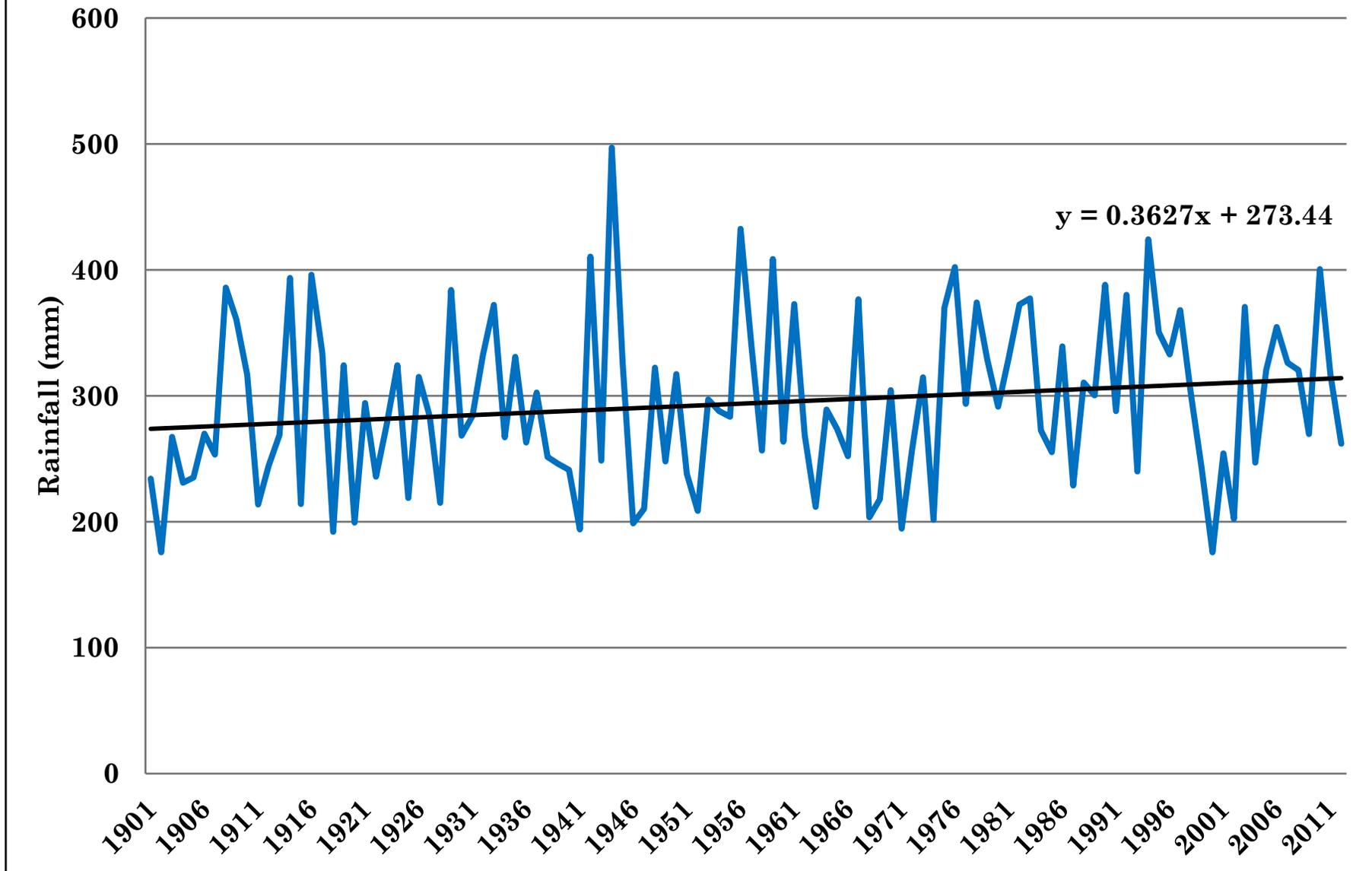
- Historical Overview of Climate Change in Pakistan
- Current trends of Climate Change in Pakistan
- Impact of Climate Change on Pakistan's Major Crops
- Responses
- CAREC and Climate Change



Source: Dr. Ghulam Rasul, Chief Meteorologist, Pakistan Meteorological Department



# Pakistan Mean Annual Rainfall (mm) 1901-2012



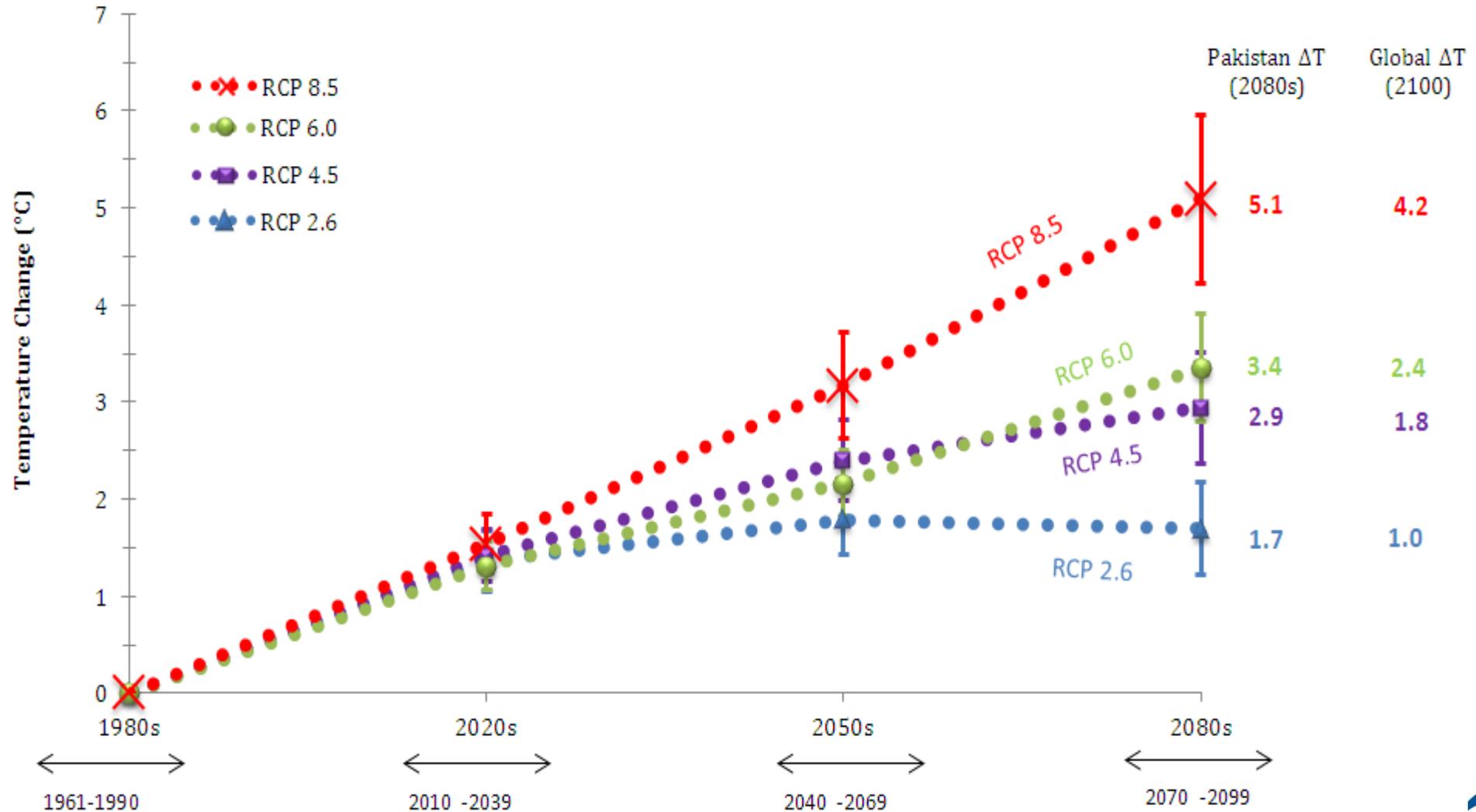
Source: Dr. Ghulam Rasul, Chief Meteorologist, Pakistan Meteorological Department



# Climate Projections for Pakistan

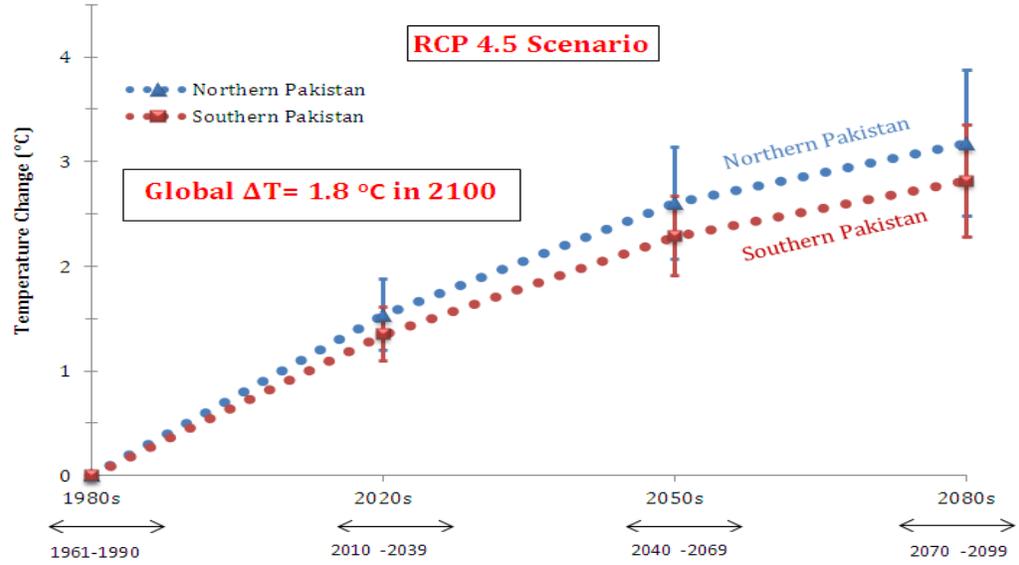
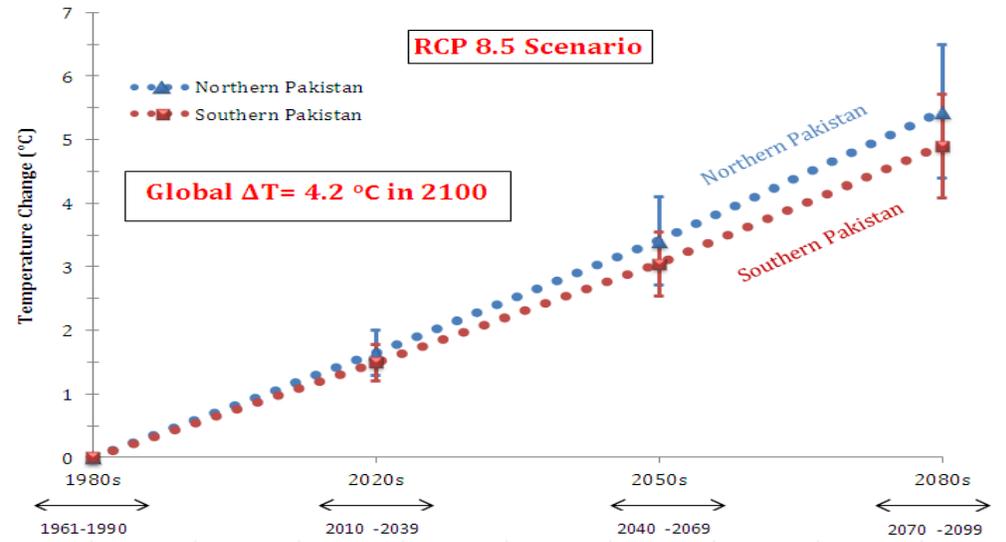
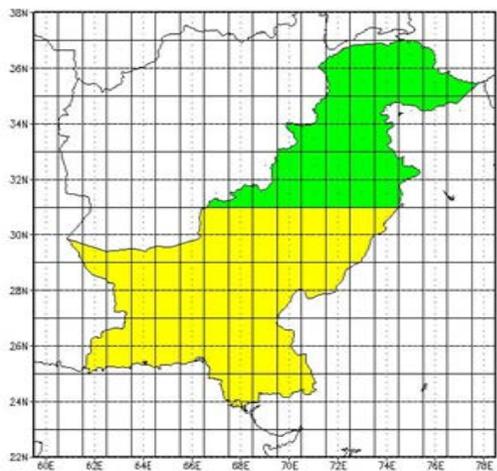
## Projected Changes in Average Temperature of Pakistan

(Corresponding to IPCC AR5 Scenarios: RCP 2.6, RCP 4.5, RCP 6.0 & RCP 8.5)



Source: Arif Goheer, Principal Scientific Officer, GCISC

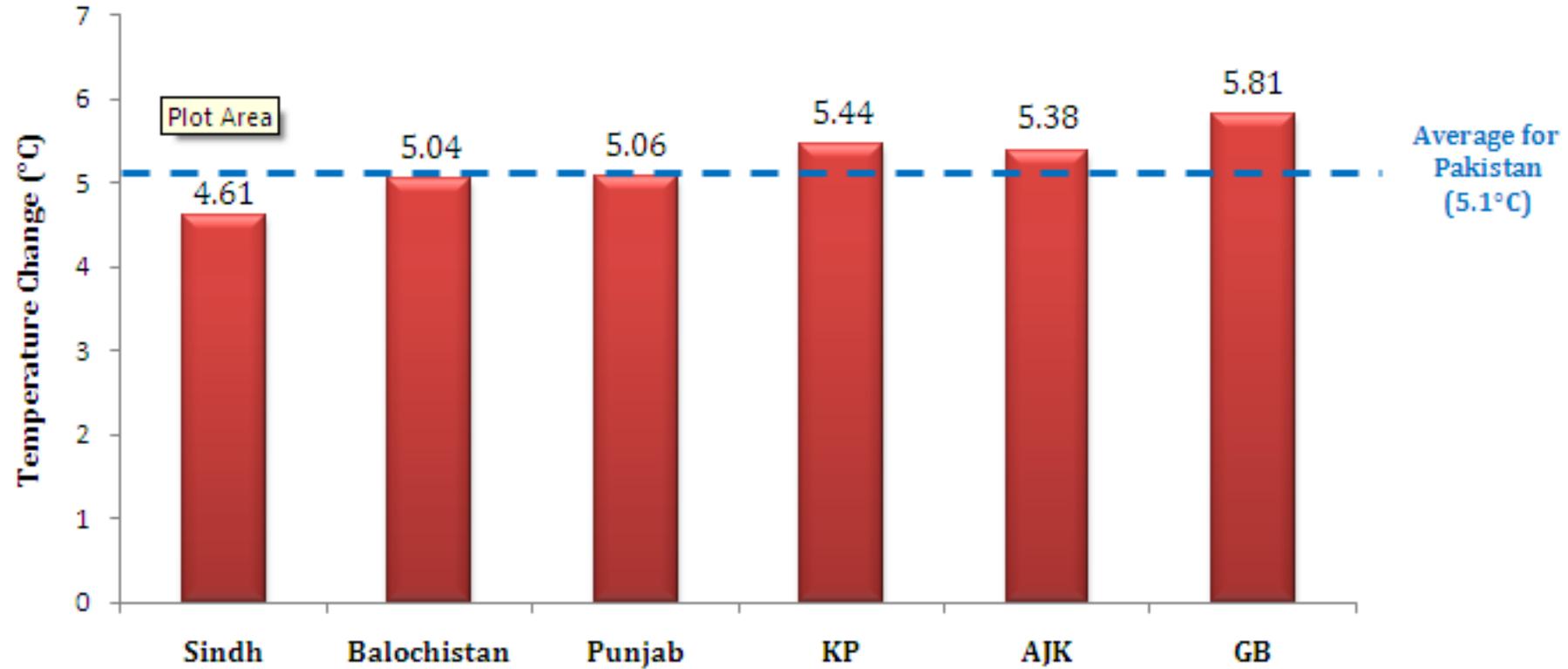
# Projected Changes in Average Temperature of Northern and Southern Pakistan



Source: Arif Goheer, Principal Scientific Officer, GCISC



**Projected Changes in Average Temperature of Provinces of Pakistan between 1990s and 2080s in RCP 8.5**



Source: Arif Goheer, Principal Scientific Officer, GCISC



# Past Climate Trends

- In 20<sup>th</sup> century, 0.6 °C average temperature increased over Pakistan
- The recent analysis performed at GCISC shows that mean annual temperature has increased over Pakistan with greater increase in Sindh and Baluchistan.
- The seasonal analysis shows that increase in temperature is higher in winter when compared with summer. Whereas, the month wise analysis shows that the maximum increase has been observed in December and February.
- Similarly, mean annual precipitation has increased over Pakistan except for AJK, where it has decreased. The increase is higher in summer as compared to winter with September and June showing the greatest increase.
- Increased frequency/ intensity of extreme events, increased monsoon variability
- Pakistan has consistently been ranked among top 10 countries most affected by climate change

# Agriculture – Pakistan's Perspective

- ❑ Contribution to GDP            18.5%
- ❑ Population                        220 million
- ❑ Workforce engaged            38.5 %
- ❑ Agricultural Systems           Irrigated, Rainfed
- ❑ Major Crops                    Wheat, Rice, Maize, Cotton, Sugarcane
- ❑ Cropping Seasons              Rabi (November – April)  
    Kharif (May – October)

# Impact of CC on Pakistan's major crops

- The objective of present study is to investigate the impact of climate (through changes in temperature and precipitation) on four major crops namely; Wheat, Rice, Cotton and Sugarcane in the Punjab Province of Pakistan.
- Estimations based on the time series data from 1980-2008, District wise
- This is the first study **incorporating scientific information** on the stages of development of each crop in order to assess the impact of climate change on each stage of the crops.

# Stages of production

- Wheat and rice production has been consists of three different stages of production and of three different optimal temperature and precipitations
- The optimal temperature of the cotton production remain the same therefore, scientifically it has not been divided into different production stages
- Similarly, the sugarcane production has been divided into four different production stages that of their optimal temperature and precipitations.

# Sugarcane: Optimal temperature and precipitation

- First stage: Optimum temperature for sowing : 20-32<sup>0</sup>C
- Optimum temperature for germination : 32-28<sup>0</sup>C
- Second stage: Maximum temperature decreasing tillering : 30<sup>0</sup>C
- Third stage: Optimum temperature for sugarcane : 28-38<sup>0</sup>C
- Fourth stage: Temperature for good sugar production : 10<sup>0</sup>C

# Impacts

- The simulations analysis carried out from 2008 to 2030. It covers almost one-generation period.
- The simulations results for wheat production in (000) tonnes shows that the when the temperature increases by 1C the cumulative loss up to 2030 would be 0.02 percent and if the temperature increases by 2C the cumulative loss up to 2030 would be 0.75 percent that of 2008.
- Moreover, the results for simulation analysis of rice production in (000) tonnes shows that when temperature increases by 1C the respective gain to rice productivity up to 2030 would be 1.85 percent and if the temperature increases by 2C the rice productivity gain would by 3.95 percent.
- The simulation results for cotton production (000) bales with increase of 1C and 2C shows that the loss to cumulative cotton production up to 2030 is 13.29 percent and 27.98 percent respectively.
- Finally, for the same increase of 1C and 2C the sugarcane (000) bales, cumulative loss up to 2030 are 13.56 percent and 40.09 percent respectively.

# Responses

- Crop Management;

- Changing in sowing window
- Changing in planting techniques

- Genetic Improvement;

- Increased seed tolerance to high temperature, drought and heat stress

- Improving Water Use Efficiency

- - Increase water productivity

# CAREC and Climate Change

- Climate change projections indicate, the climate change will further aggravate the economies and livelihoods of local population.
- High economic costs are unavoidable for every country if adaptation measures are not implemented in the CAREC region.
- Financing of the adaptation and mitigation is an important aspect of determining speed and spatial coverage of climate adaptation interventions.
- **Setting up stronger regional climate change cooperation for CAREC region (RCCC)**
- **Regional cooperation and joining of the resources most probably will reduce both costs and improve impact of climate efforts.**

Thanks



# Main reference

**For specification of the econometric models and other considerations consult our published paper.**

- The Impact of Climate Change on Major Agricultural Crops: Evidence from Punjab, Pakistan, The Pakistan Development Review, Vol 51:4, 261-276