Living with Climate Variability and Change

Understanding the Uncertainties and Managing the Climate Risks in Agriculture

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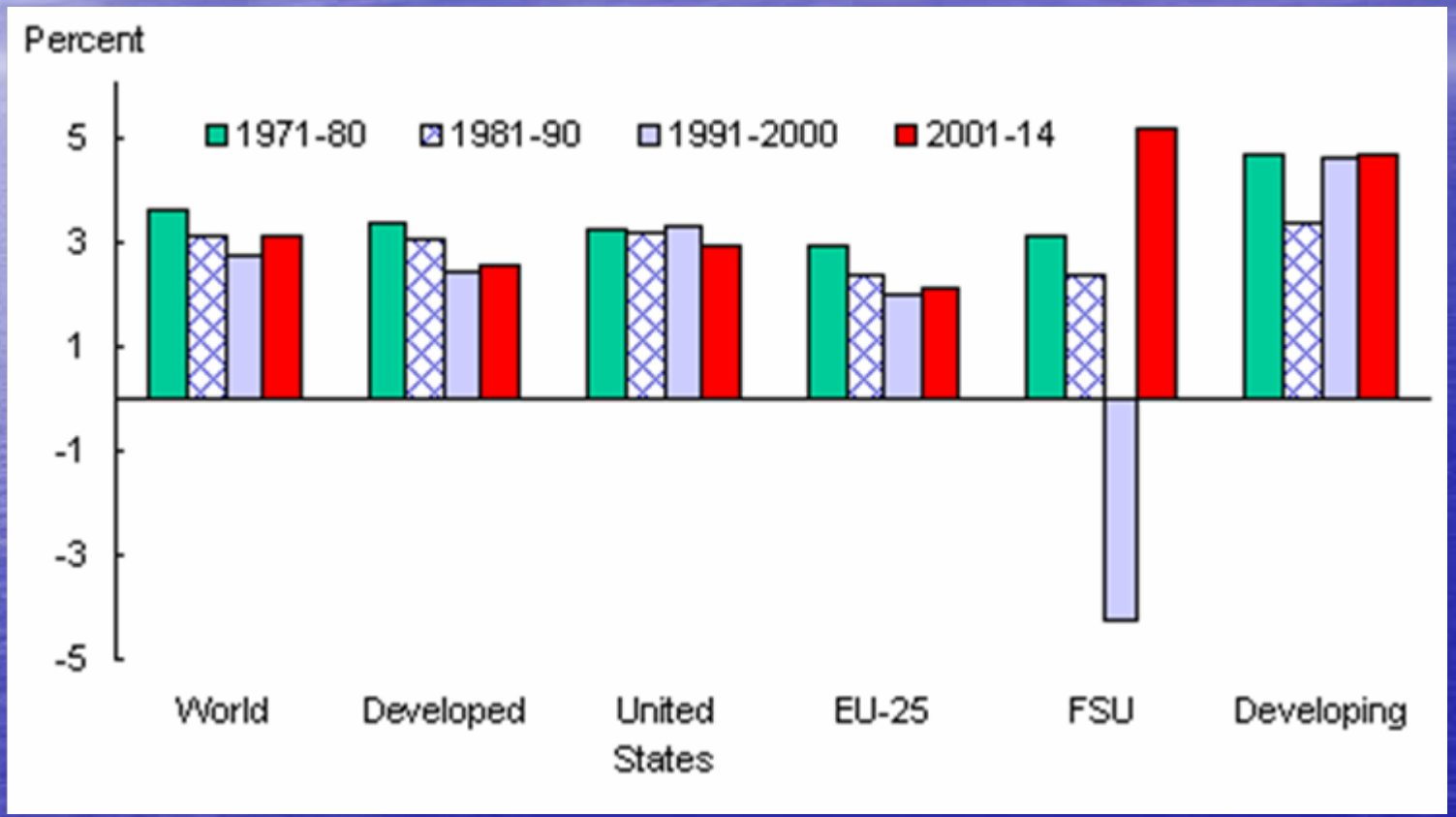
GDP Growth Rates (Decadal)



Source: USDA (2005)

Economic development will increase the global food demand.

Food demand and hunger

- The World Food Summit 1995 (WFS) estimated that approximately 840 million people in developing countries subsisted on diets that are deficient in calories and nutrition;
- 96% of these insecure people suffer from chronic deficiencies; more than 25% of children under age 5 in developing countries are malnourished.
- Significant population in developing countries experience temporary energy shortfalls caused by natural disasters of hydro-meteorological origin;
- MDG 1 of halving the number of poor and hungry people by the year 2015 is a challenge for the International Community.

Developing Economies and increased vulnerability

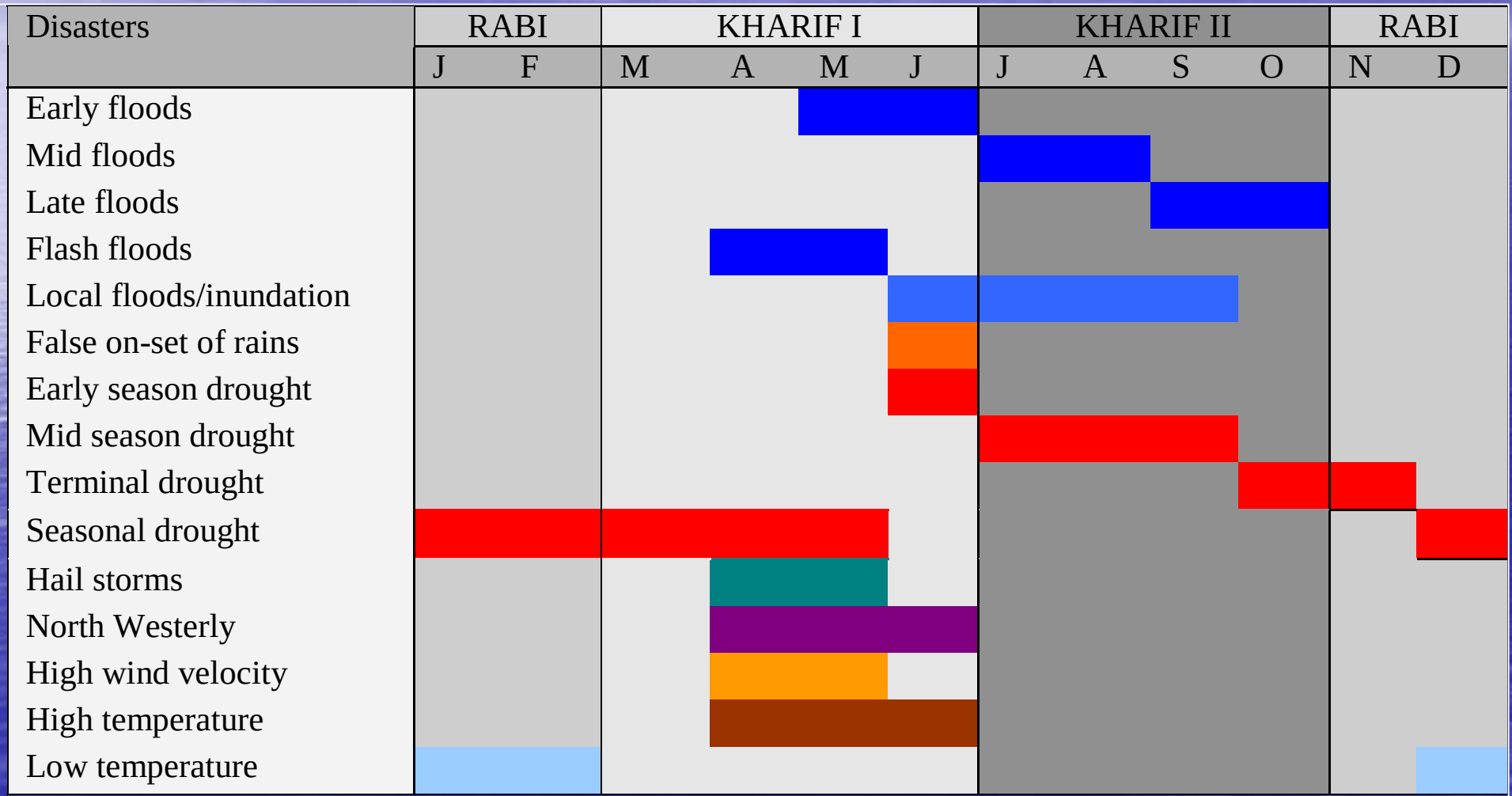
- Economic growth in developing countries will lead to crop intensification which may result in land degradation, desertification, higher green house emissions and waning harvests;
- Temperature rise, higher evapo-transpiration rates with consequent changes in hydrologic cycle will lead to extreme weather events like floods, droughts and cyclones;
- Increased stress on natural resources will lead to loss of forest flora and fauna;
- Increased vulnerability of agricultural systems with deterioration in their natural, physical, social and financial capital is likely to lower farm productivity and impoverishment of farmers worsening global food security;
- Rural women in developing countries will be impacted more harshly as they play an important role in the livelihoods of their families;

Impact of Crop Intensification (Bangladesh)

- Crop intensification started in 1960s; single-cropped areas converted into multi-crop area.
- Rice has been the dominant crop in all crop seasons leading to nutrition deficiencies in diet.
- Harmful effects of continuous wet culture resulting in declining yields, reduced availability of nutrients.
- Depletion of organic matter due to replacement of legume and green manure-based cropping systems.
- Lowering of ground water level due to over exploitation and widespread arsenic pollution.

Climate variability exposes system to multiple hazards

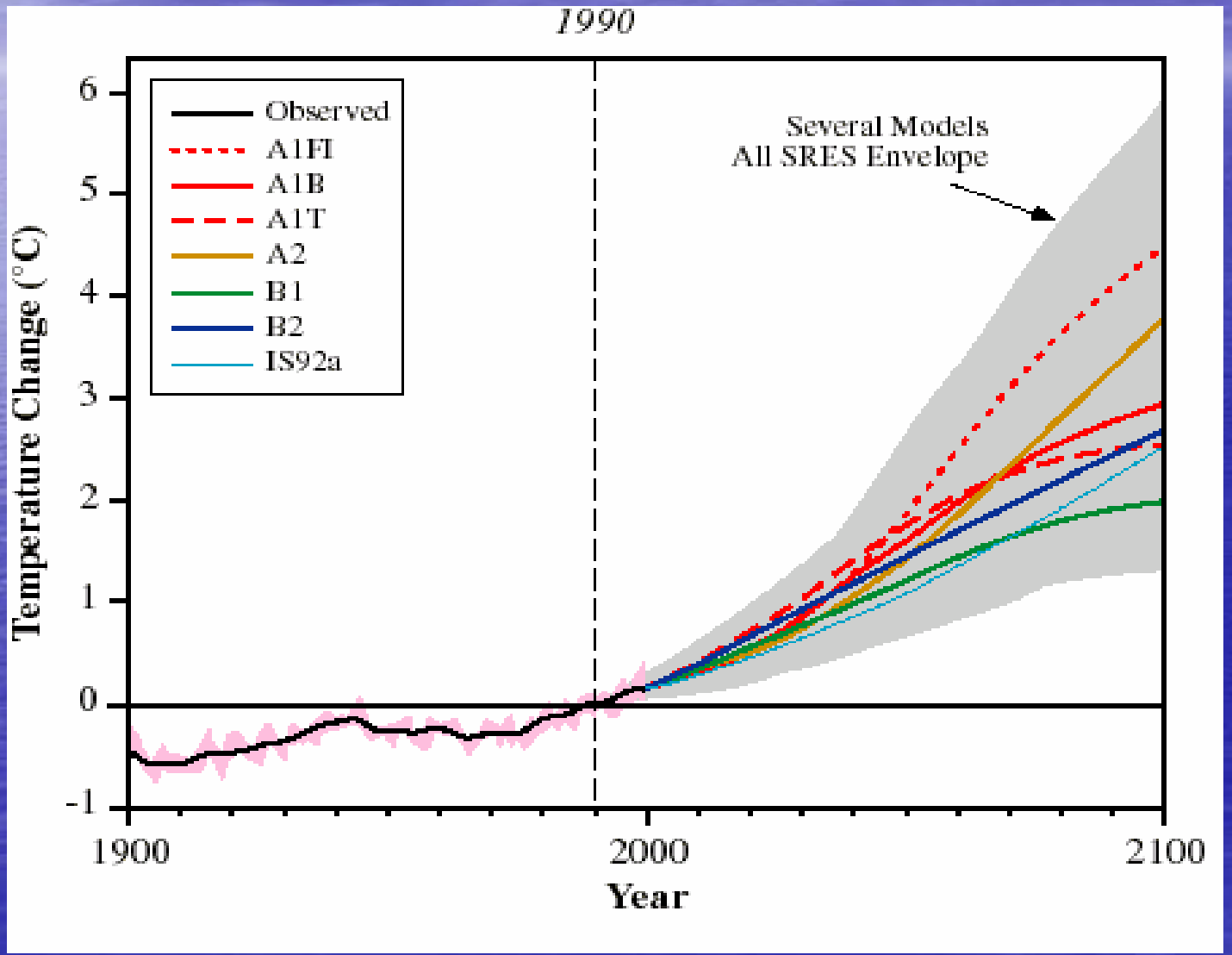
Hazard calendar for Bangladesh



Sustaining Crop Intensification and food security

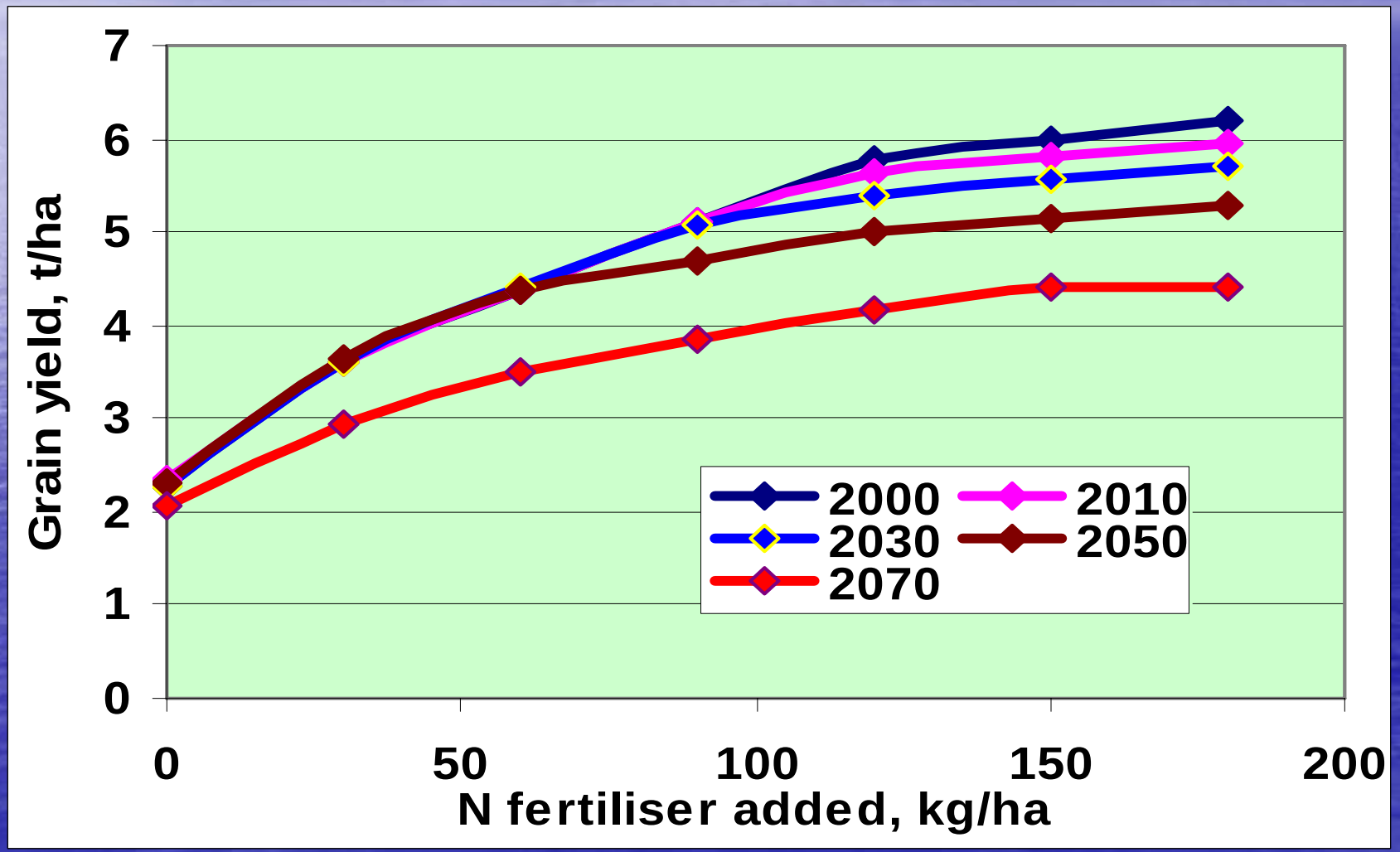
- Policy strategy in Bangladesh requires shifting of rice cultivation to monsoon season – a risky season, but climate information provides a basis for risk management;
- Historical climate risk analysis guides to re-design crop diversification plan considering hazard risk analysis.
- Long-lead climate and extended range weather forecasts provide a basis for risk management in sustaining crop diversification plan against climate variability and climate change.

Projected rise in surface temperature

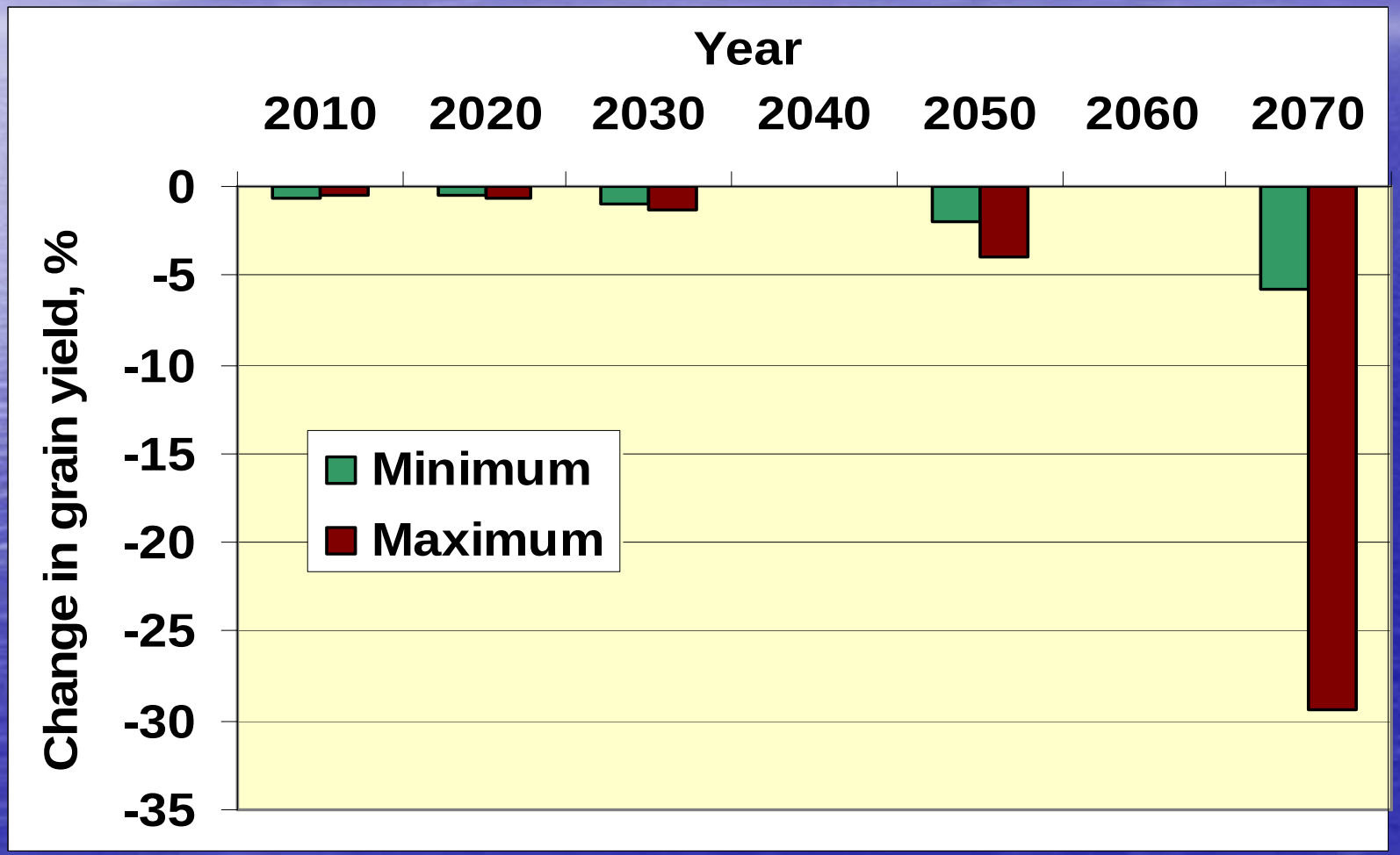


Source:
IPCC 2001

Declining Response of Wheat to Warming Scenarios



Simulated Impact on Irrigated Wheat Yields in North India



Minimum and maximum changes refer to the impacts under different scenarios

Impact of heat wave in March 2004 on wheat production in India

- Increased heat: + 5-8 ^{o}C in north and central India from 5th March to 28th March, 2004
- Caused a loss of 4.5 million tons of wheat

Decreasing global availability of freshwater

Year	Population (millions)	Average annual renewable global water resources (km^3)	Potential water availability (m^3/yr)
1960	3039.7	44800	17532
1980	4454.3	44800	10058
2000	6079.0	44800	7370
2025	7835.9	44800	5717

(Source: Marios, 2004)

Water Use and Scarcity

- In 2025, 48 countries with about 3 billion people are projected to face water shortages.
- Agriculture is the biggest user of water, accounting world wide for about 69% of all withdrawals.
- Domestic use amounts to about 10% and industry uses some 21% (Fao, 2003).
- As climate change exacerbate risks, water users will need to adopt integrated and adaptive approaches.

Impact of Climate Variability: El Niño 1997

Indonesia

- 93% of drought years in Indonesia are linked to El Niño years;
- Severe drought reduced rice yields, requiring the importation of upto 5 million tones of rice;
- Economic crisis devalued rupiah by about 80%, pushing up price of imported rice to four times pre-crisis levels.
- Forest fires raged out of control in Sumatra and Kalimantan.

The Philippines

- El Niño and El Peso collided and magnified impact.
- 60% devaluation of Peso.
- Per capita GNP declined by 2.7%.
- Agriculture declined by 7% and industry by 1.7%.
- Food and basic commodity prices increased rapidly.

Climate variability in India

Dates of Onset of South-west Monsoon over Kerala & Mumbai-1901-70.

Dates		Number of Years	
		Kerala	Bombay
May	11-15	5	0
	15-20	8	0
	21-25	7	1
	26-31	12	3
June	1-5	20	12
	6-10	14	22
	11-15	3	25
	16-20	0	4
	21-25	1	3
Mean date		May 30	June 9
Median date		June 1	June 9
Range		May 11 to June 25	May 20 to June 25
Standard deviation (days)		9	6

Source: Government of India, Ministry of Agriculture and Irrigation, (1976), Report of the National Commission on Agriculture.

Climate variability in India

Coefficient of Variation of Rainfall During Monsoon season

Period	Region	Constant of variation (CV)
June	West Coast, North-east Assam	30-40%
	Elsewhere	60-100%
July-August	East of longitude 800 E (Chennai-Jabalpur-Bareilly) & along West coast	40% or less
	North-east India	50-100%
	Peninsula or leeside of ghats- MP, Karnataka, Rayalaseema & Tamil Nadu	
September	Peninsula including coast	60% or more

Source: Government of India, Ministry of Agriculture and Irrigation, (1976), Report of the National Commission on Agriculture.

Frequency of Droughts in India

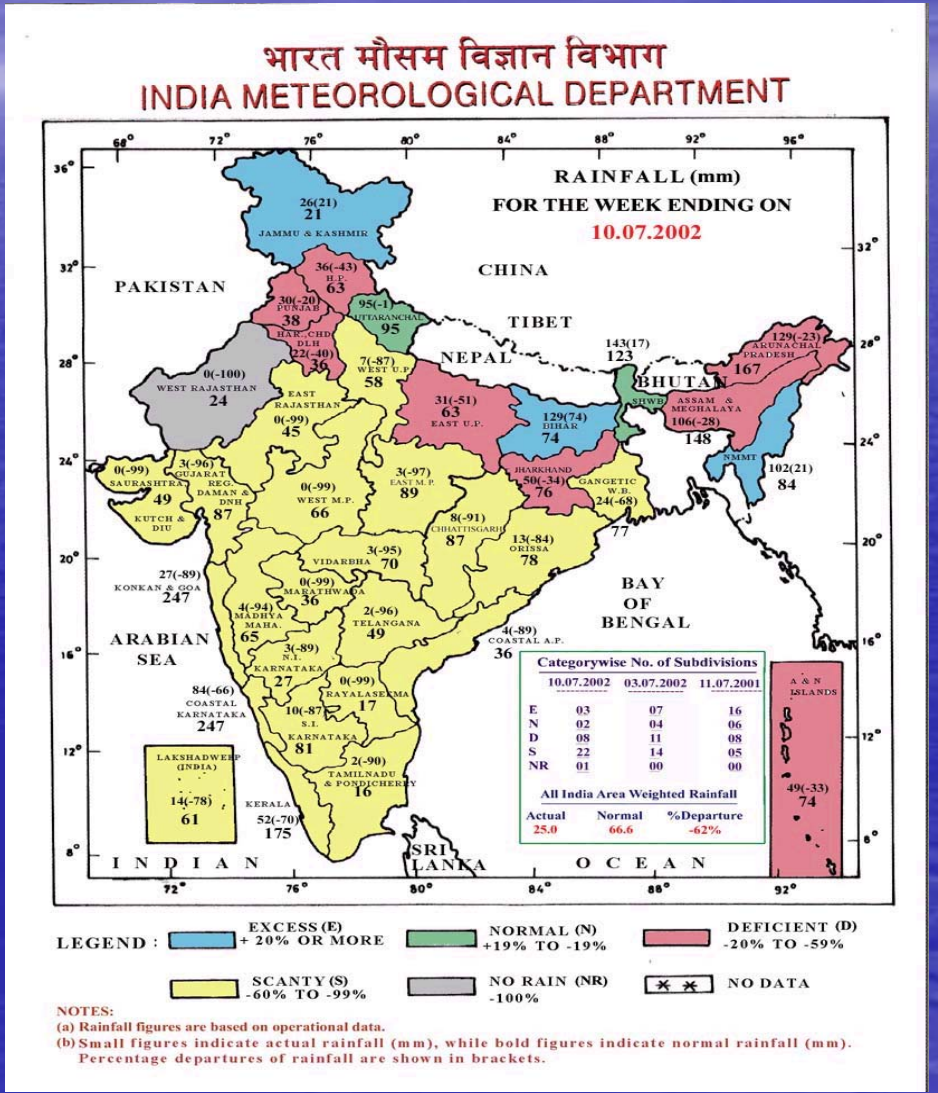
Frequency of Droughts	Whole India		Dry Tropical Regions	
	Geographical Area	Cropped Area	Geographical Area	Cropped Area
2-3 years	13.2	11.2	18.6	14.7
3 years	11.6	14.5	15.6	18.4
4 years	36.5	42.4	51.4	55.7
5 years	30.9	30.4	14.4	11.2
> 5 years	7.8	1.4	-	-
Total	**100**	**100**	**100**	**100**

Source: Gadgil, et al. (1988)

Managing Climate Variability

Managing intra-seasonal drought: 2002 Drought in India

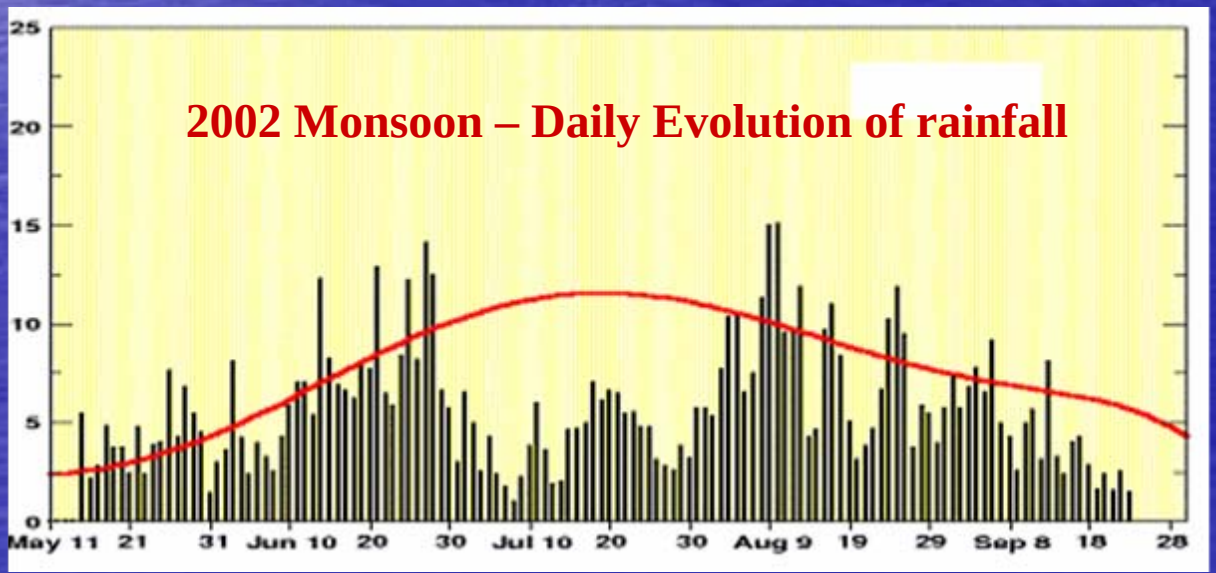
- July is the wettest month of the year.
- Most active period for agriculture operation.
- Most crucial for determining severity of drought in North West India.
- July 2002, the driest ever since 1875.



Managing Climate Risks

Managing intra-seasonal drought: 2002 Drought in India

- Advance climate information would have helped to reduce the cost of investment in *kharif* crops at farm level.
- Pro-active policy decisions require extra-information on climate and related market and price risks on a much larger spatial scale.



Understanding Climate Variability and Change

Recent Advances in Prediction Science

- Generation of skill-full, reliable and location specific **seasonal climate forecasts** through statistical and dynamical schemes.
- Development of real-time **monitoring systems** to track the nature of causes and impacts (Satellite meteorology and remote sensing techniques).
- Development of **climate change scenarios** through Global Circulation Models (GCMs).

Managing extreme events

Integrating climate information into response systems

- Integration of spatial and temporal monitoring tools like crop models, water balance models and Normalized Difference Vegetation Index (NDVI) helps to assess the impact of disasters several weeks before harvesting a crop.
- Linking agricultural monitoring, climate information and humanitarian response systems are essential for effective delivery of humanitarian assistance.
  - food needs assessment
  - emergency appeal and resource mobilisation
  - planning delivery of humanitarian assistance

Challenges in Climate Prediction

- Global Circulation Model outputs.
- does it match with user need and scientific capacity of information brokers?
- Forecasts are too general in terms of space and time. Forecast needs are at local level - downscaling techniques needs to be improved.
- Forecast information timing does not match user needs and their livelihood portfolios.
- Low prediction skill of the models and less confidence to use at local levels.
- Uncertainty in future climate change projections.

Challenges in Risk Communication

- The user community is faced with making an absolute decision (yes or no).
- Forecasts are in the form of probabilities.
- Distortion of forecast information and knowledge.
- Enhanced role of media in policy advocacy, timely information to guide localized decisions, awareness raising etc.,

Experiences in generating demand driven climate information

Understanding decision options and lead time requirements of end users (Bangladesh)

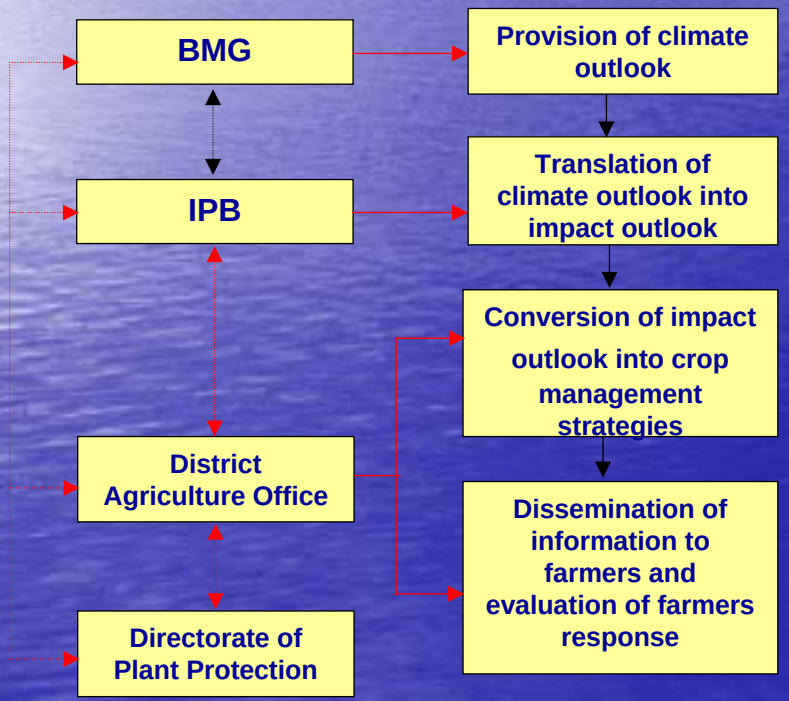
Stakeholders	Issues	Lead Time
Farmers	Planning for early Aus paddy and also late Boro and transplanted Aman paddy	Seasonal Forecast
	harvesting of crops (I.e. Boro, Aman, Jute)	2 weeks
Fishermen	Planning for culture fisheries	Seasonal Forecast/ 2 Weeks
	For preparing trap and protect pond by netting	1 weeks
Labourers	Agricultural employment	2 weeks
Boatmen	Homesteads security	2 weeks
Traders	Market price, transportation	1 week
Women	managing homesteads	1 week

Challenges in Partnerships and institutional alignment

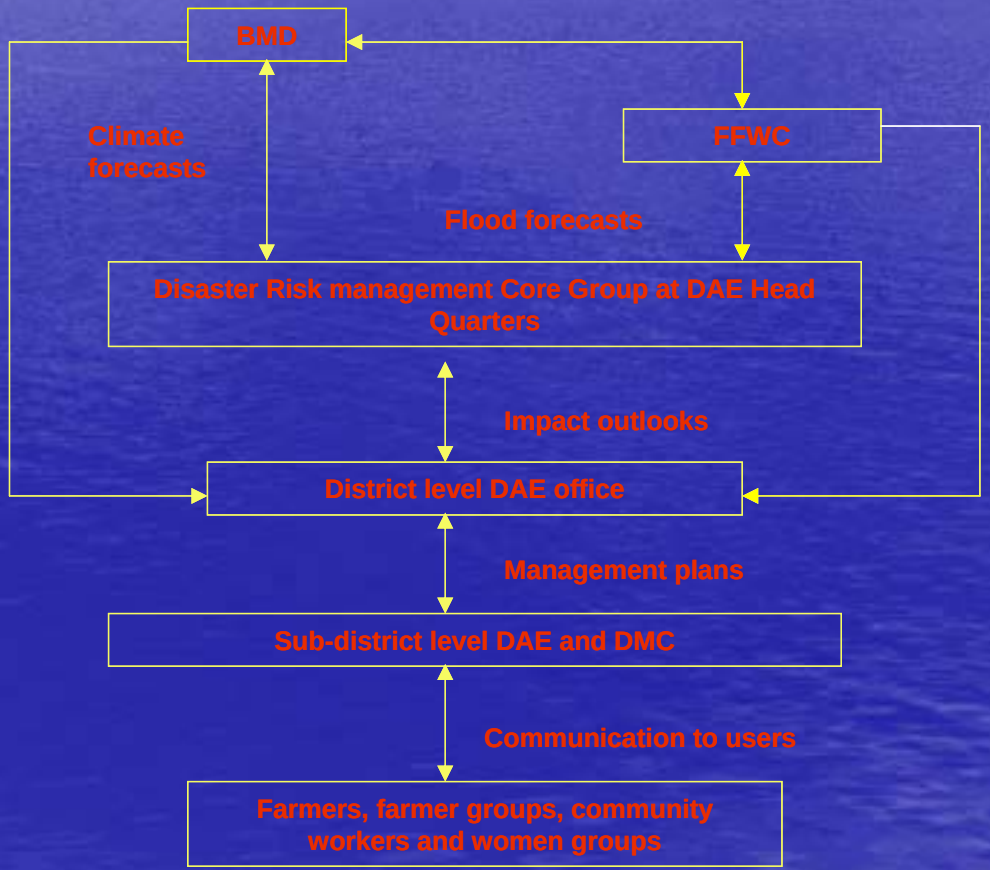
- **Climate information products and tools are yet to be fully utilized:**
  - **Researchers do not fully appreciate the institutional, economic and cultural circumstances within which decisions are made**
  - **Decision makers frequently do not actively seek new source of information from experts to make more informed decisions**
  - **Innovative public private partnerships are needed to develop sustainable farming technologies and hi-tech agricultural solutions based on climate information.**
- **Capacities to generate climate information rest with advanced climate centers, while the need and demand lies with local communities.**
- **The development of sophisticated models for regional impact and adaptation studies and focused farm specific climate change information should be accorded high priority.**
- **The uncertainties of climate change as well as socio-economic scenarios in the long period horizon not conducive to efforts in mainstreaming adaptation in development planning in the present.**

Developing Enabling Institutional Framework mainstreaming climate risk management programs

Indonesia

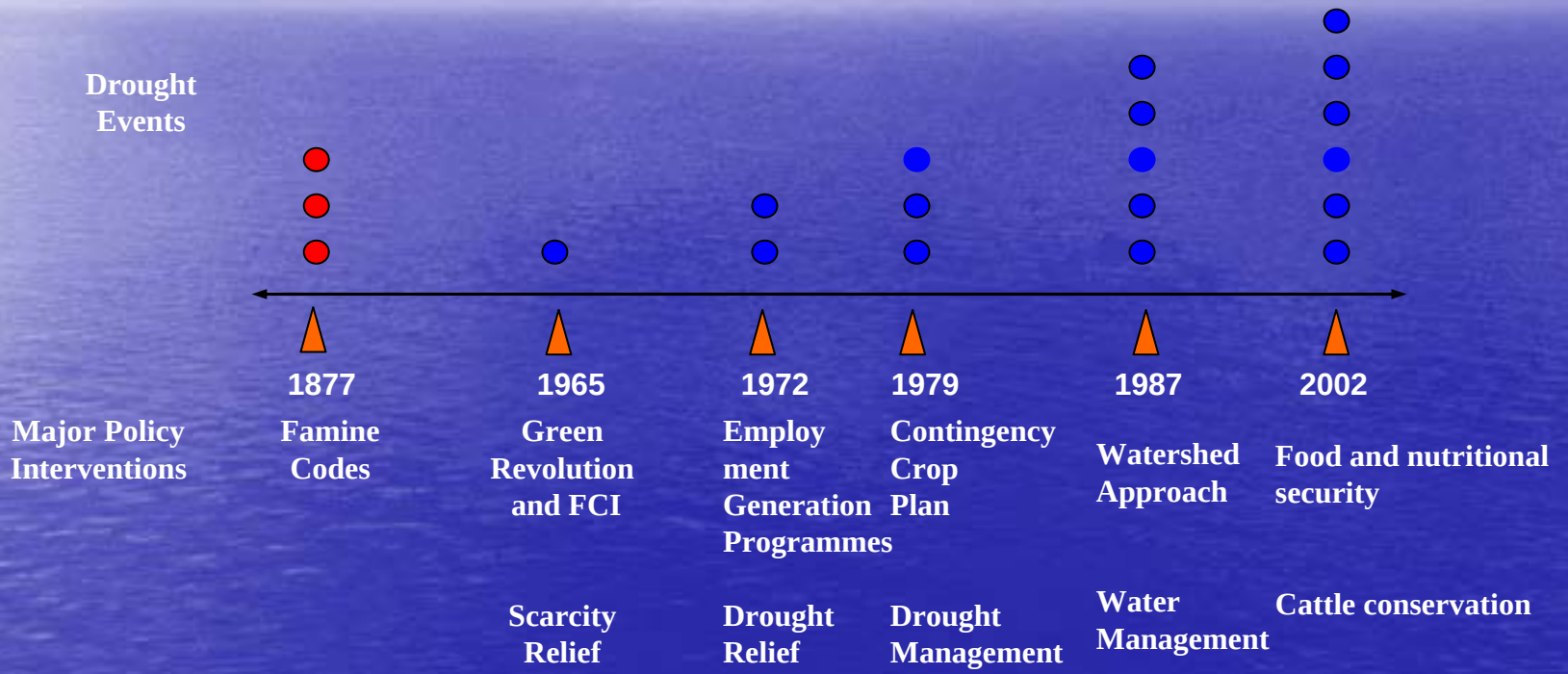


Bangladesh



Experiences of policy response in India

Need for paradigm shift towards proactive planning from reactive planning



Mitigation Options in a participatory Framework

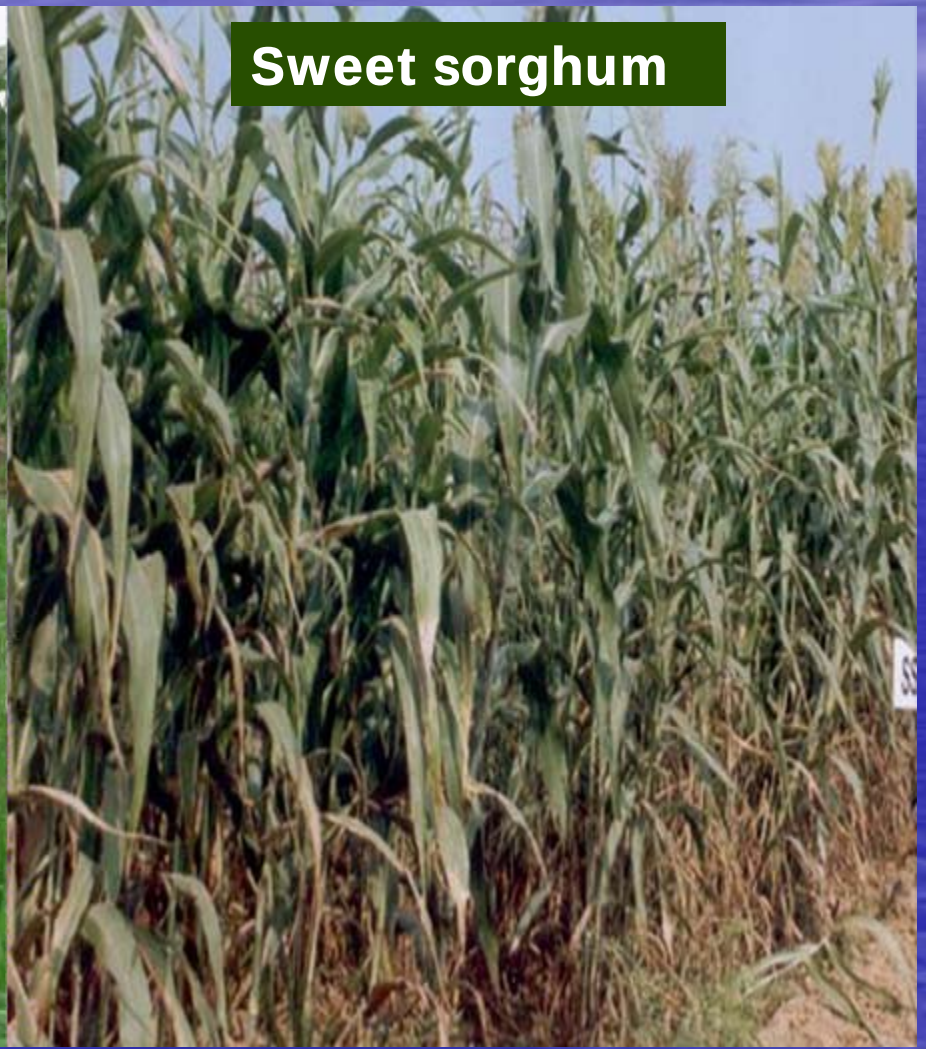
- Enhancing carbon sink through afforestation and Agro-forestry;
- Resource conservation technologies;
- Enriching soil organic matter and combating desertification;
- Biofuels (Jatropha, Ethanol)

Mitigation: Biofuels

Jatropha-wheat intercropping

- Utilization of 2-7 M tons of (damaged) food-grain or 5-12 M tons of straw can produce ethanol needed for 10% blending upto 2010. Area needed to produce this is < 1 district

Sweet sorghum



Agriculture – An important Part of Solution

- Agriculture is at the heart of climate change issues and its centrality should be recognized in mitigating and adapting to its effects;
- Climate change mitigation and adaptation measures need to be integrated into national development plans and poverty reduction strategies;
- The system of CO_2 emissions quota market should include agriculture for it to contribute effectively to climate change mitigation;

Thank you