

# **Impacts of Climate Change on Agriculture and Strategies to Ensure Economic Development of Agriculture Sector**

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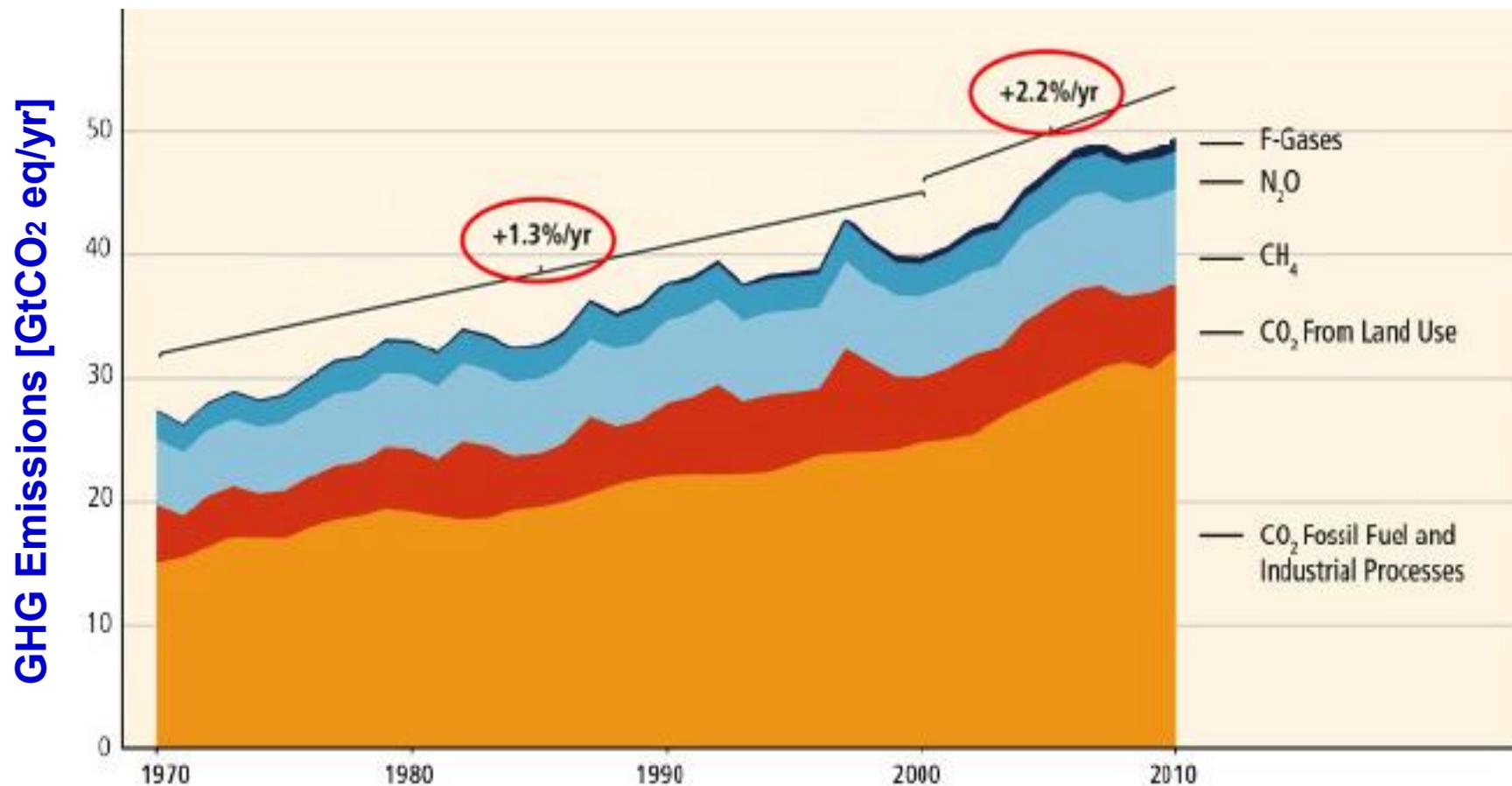
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# Objective

- Climate change, which is widely accepted as the single most pressing issue facing society on a global basis, affects agricultural performance by altering the range and magnitude of climatic parameters which in turn affect biodiversity and terrestrial ecosystem services.
- The growing awareness of the impacts of climate change on agriculture is forcing policy makers to refocus on the sustainability of agricultural production.
- This presentation focuses on the impacts of climate change on the new models of agricultural development and what steps need to be taken to ensure the economic development of the agricultural sector.

GHG emissions growth between 2000 and 2010 has been larger than in the previous three decades



Source: IPCC AR5 SYR SPM.2

# Sources of Emissions

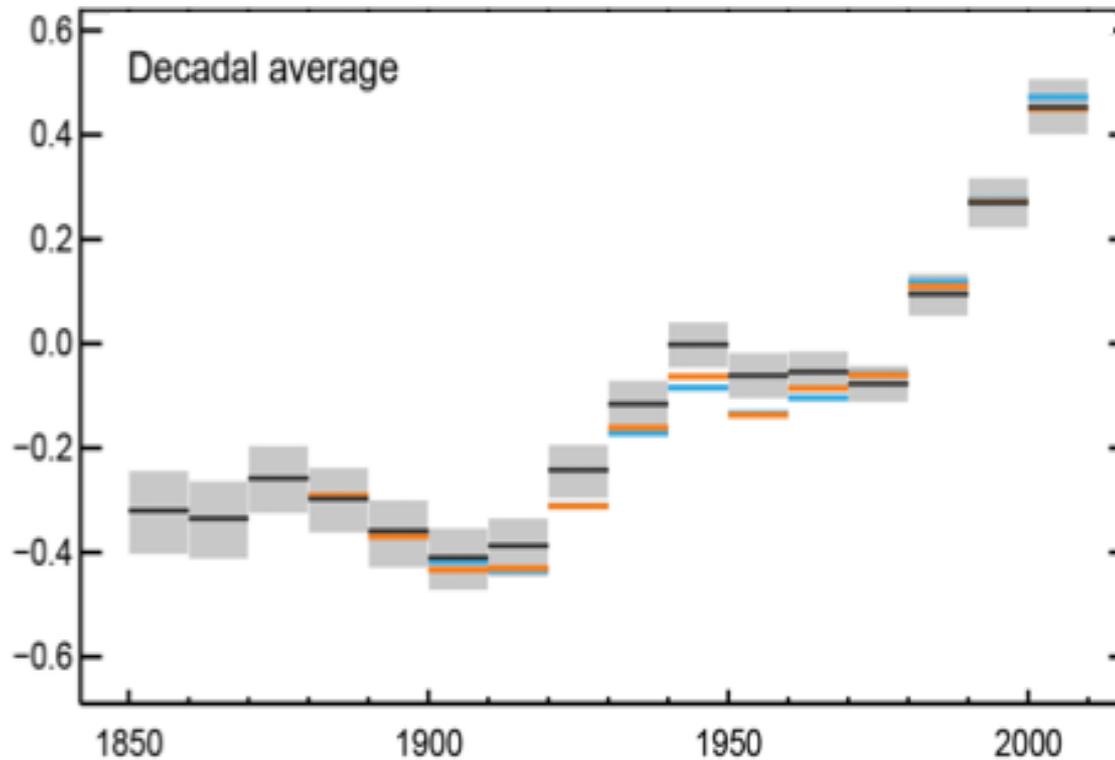
Energy production remains the primary driver of GHG emissions



2010 GHG emissions

# Temperatures continue to rise

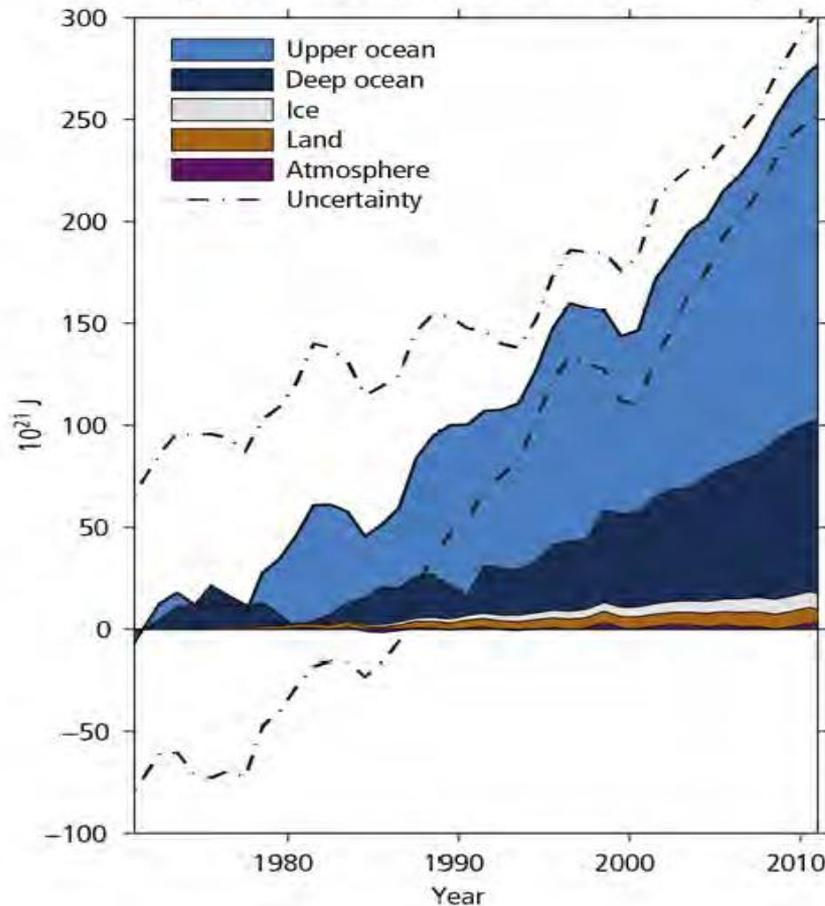
Each of the past 3 decades has been successively warmer than the preceding decades since 1850



Globally averaged combined land and ocean surface temperatures

# Oceans absorb most of the heat

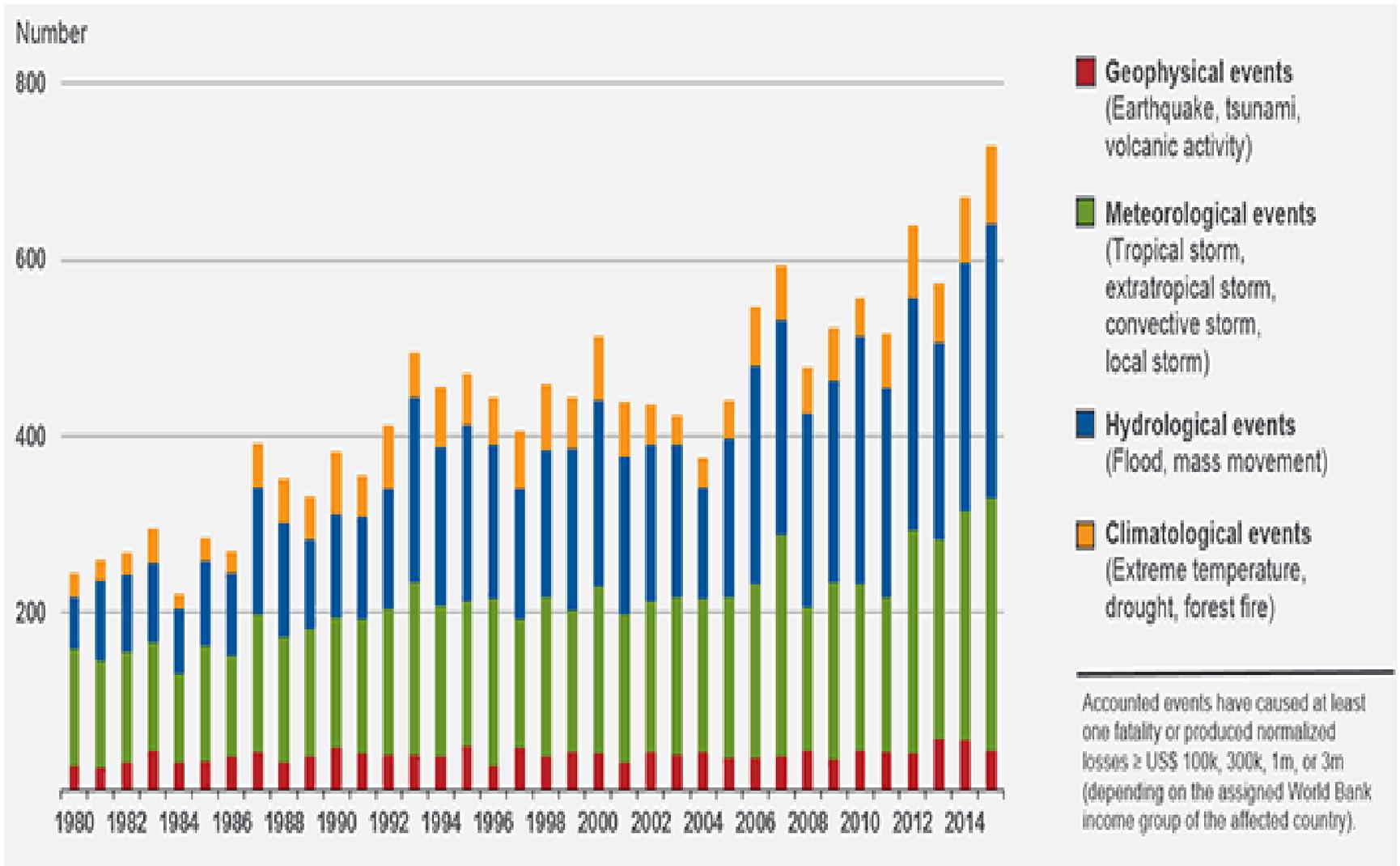
Energy accumulation within the Earth's climate system



- More than 90% of the energy accumulating in the climate system between 1971 and 2010 has accumulated in the ocean

- Land temperatures remain at historic highs while the ocean temperatures continue to climb

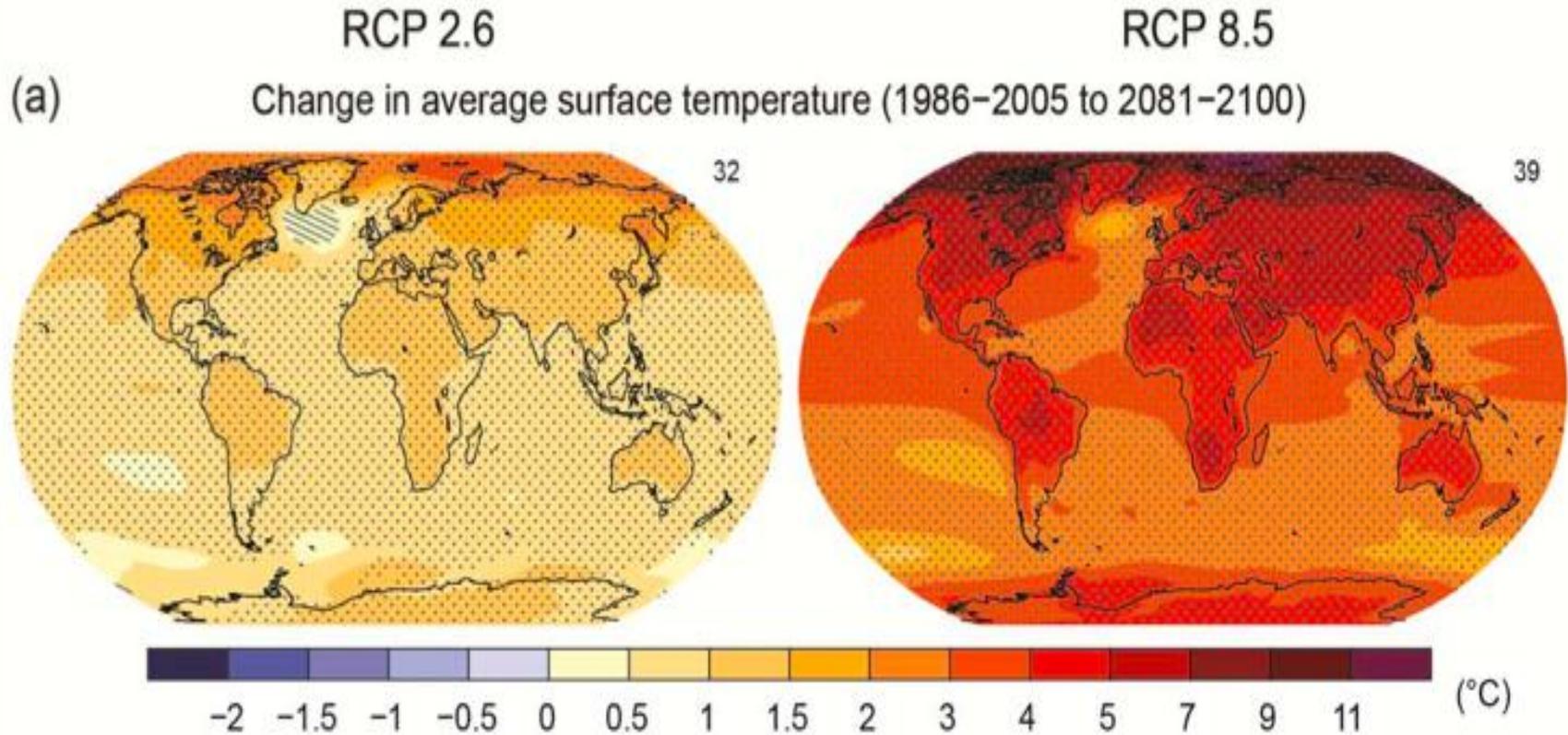
# World Natural Catastrophes (1980-2015)



Source: © 2016 Munich Re, Geo Risks Research, NatCatSERVICE. As of March 2016.

# **Climate Change – Future Projections**

# Projected Mean Surface Temperature by end of 21<sup>st</sup> Century



*The temperature increase during the last 100 years is only about 0.8°C*

# Projected climate changes

**Continued emissions of greenhouse gases will cause further warming and changes in the climate system**



Oceans will continue to warm during the 21st century



Global mean sea level will continue to rise during the 21st century



It is very likely that the Arctic sea ice cover will continue to shrink and thin as global mean surface temperature rises



Global glacier volume will further decrease

AR5 WGI SPM

# Potential Impacts of Climate Change



Food and water shortages



Increased displacement of people



Increased poverty



Coastal flooding

AR5 WGII SPM

# **Impacts of Climate Change on Agriculture**

# Increasing weather and climate extremes are impacting agriculture (1)

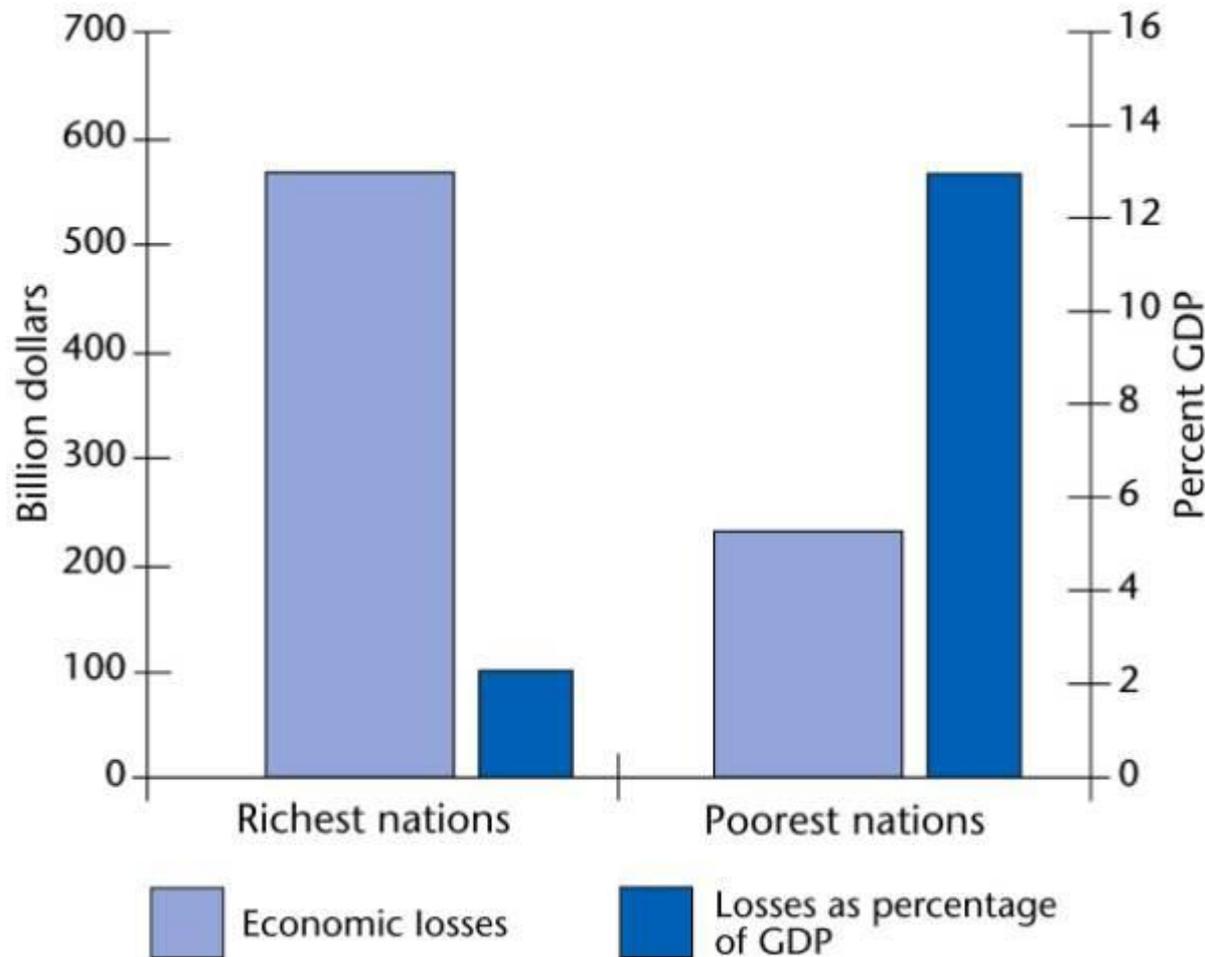
- Of the total annual crop losses in world agriculture, many are due to direct weather and climatic effects such as droughts, flash floods, untimely rains, frost, hail, and severe storms .
- Between 2003 and 2013, natural hazards and disasters in the developing regions affected more than 1.9 billion people and resulted in nearly 500 million US dollars in estimated damage (FAO, IFAD and WFP, 2015).



## **Increasing weather and climate extremes are impacting agriculture (2)**

- The agriculture sector – including crops, livestock, fisheries and forestry – absorbs approximately 22 percent of the economic impact caused by medium- and large scale natural hazards and disasters in developing countries.
- Agricultural impacts from natural events and disasters most commonly include: alteration of ecosystems, contamination of water bodies, loss of harvest or livestock, increased susceptibility to disease, and destruction of irrigation systems and other agricultural infrastructure (EPA, 2015).
- These impacts can have long lasting effects on agricultural production including crops, forest growth, and arable lands, which require time to mature.

# Developing Countries are Hit the Hardest ...



# Climate Change Impacts on Agriculture

- Agriculture has been and will continue to be significantly affected by changes in climate conditions - quantity, quality, cost of production
- Existing adaption strategies can help offset many – but not all – effects over the next 20-30 years; effects are very likely to worsen significantly beyond then, especially if Green House Gas emissions remain high
- Improving the resilience of agricultural systems to climate change requires protection of the natural resource base (water & soil) and development of new strategies, tools, and practices for adaptation

# Effects and Sensitivity Vary by Commodity

- Corn: high nighttime temperatures, high temperatures during pollination, water stress
- Soybeans: water stress, high temperatures
- Wheat and small grains: extreme events, water stress
- Rice: temperature extremes during pollination, water management
- Cotton: high temperatures during boll fill
- Pasture and rangeland: water stress
- Fruit trees: high temperatures during fruit development
- Specialty crops: water stress, high temperatures



# Increased Biotic Stresses Will Significantly Affect Agriculture

## Insect pests

- Greater numbers, increased insecticide resistance
- Geographic ranges increases & decreases
- Imports from foreign sources

## Pathogens

- Host-pathogen response changes (plants, insects, non-crop reservoirs)
- Cultural control measures may be less reliable
- Extreme events can spread

## Weeds

- Increased vigor, herbicide resistance
- Geographic range increases & decreases

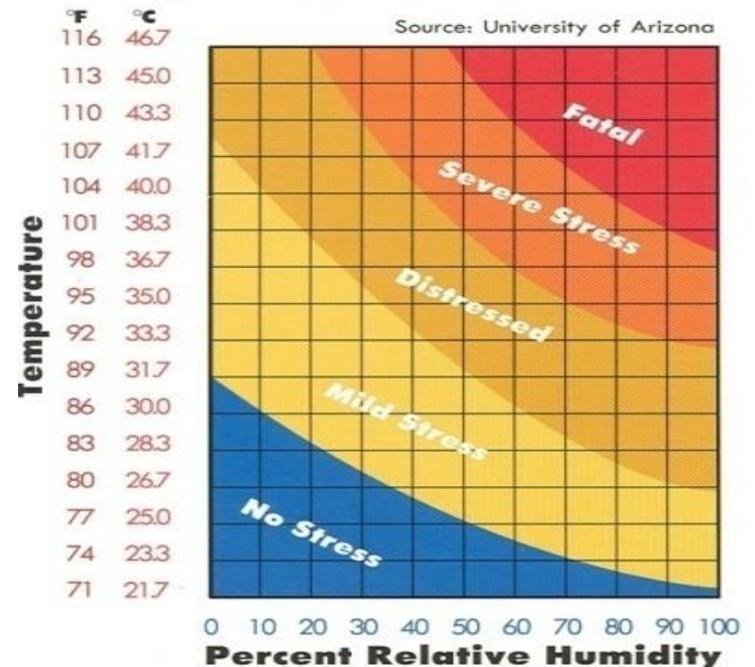


# Livestock Production Vulnerable

- Feed Grain & Forage
  - Quantity & Quality Decrease
  - Production Cost Increase
- Animal Heat & Humidity Stress
  - Reduces growth, reproduction, production (meat, dairy, eggs)
  - Climate control costs increase
- Disease & Pests
  - Frequency, intensity, distribution
  - Abundance and/or distribution of competitors, predators, & parasites of vectors themselves

## Dairy Heat Stress Chart

Source: University of Arizona



To use this chart: Simply match up the temperature on the vertical scale with the day's relative humidity on the horizontal scale.

**How to ensure economic development of  
agricultural sector ?**

# **Effective Decision Making to Limit Climate Change Impacts and Ensure Economic Development of Agriculture**

Effective decision making to limit climate change and ensure economic development of agriculture sector can be made by a wide range of analytical approaches for:

- evaluating expected risks and benefits
- recognizing the importance of governance, ethical dimensions, equity, value judgments, economic assessments and
- diverse perceptions and responses to risk and uncertainty

# Weather and Climate Risk Management Involves a Wide Range of Decisions and Actions

## Weather and Climate Risk Management

### Risk Identification

- Historical impacts of weather and climate extremes
- Changing trends
- Vulnerability assessment
- Risk factors
- Risk quantification

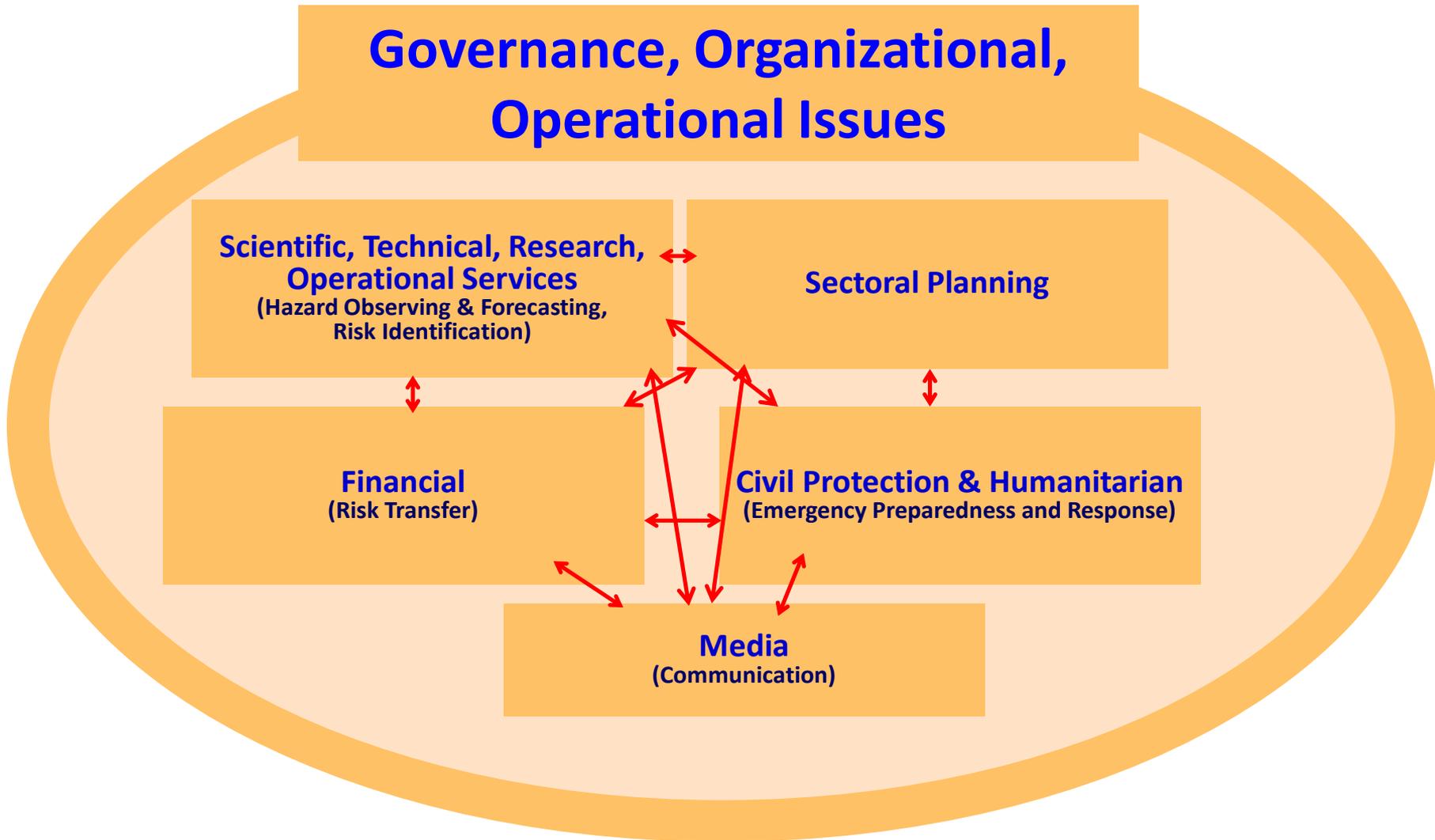
### Risk Reduction

- Sectoral planning (short to long term)
- Early Warning Systems
- Preparedness planning
- Education and training

### Risk Transfer

- Financial tools
  - Insurance
  - Weather derivatives
  - Cat bonds

# Need for Partnerships and Coordination Among Different Players (Private, Public, Academia) Involved in Weather and Climate Risk Management



# Addressing Climate Change through Sustainable Agricultural Development Policies

- Addressing climate change should be considered an integral element of sustainable agricultural development policies.
- Four of the 17 Sustainable Development Goals (SDGs) ie., 2, 6, 13, and 15 address the issue of weather, climate and sustainable agriculture.
- Sustainable Development Goal (SDG) No. 13 addresses the issue of combating climate change and its impacts.
- While addressing the other three SDGs 2, 6 and 15, it is important to implement climate change mitigation and adaptation strategies.

# GOAL 2

END HUNGER, ACHIEVE FOOD SECURITY AND  
IMPROVED NUTRITION AND PROMOTE  
SUSTAINABLE AGRICULTURE

**SUSTAINABLE DEVELOPMENT GOALS**

More at [sustainabledevelopment.un.org/sdgsproposal](https://sustainabledevelopment.un.org/sdgsproposal)

# GOAL 6

ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT  
OF WATER AND SANITATION FOR ALL

**SUSTAINABLE DEVELOPMENT GOALS**

More at [sustainabledevelopment.un.org/sdgsproposal](https://sustainabledevelopment.un.org/sdgsproposal)

# GOAL 13

TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE  
AND ITS IMPACTS\*

Acknowledging that the United Nations  
Framework Convention on Climate Change is the  
primary international, intergovernmental forum for  
negotiating the global response to climate change

**SUSTAINABLE DEVELOPMENT GOALS**

More at [sustainabledevelopment.un.org/sdgsproposal](https://sustainabledevelopment.un.org/sdgsproposal)

# GOAL 15

PROTECT, RESTORE AND PROMOTE SUSTAINABLE USE OF  
TERRESTRIAL ECOSYSTEMS, SUSTAINABLY MANAGE  
FORESTS, COMBAT DESERTIFICATION, AND HALT AND  
REVERSE LAND DEGRADATION AND HALT  
BIODIVERSITY LOSS

**SUSTAINABLE DEVELOPMENT GOALS**

More at [sustainabledevelopment.un.org/sdgsproposal](https://sustainabledevelopment.un.org/sdgsproposal)

# PARIS 2015 UN Climate Change Conference



PARIS2015  
UN CLIMATE CHANGE CONFERENCE  
COP21·CMP11

COP 21 in Paris, Parties to the UNFCCC reached a landmark agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future.

The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

The Paris Agreement requires all Parties to put forward their best efforts through “nationally determined contributions” (NDCs) and to strengthen these efforts in the years ahead.

# Key mitigation technologies in agriculture

- A large proportion of the mitigation potential of agriculture (excluding bioenergy) arises from soil carbon sequestration. Crop and grazing land management can be improved to increase soil carbon storage
- Restoration of cultivated peaty soils and degraded lands
- Improved rice cultivation techniques and livestock and manure management to reduce methane emissions
- Improved nitrogen fertilizer application techniques to reduce nitrous oxide emissions
- Dedicated energy crops to replace fossil fuel use
- Improved energy efficiency

# Key Mitigation Technologies – Carbon Sinks in Forests

- About 65% of the total mitigation potential is located in the tropics and about 50% of the total could be achieved by reducing emissions from deforestation
- Forest-related mitigation options can be designed and implemented to be compatible with adaptation, and can have substantial co-benefits in terms of employment, income generation, biodiversity and watershed conservation, renewable energy supply and poverty alleviation.
- The new online [“Learning tool on Nationally Appropriate Mitigation Actions \(NAMAs\) in the agriculture, forestry and other land use \(AFOLU\) sector”](#) of Food and Agriculture Organization of the United Nations (FAO) supports the efforts of developing countries in the identification, development and implementation of country specific mitigation actions in the context of national sustainable development.

# Climate Change Adaptation Strategies

There are several adaptation measures that the agricultural sector can undertake to cope with future climate change. These include:

- Changing planting dates
- Planting different varieties or crop species
- Development and promotion of alternative crops
- Developing new drought and heat-resistant varieties
- More use of intercropping
- Using sustainable fertilizer and tillage practices (improving soil drainage, no-till, etc)
- Improved crop residue and weed management
- More use of water harvesting techniques
- Better pest and disease control for crops
- Implementing new or improving existing irrigation systems  
(Reducing water leakage, soil moisture conservation - mulching)

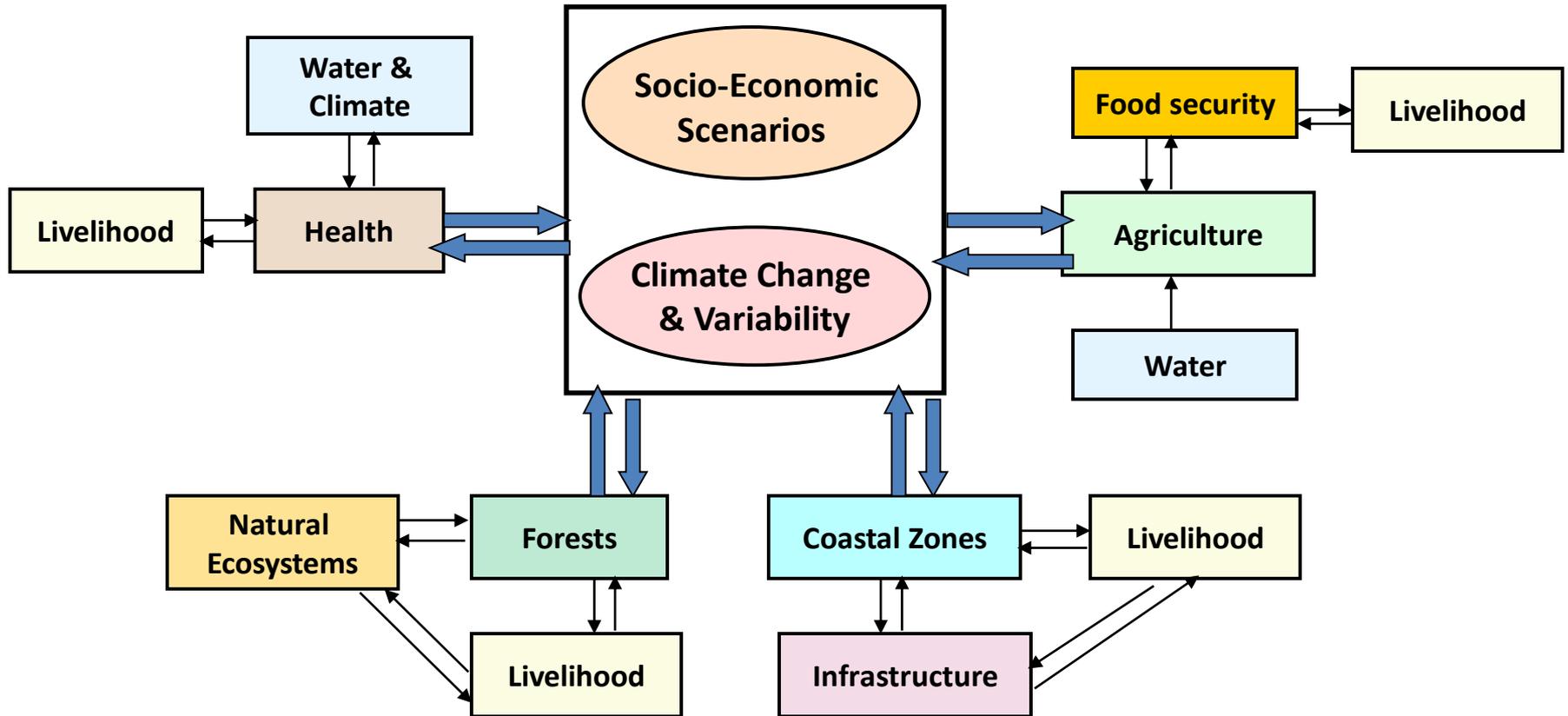
# Climate Change Adaptation Strategies (contd.)

- Improved livestock management (Providing housing and shade, change to heat-tolerant breeds, change in stocking rate, altered grazing and rotation of pasture)
- More use of agroforestry practices
- Improved forest fire management (altered stand layout; landscape planning; dead timber salvaging; clearing undergrowth; insect control through prescribed burning)
- Development of early-warning systems and protection measures for natural disasters (droughts, floods, tropical cyclones, etc)



Need to strike a balance between  
Technical and Structural solutions  
and  
Social and Institutional Constraints

# Balancing Solutions and Constraints through Integrated Assessments



# Conclusions

- All the major international agreements, to which almost all countries are now committed, emphasize that countries should implement policies aimed at climate change mitigation and greater sustainability in the agricultural sector.
- Proper incorporation of weather and climate considerations in the development of improved strategies for this purpose requires a much longer time frame than has been used in the past.
- Priorities should be given for actions that maximize synergies between adaptation, mitigation, food production and sustainable development.
- Emphasis should be placed on a well coordinated research thrust on development pathways for effective natural resource management and sustainable agriculture.

Thank you very much for your attention

