



Development and Climate: Integrating Agricultural Strategies

P.K. Aggarwal

Indian Agricultural Research Institute
New Delhi, India

pramodag@vsnl.com



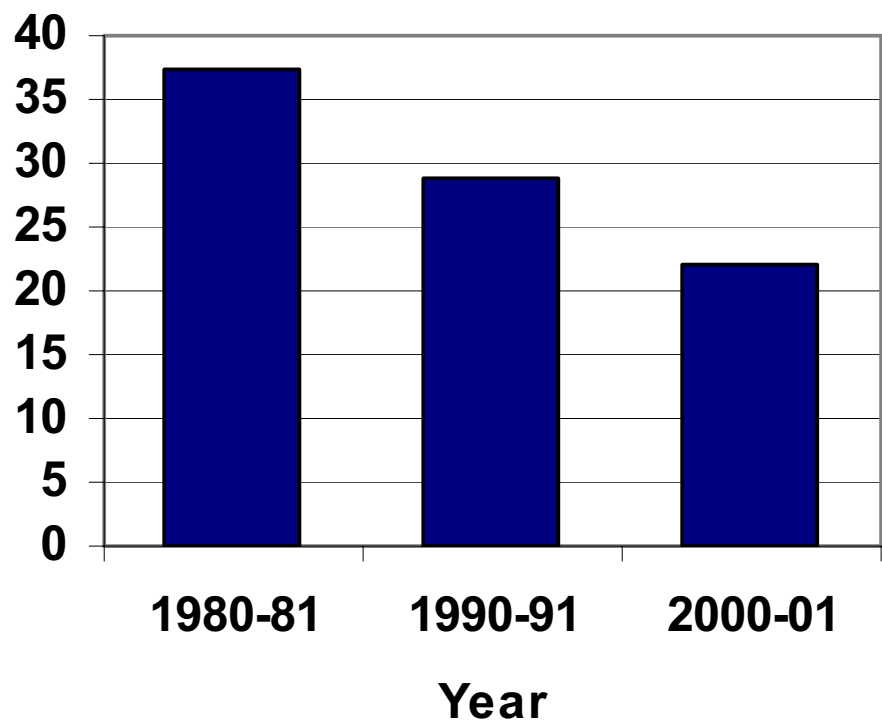
Agriculture led (rural) development

- Food production increased from 65 to 210 million tons
- Land saved - more than 50 million ha
- Calorie intake increased from 1900 to 2500 Kcal/capita/day
- Poverty decreased in rural areas from 55% (in 1973) to 26% (in 1998)
- Human development index improved from 0.41 (in 1972) to 0.60 (in 2002)

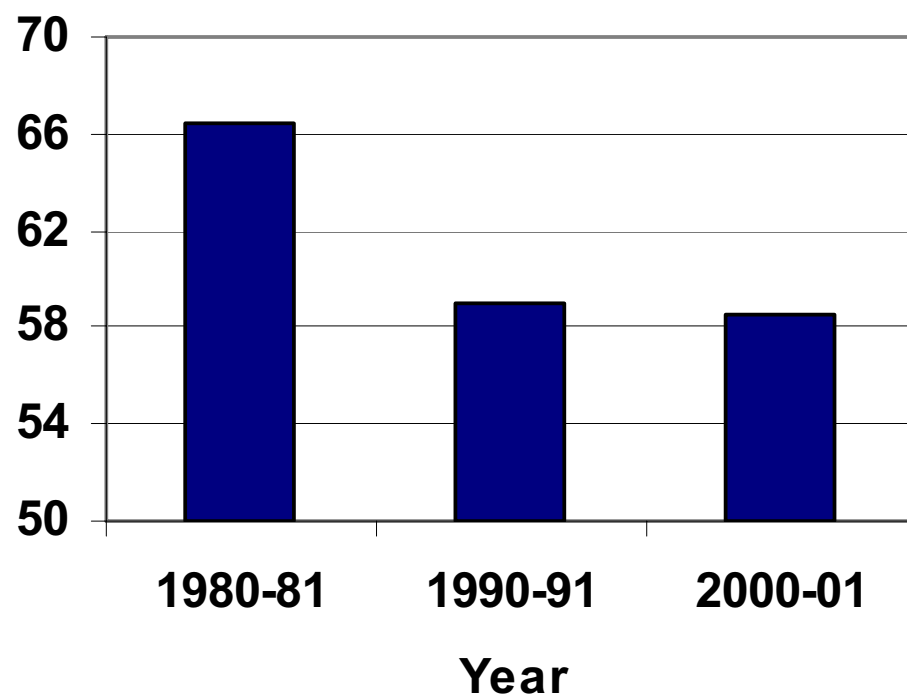


Changing Importance of Indian Agriculture

Share of agriculture in GDP (%)



Population dependent on agriculture (%)





Agriculture remains important for (rural) development

- **Largest land and water user**
- **Important for livelihood security of large rural population, despite migration to urban areas**
- **Key for even urban food security**
- **National GDP growth target of 9-10%. Agriculture's role crucial; leads to industrial growth**



Indian Agriculture: Additional Challenges

- **Increasing** demand for (quality) food
- **Increasing** competition for land, water
- **Increasing** employment pressure
- **Increasing** pressure to enhance profitability
- **Increasing** environmental concerns
- **Increasing** globalization
- **Increasing** interest in biofuels

Trade-offs among these goals



Climate and Indian Agriculture

- Indian agriculture is considerably dependant on changes in weather
- It also contributes significantly to climate change
- Need to understand the impacts of increasing climatic risks, possible adaptations, and mitigation strategies

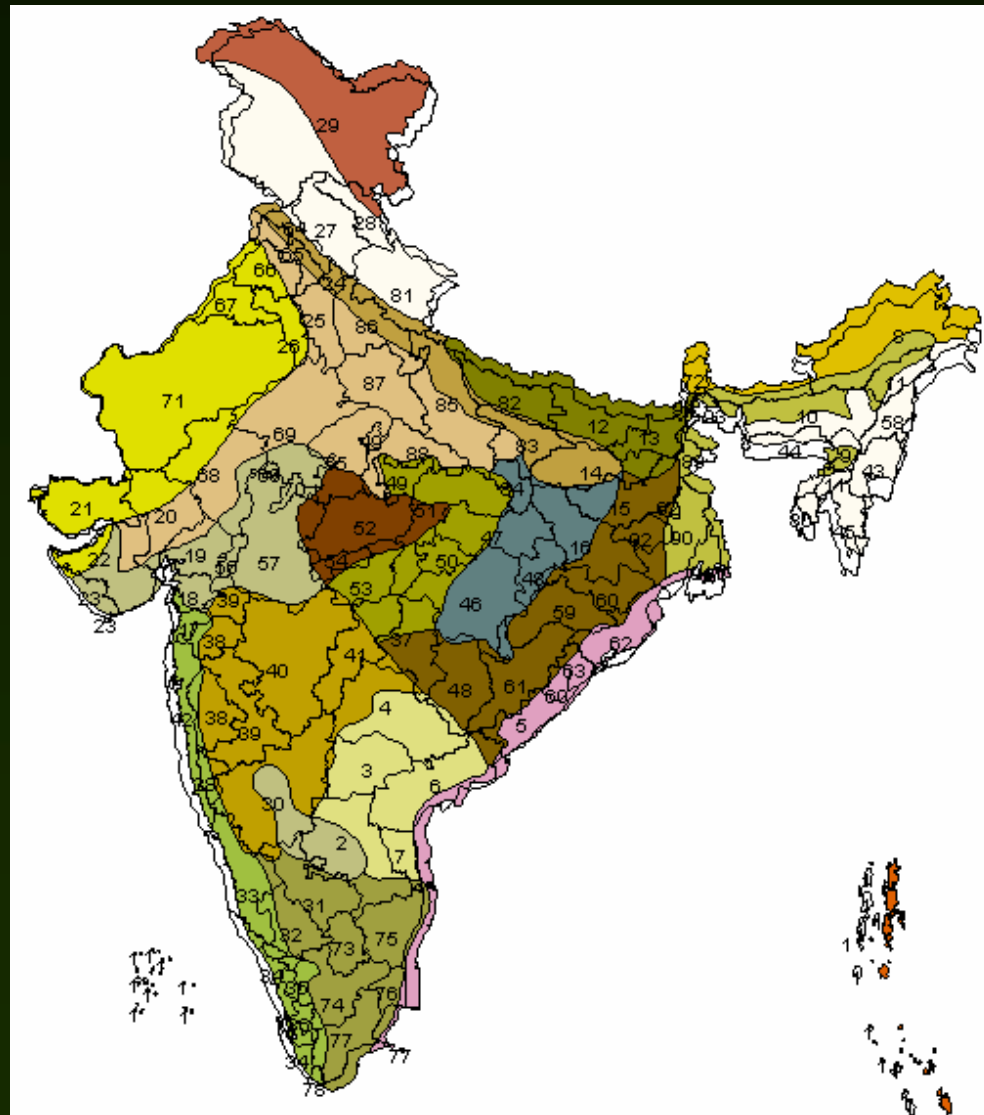


Impact of Climate Change on Food Supply

Items	Production (million tons)	Demand of food (million tons)	
		2000	2010
Rice	85.4	103.6	122.1
Wheat	71.0	85.8	102.8
Coarse grains	29.9	34.9	40.9
Total cereals	184.7	224.3	265.8
Pulses	16.1	21.4	27.8
Foodgrains	200.8	245.7	293.6
Fruits	41.1	56.3	77.0
Vegetables	84.5	112.7	149.7
Milk	75.3	103.7	142.7
Meat and eggs	3.7	5.4	7.8
Marine products	5.7	8.2	11.8



Agro-Ecological Regions

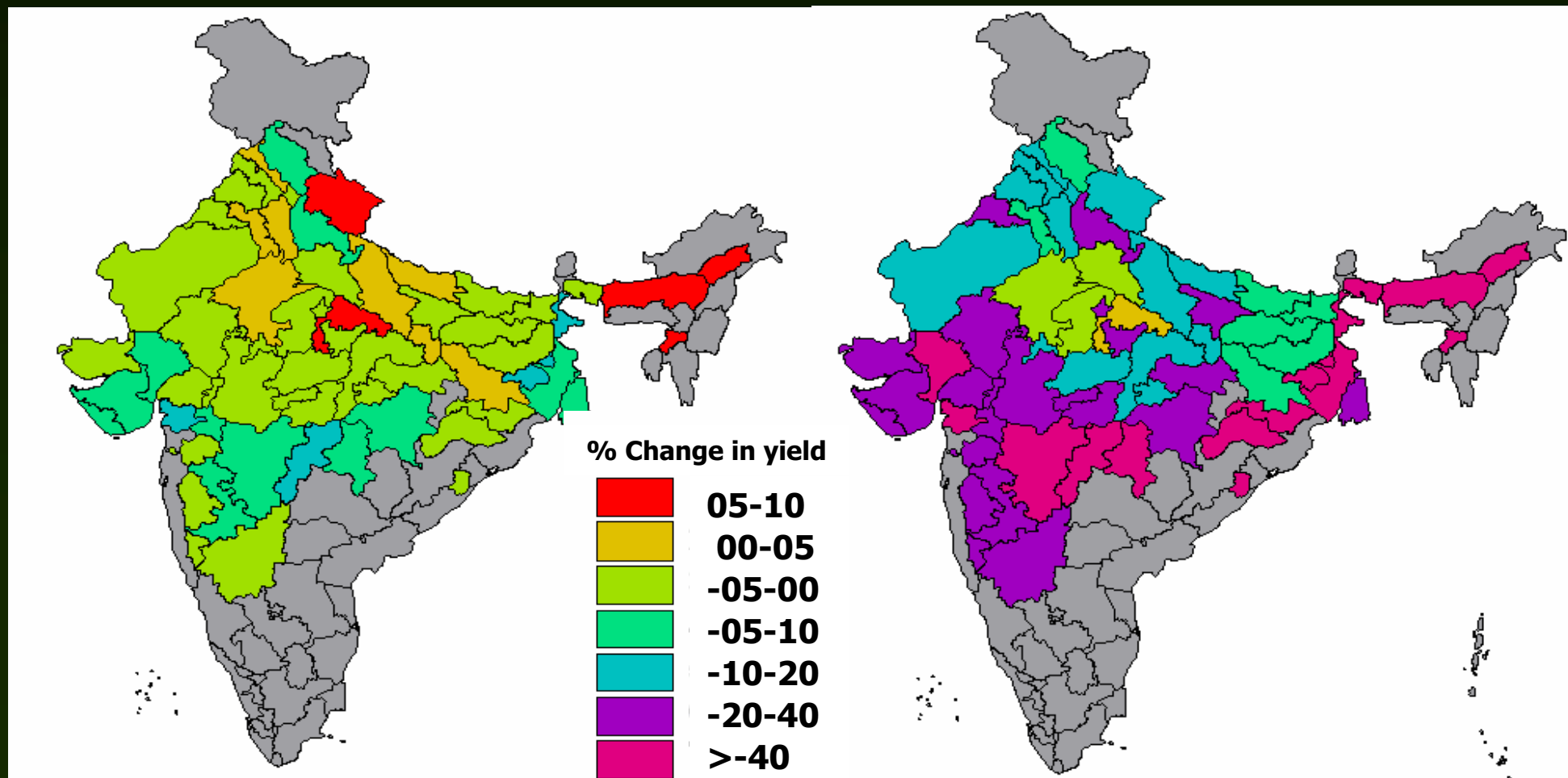




Impact of climate change on wheat yields in a pessimistic technology scenario

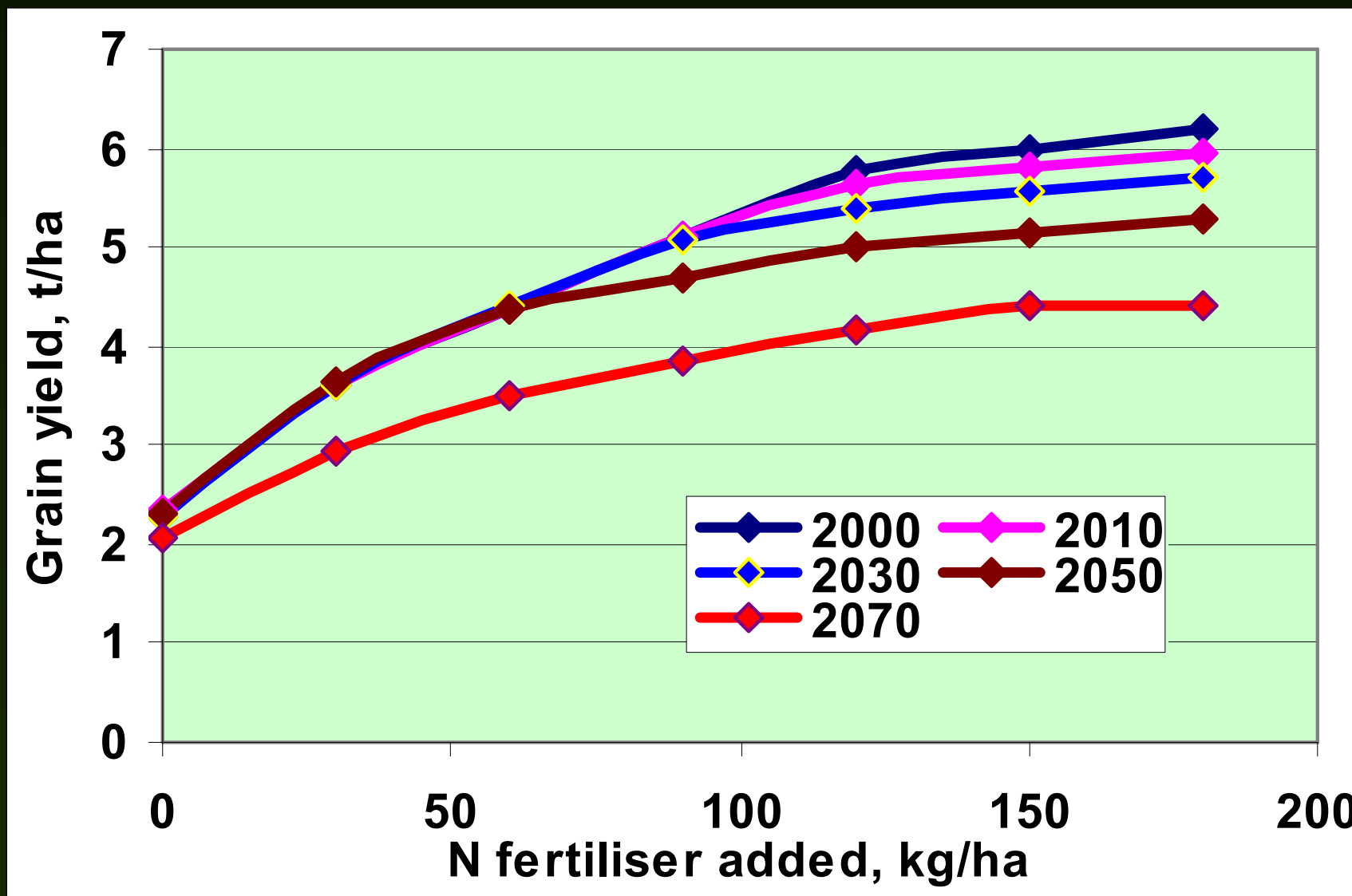
2020

2050



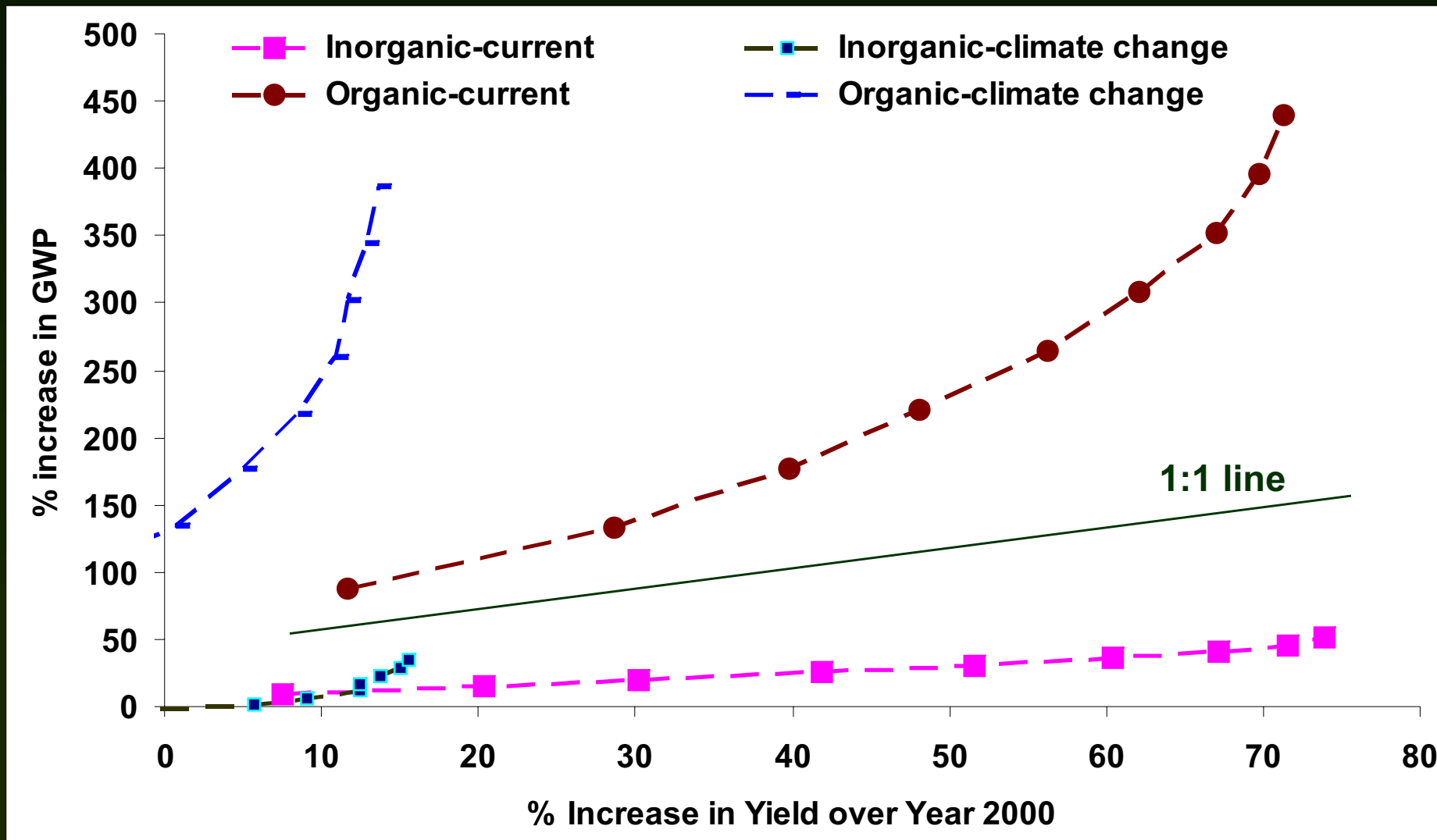


Declining Response of Wheat to Improved Management in Global Warming Scenarios





Trade-Offs between Increasing Productivity and GWP





Adaptation in agriculture is a continuous process

- 1. Agriculture diversity is a manifestation of climatic adaptation**
- 2. Farmers/society have always adapted when allowed by technology availability, their socio-economic capacity.**
- 3. Induced adaptation by innovation:**
 - Green revolution of 1960s
 - Resource conservation technologies such as zero tillage
 - GMOs

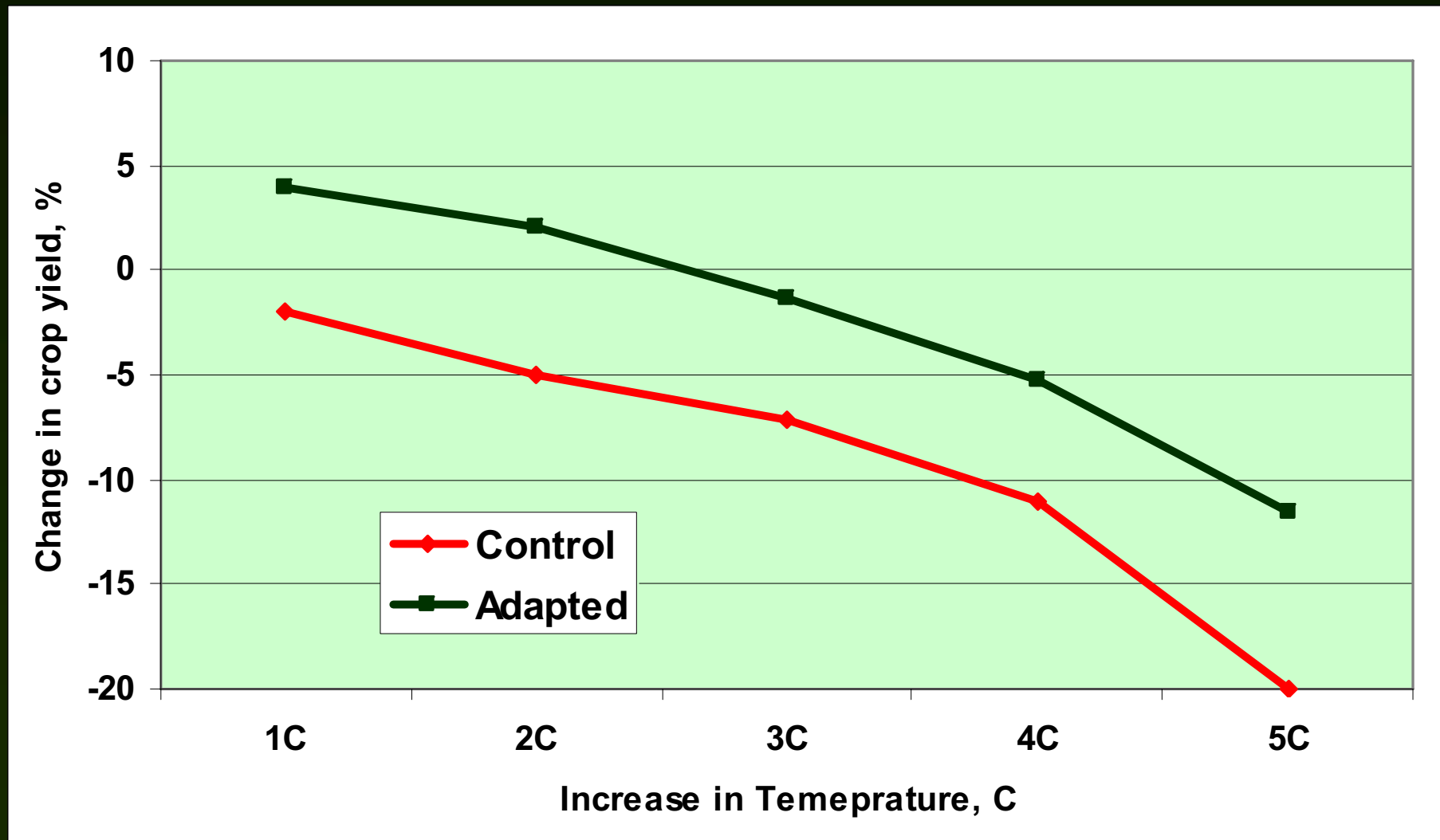


Adaptation options to climatic change: autonomous

- ❑ Changing varieties/crops
- ❑ **altering fertiliser rates**
- ❑ altering amounts and timing of irrigation
- ❑ **'harvest' water**
- ❑ conserve soil moisture (e.g. crop residue retention)
- ❑ **use water more effectively**
- ❑ altering the timing or location of cropping activities
- ❑ **diversifying income including livestock raising**



Scope of autonomous adaptations in wheat in north India in different scenarios





Adaptation options to climatic change: Planned

- Investments in adaptation research capacity
- Improved communication of climate changes and options to adapt to them
- Investments in infrastructure for water management and for product transportation and marketing
- Changes in policies and institutions, e.g. incentives for resource conservation and use efficiency
- Credit for transition to adaptation technologies
- Relocation to more productive areas
- Creating alternate livelihood options and reducing dependence on agriculture
- Greater insurance coverage for the farm

Mitigation of Climatic Change/ Feedbacks on Environment



- ❑ **Agro-forestry**
- ❑ **Resource conservation technologies**
- ❑ **Biofuels**

Mitigation: Biofuels

Jatropha-wheat intercropping



Sweet sorghum



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



Conclusions: Complex future agricultural scenario

Multi-functional agriculture for development

- Food production
- Feed, fibers, medicines
- Employment
- Environmental services: biomass-energy, recreation, tourism, pollution management, carbon sequestration



Knowledge management in agriculture: Need to understand the big picture

