

ASSESSING IMPACTS OF CLIMATE CHANGE ON CEREAL PRODUCTION AND FOOD SECURITY IN BANGLADESH

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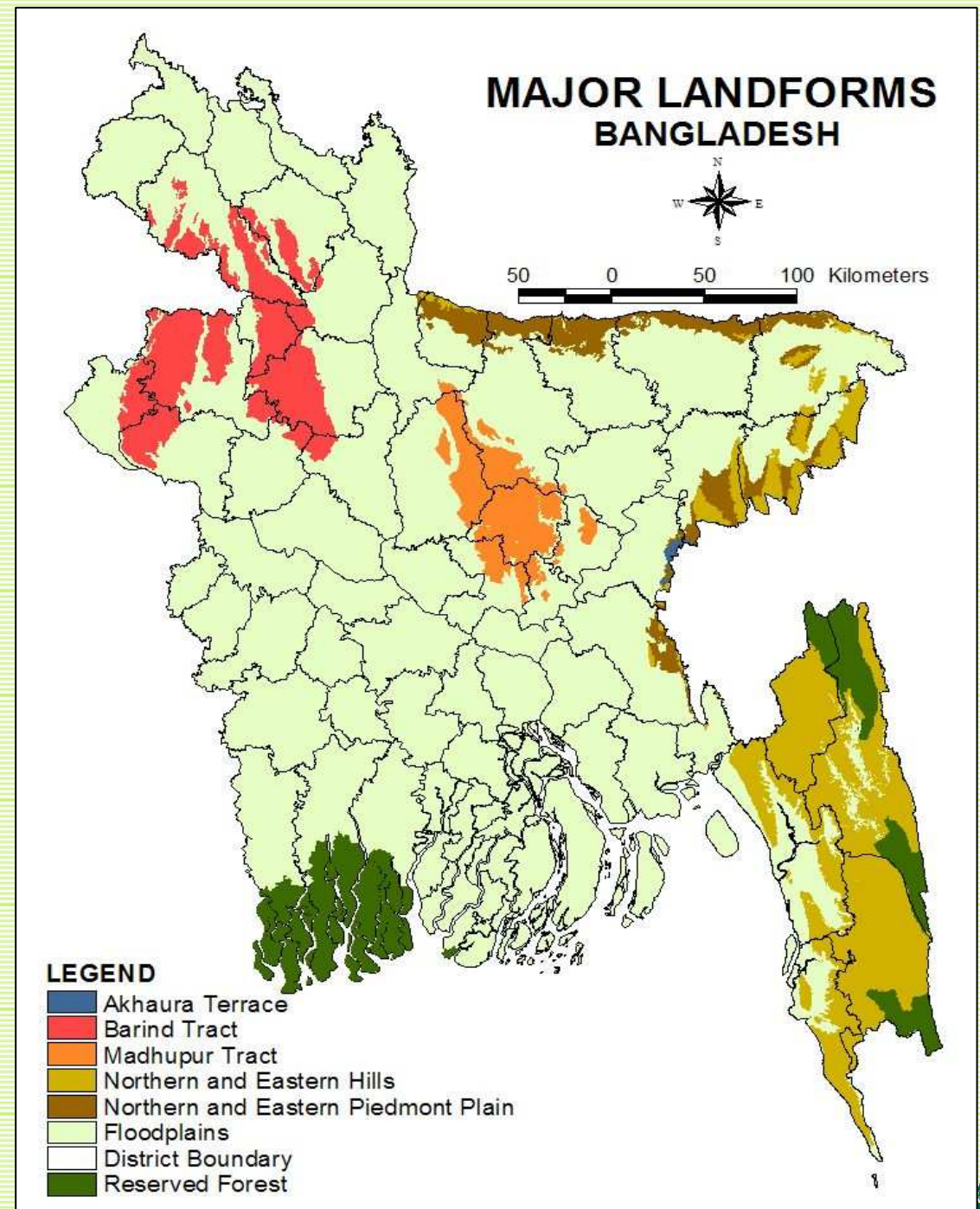


Introduction

- ❑ **As a consequence of future climate change agriculture is likely to be affected**
- ❑ **Estimated population of Bangladesh stands at over 143.4 million and is likely to double again in another 35 years**
- ❑ **To keep pace with population growth and shrinking land resource base the food production should be doubled by the year 2020**
- ❑ **Cereal production more than doubled in the last 25 years and the production gains were achieved mainly due to yield increases**



- ❑ Floodplains and piedmont plains occupy almost 80% of the land area
- ❑ Slightly uplifted fault blocks (terrace) occupy about 8%
- ❑ Hills occupy about 12% of the land



General Vulnerabilities of Crop Agriculture in Bangladesh

- ❑ The climate in Bangladesh is changing and it is becoming more unpredictable every year
- ❑ Uncertainty of rainfall and uneven temporal and spatial distribution
 - ❑ Flooding
 - ❑ longer dry spells → droughts
 - ❑ Cyclones
 - ❑ salinity intrusion → extra bearing on the agriculture and on the potable water
- ❑ Predictions are - more floods, untimely floods, more droughts, salinity intrusion, and more cyclones with higher intensities



IPCC Predictions

Temperature

- ❑ Global average surface temperature has increased
- ❑ By the year 2100 the globally averaged surface temperature is projected to increase by 1.4 to 5.8° C
- ❑ It is very likely that there will be fewer very cold days in South Asia. Warming greater than the global mean is projected for this region (3.3°C) [AR4 (2007)]
- ❑ Models show a median increase of 3.3°C in annual mean temperature by the end of the 21st century.
- ❑ The median warming varies seasonally from 2.7°C in JJA to 3.6°C in DJF, and is likely to increase northward in the area, particularly in winter, and from sea to land.



IPCC Predictions

Precipitation

- ❑ Increases in global mean rates of precipitation and evaporation
- ❑ Larger year-to-year variations in precipitation are very likely (90-99% chance)
- ❑ Over South Asia, the summer is dominated by the southwest monsoon, which spans the four months from June to September and dominates the seasonal cycles of the climatic parameters
- ❑ The precipitation will be like SON 15% DJF -5%.



Materials and Methods

- ❑ A simulation study was conducted to assess the climate change related vulnerability of foodgrain production in Bangladesh

- ❑ A Three high yield variety (HYV) rice crops, grown during three seasons:
 - ❑ Aus (March-August) cultivar-*BR3*
 - ❑ Aman (July-November) cultivar-*BR11*
 - ❑ Boro (December-May) cultivar-*BRR1 Dhan29*

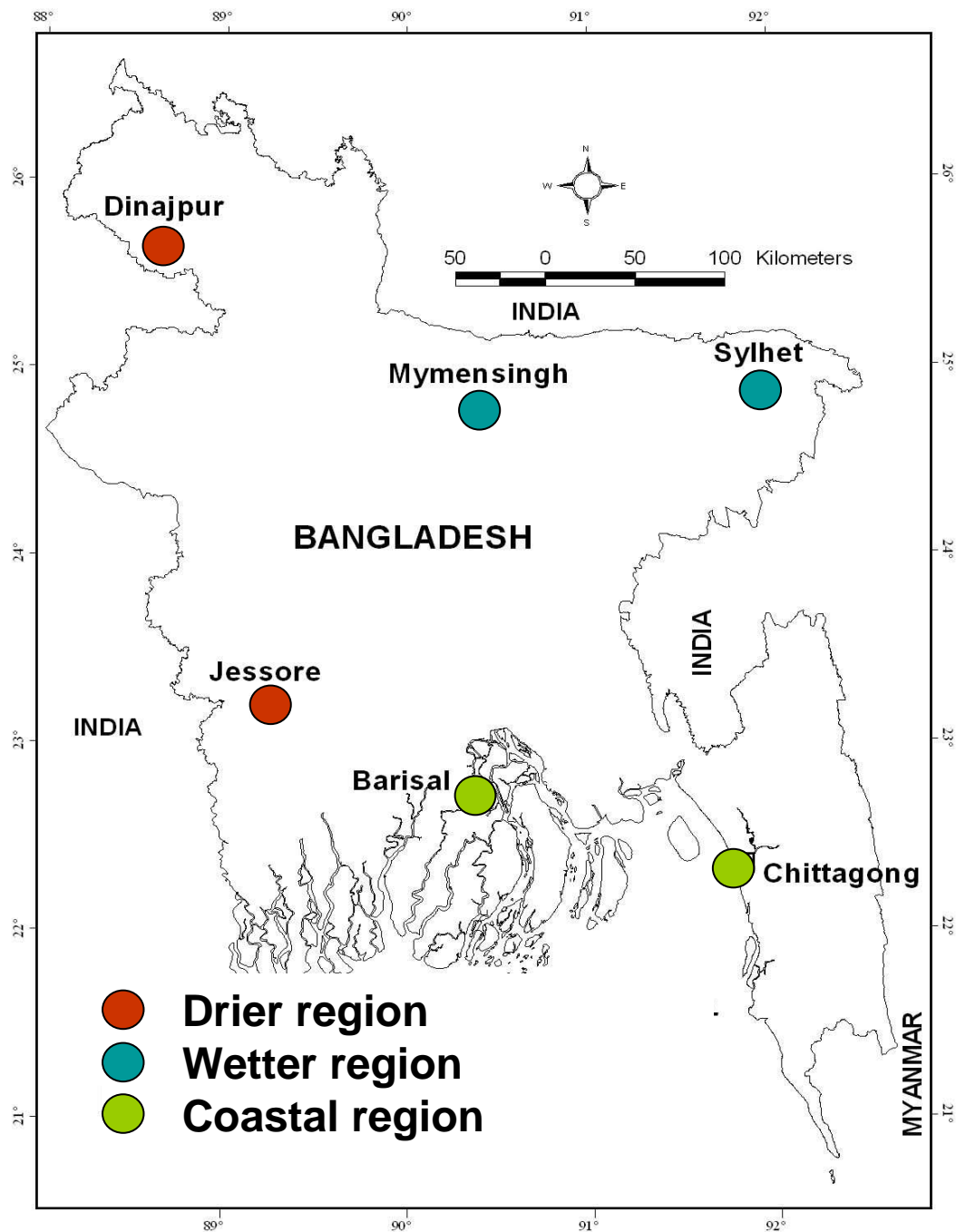
- and
- ❑ Wheat (November-April) cultivar-*Shourav*



CROP MODELS

- ❑ The simulation runs for rice and wheat were made by using CERES-Rice and CERES-Wheat crop models of Decision Support System for Agrotechnology Transfer (DSSAT) version 4.0 (Hoogenboom et al., 2003).
- ❑ **Genetic coefficients.** To obtain reasonable outputs from the crop simulation models, it is necessary to have the appropriate genetic coefficients for the selected cultivars. Since the genetic coefficients for the varieties considered in this study were not available, they were estimated.





For the rice six location representing the:

- Drier region (Dinajpur and Jessore)**
- Wetter region (Sylhet and Mymensingh)**
- Coastal region (Chittagong and Barisal)**

For wheat three locations (Jessore, Mymensingh, and Dinajpur) were chosen for the study

CLIMATE CHANGE SCENARIOS

- ❑ The extent of change in climatic parameters or the 'delta values' of mean temperature and precipitation were generated by using **MAGICC 2.4 (Model for the Assessment of Greenhouse-gas Induced Climate Change)** and **SCENGEN 2.4 (2000)**, meaning **SCENario GENerator**. The following model parameters for Emission Scenario IS92a (IPCC Third Assessment Report, 2001)

- ❑ According to the best guess of IPCC emission scenario IS92a, the concentration of CO₂ for 2050 and 2070 are 515 ppmv and 575 ppmv respectively.

- ❑ Delta values for mean temperature and precipitation were generated for the GCMs –
 - GFDL-TR = Geophysical Fluid Dynamics Laboratory Transient,
 - HadCM2 = Hadley Centre
 - UKTR = UK Met. Office/Hadley Centre Transient with respect to the base year of 1990.
 - Default MAGGIC model parameters and high climate sensitivity were used for two time intervals 2050 and 2070.



Delta values for mean temperature and rainfall generated for various Global Circulation Models for 2050 and 2070 using MAGICC 2.4/SCENGEN 2.4

Season	Global Circulation Models											
	GFDL-TR				HadCM2				UKTR			
	Mean Temp (°C)		Rainfall (%)		Mean Temp (°C)		Rainfall (%)		Mean Temp (°C)		Rainfall (%)	
	2050	2070	2050	2070	2050	2070	2050	2070	2050	2070	2050	2070
DJF	1.5	2.1	-1.4	-1.9	1.9	2.6	35.6	48.9	2.0	2.2	-5.2	-7.2
MAM	1.4	1.9	7.6	10.4	1.8	2.5	-1.8	-2.4	1.7	2.1	6.8	9.3
JJA	1.3	1.8	18.5	25.5	1.9	2.7	-0.2	-2.2	1.7	1.7	24.0	33.0
SON	1.3	1.8	7.4	10.3	2.1	2.9	-8.1	-5.7	1.7	1.9	-0.3	-0.4



CLIMATE CHANGE SCENARIOS

Temperature

- ❑ The range of change in mean temperature with respect to base year (1990) was different for the three GCMs.
- ❑ GFDL-TR predicted delta values ranging from 1.1 to 1.7 °C for 2050, while it varied from 1.5 to 2.3 °C for 2070.
- ❑ UKTR suggested mean temperature increase was 1.5 to 2.1 °C in 2050 and 1.2 to 2.7 °C in 2070.
- ❑ HadCM2 generated delta values, temperature would increase 1.3 to 2.9 °C in 2050 and 1.7 to 4.0 °C in 2070.



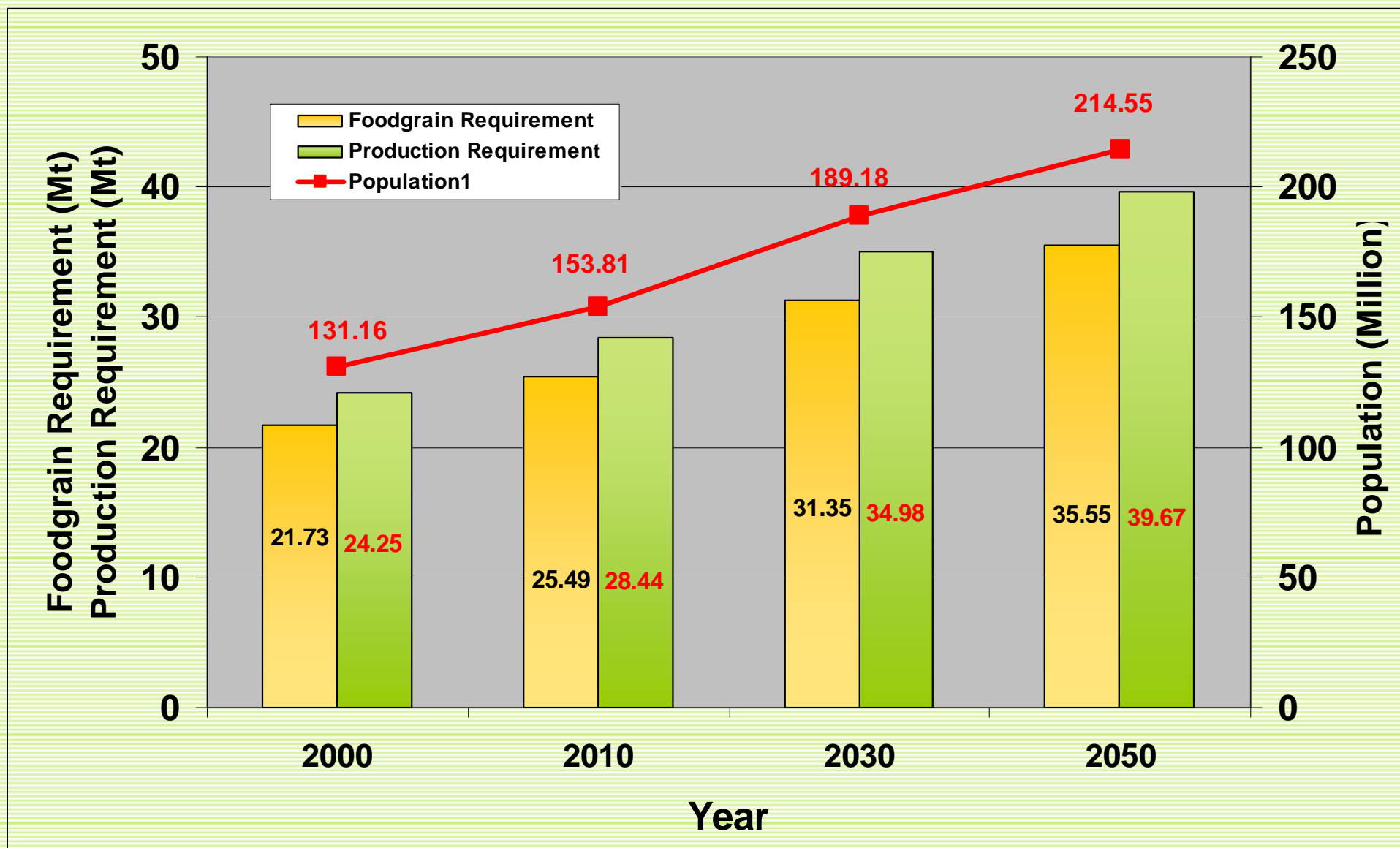
CLIMATE CHANGE SCENARIOS

Precipitation

- Different GCMs predict different sets of values for rainfall increase (or decrease).
- Among the three GCMs, GFDL-TR predicted milder changes
- HadCM2 suggested severe changes and the values increased with time.
- In case of rainfall, GFDL-TR and UKTR both predicted a decreasing tendency in future during winter season



Projected Population, Foodgrain Requirement and Production from 2000 to 2050



T. Aus Rice Yields

- ❑ With different climate change scenarios it was evident that in case of T. Aus rice under GFDL50 scenario compared to Baseline 3.8% and 15.7% yield increase were noted in Jessore and Barisal respectively.
- ❑ Under GFDL70 scenario yield increases were recorded for all six locations which varied from 3.2% in Dinajpur to 14.8% in Jessore.
- ❑ Under HADC50 and HADC70 scenarios yield reduction occurred in all locations and the percentages varied from 13.5 in Jessore to 43.6 in Dinajpur. In most case the yield reductions were around 25%.
- ❑ For T. Aus grown under UKTR50 scenario the yield differences compared to baseline varied between +3.4% in Jessore and -15.4% in Mymensingh and Chittagong.



T. Aman Rice Yields

- ❑ For T. Aman rice under GFDL50 scenario the percent change in yields over Baseline varied between -4.9 and 1.4 in Dinajpur and Barisal, respectively.
- ❑ Under GFDL70 scenario the percent change in yields over Baseline varied between -5.2 and 0.1 in Dinajpur and Barisal, respectively.
- ❑ For HADC50 scenario the yield differences were between -13.5% and +1.9% in Jessore and Barisal, respectively.
- ❑ Yield reductions were observed in all locations under HADC50 scenario, maximum for Dinajpur (-7.7%) and minimum (-1.4%) in Jessore. The effect of UKTR50 and UKTR70 on T. Aman rice was yield negative in all six locations. The effect of latter scenario was harsher than the former. Yield reductions ranged from 3.2% in Jessore to 14.2% in Dinajpur.



Boro Rice Yields

- ❑ Significant increased Boro yields were noted for GFDL70 scenario irrespective of locations.
- ❑ Under this scenario highest yield increase was recorded in Mymensingh (15.5%) followed by Sylhet (10.7%).
- ❑ However, only in few cases negative effect were seen; -5.7% in Dinajpur for HADC50 scenario, in Chittagong -3.6 % for UKTR50, -1.7% for UKTR70 and -0.9% HADC50; and -0.6% for UKTR50 in Jessore and Barisal.



Wheat Yields

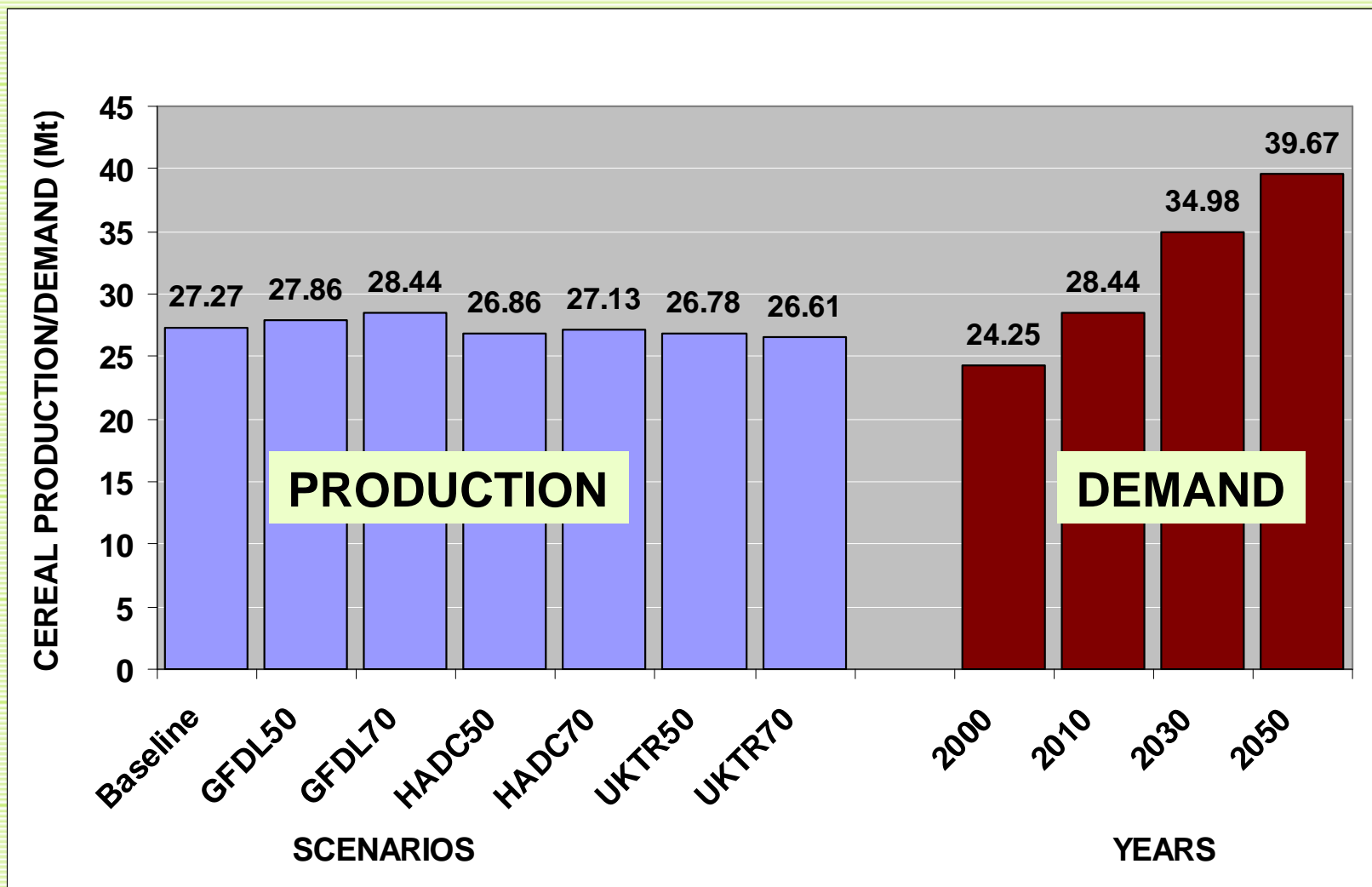
- ❑ Under the Baseline scenario yields of wheat varied from a minimum of 2.67 t ha⁻¹ in Mymensingh to a maximum of 3.01t ha⁻¹ in Dinajpur.
- ❑ Simulation results show that all the scenarios for 2050 had positive effect on wheat yield. Highest relative yield increases were around 29.0% in Jessore and Mymensingh and 20.4% in Dinajpur.
- ❑ Conversely, all the scenarios for 2070 had negative effect on wheat yield. Highest relative yield decreases were 25.6% in Jessore and 23.0% in Dinajpur and Mymensingh. the reductions ranged from 15.8 to 25.6%.

Aggregated rice and wheat production of under different climate change scenarios

- ❑ ***Aus Rice:*** The average aggregated production of Aus rice in Bangladesh was 1.72 M t during 2005-2006. Productions were reduced by 1.5-25.8% under different climatic scenarios. Only with GFDL70 scenario 7.8% increase in production was recorded.
- ❑ ***Aman Rice:*** The aggregated production of Aman rice for 2005-2006 was 10.81 M t. Simulation results show that under all scenarios, production was lowered from 0.4% for GFDL50 scenario to 10.0% for UKTR70.
- ❑ ***Boro Rice:*** The baseline production of Boro rice for 2005-2006 was 13.98 M t. Under the all climate scenarios, production increased by 1.2% for HADC50 and 9.5% for GFDL70 scenarios.
- ❑ ***Wheat:*** The aggregated production of wheat for 2005-2006 was 0.735 M t. It was interesting to note that with all the scenarios for 2050 the wheat production increased in the tune of 19.35 to 25.98%. While Under scenarios for 2070 the production decrease ranged from 17.19 for GFDL70 to 24.14% for HADC70 scenarios.



PRODUCTION VS DEMAND



Conclusion

- ❑ Under business as usual scenario, with the available technologies Bangladesh has the potential to meet her demand for cereals up to 2025 and even beyond.
- ❑ It is difficult to predict the consequences of climate change on agriculture as a whole. Cereal demand will be difficult to meet as the population is very likely to be more than 214 million by the year 2050.
- ❑ However, under changed scenarios, new technologies need to be developed to combat climate change and sea level rise coupled with the great pressure of population increase.





Thank You Very Much.....

