



Agricultural Engineering & Farm Mechanization Options Under Climate Change Scenarios in Pakistan

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Pakistan**

Contents

- **Country's background**
- **Climate change and agriculture**
- **National policy initiatives**
- **Farm mechanization and needs for adjustments**
- **Recommendations**

PAKISTAN LANDCOVER

0 SCALE 400 Km.



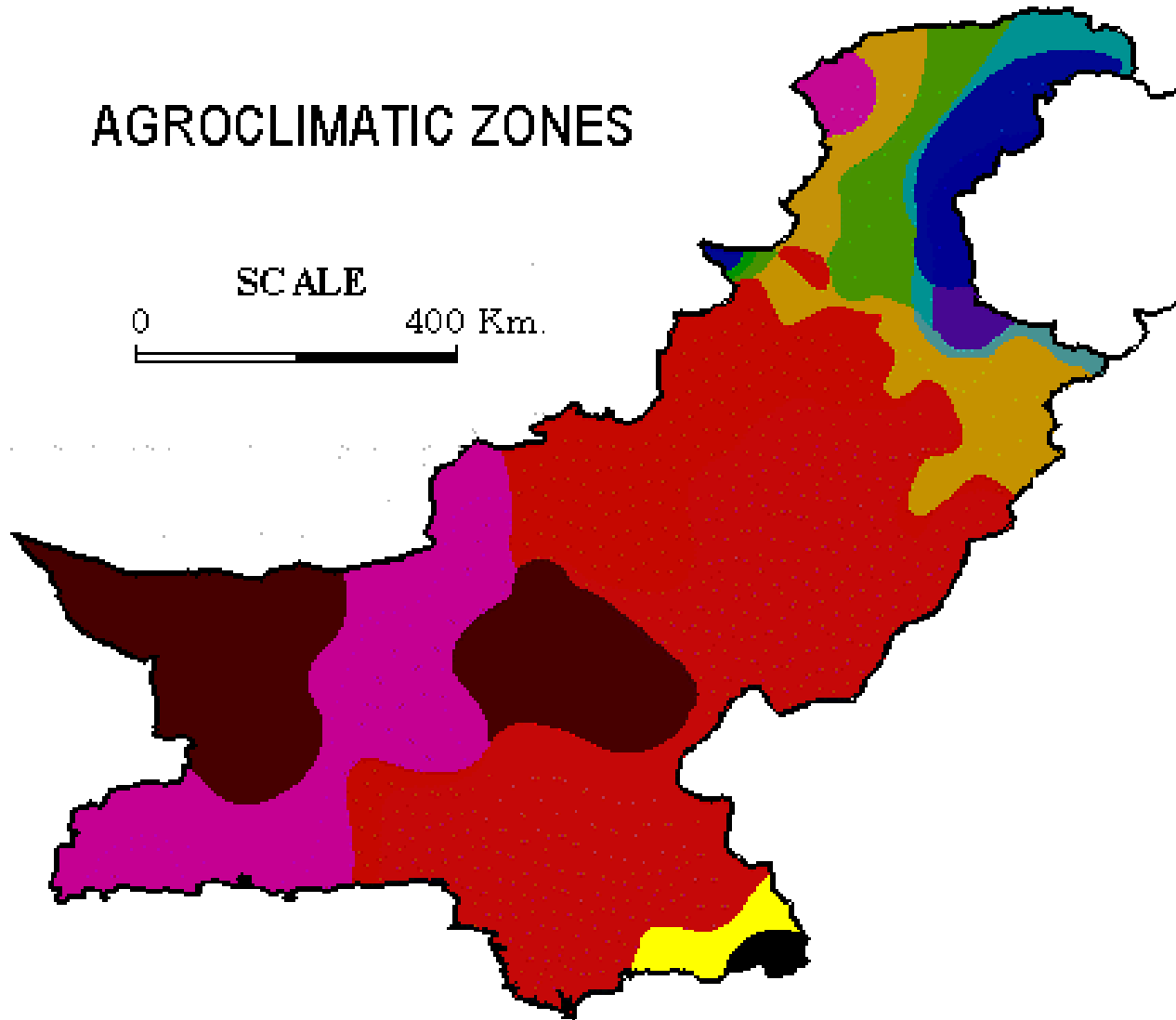
LEGEND

- Snow
- Water
- Coniferous forest
- Scrub forest
- Plantation
- Riverain forest
- Mangrove forest
- Tidal delta
- Irrigated Agriculture
- Rainfed Agriculture
- Shrub lands
- Sandy Deserts
- Rock outcrops

Data Source: NOAA image data, dated Oct.14,1992.
Developed by WRI, NARC, Islamabad, in collaboration with IUCN, Pakistan.

AGROCLIMATIC ZONES

SCALE



LEGEND

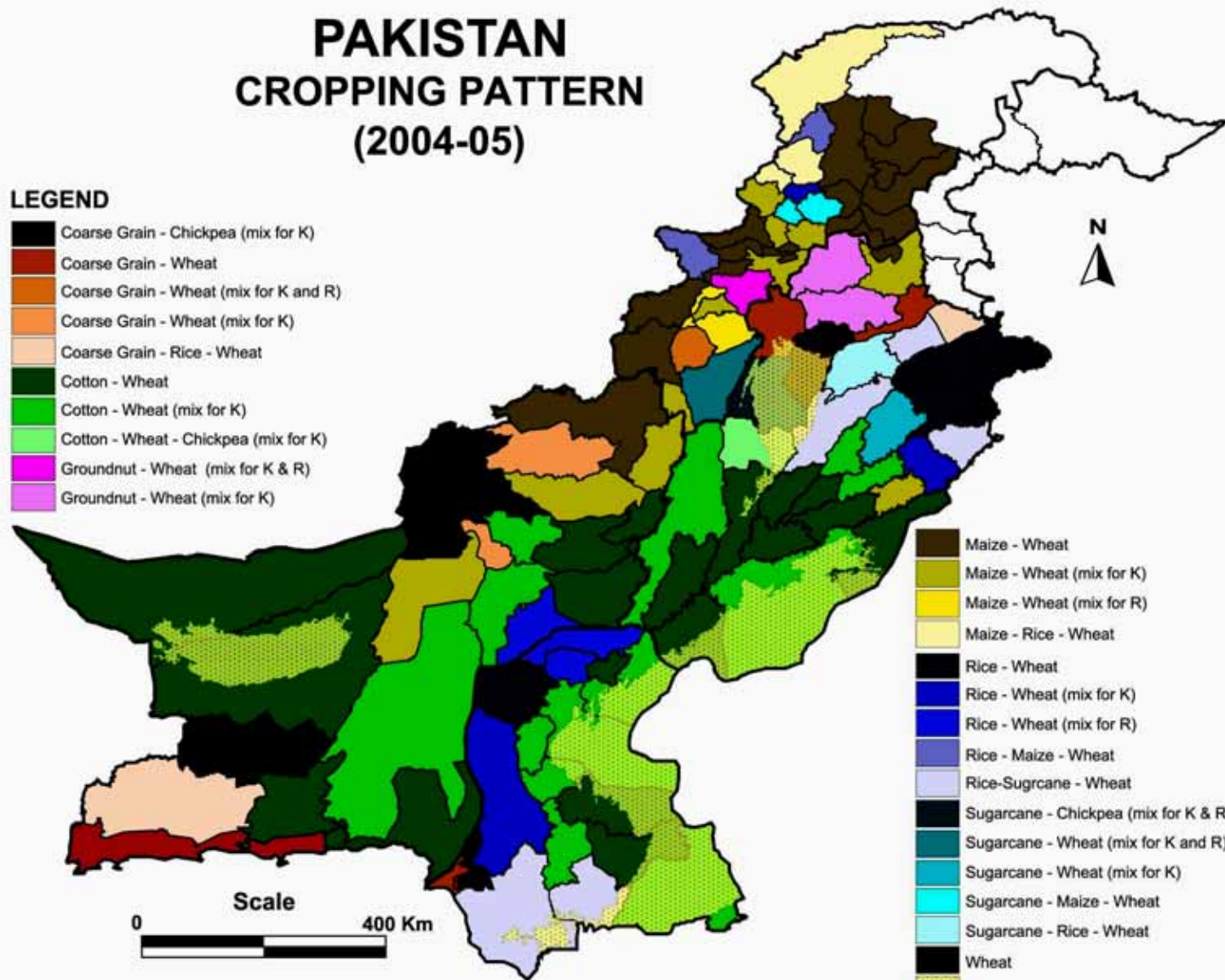
- Humid (K*, R**)
 - Humid (K), Sub-Humid (R)
 - Humid (K), Semi-arid (R)
 - Sub-Humid (K), Humid (R)
 - Sub-Humid (K,R)
 - Sub-Humid (K), Semi-arid (R)
 - Sub-Humid (K), arid (R)
 - Sub-Humid (K), Hyper-arid (R)
 - Semi-arid (K), Humid (R)
 - Semi-arid (K, R)
 - Semi-arid (K), Arid (R)
 - Semi-arid (K), Hyper-arid (R)
 - Arid (K), Semi-arid (R)
 - Arid (K,R)
 - Arid (K), Hyper-arid (R)
 - Hyper-arid (K), Semi-arid (R)
 - Hyper-arid (K), arid (R)
 - Hyper-arid (K,R)
- * Kharif ** Rabi

Data Source: Pakistan Meteorological Department & W/RRI, NARC, Islamabad.

PAKISTAN CROPPING PATTERN (2004-05)

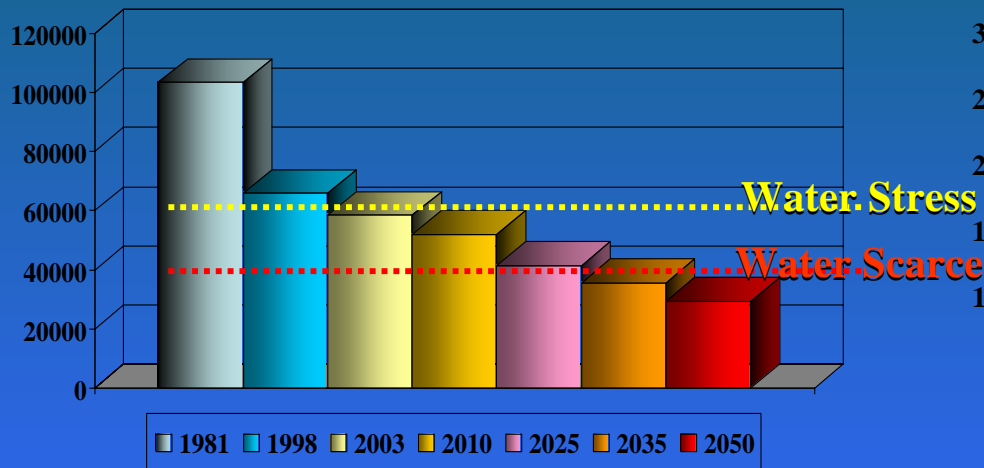
LEGEND

- Coarse Grain - Chickpea (mix for K)
- Coarse Grain - Wheat
- Coarse Grain - Wheat (mix for K and R)
- Coarse Grain - Wheat (mix for K)
- Coarse Grain - Rice - Wheat
- Cotton - Wheat
- Cotton - Wheat (mix for K)
- Cotton - Wheat - Chickpea (mix for K)
- Groundnut - Wheat (mix for K & R)
- Groundnut - Wheat (mix for K)

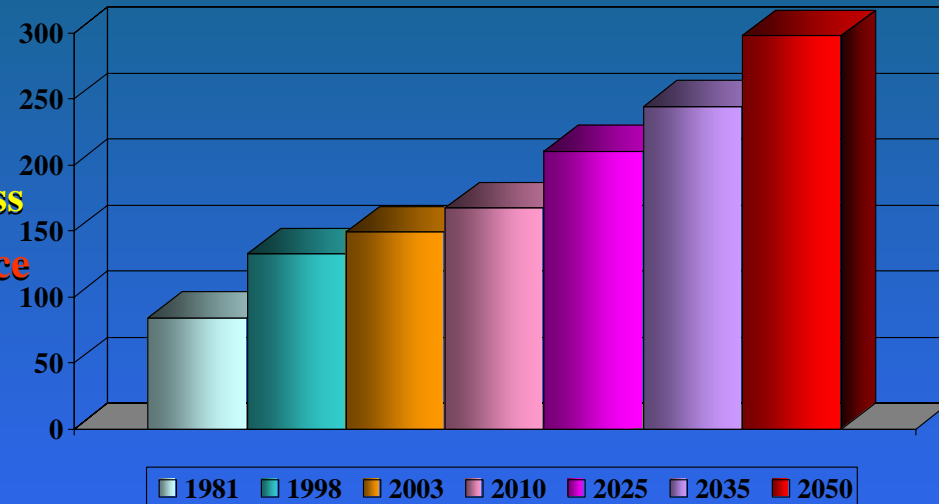


Data Source: Agriculture Statistics Division (Economic Wing), MINFAL, Govt. of Pakistan.
Developed by: RUP, WRRRI, NARC/PARC (2007).

Per Capita Water Availability (ft³/year)



Population (millions)

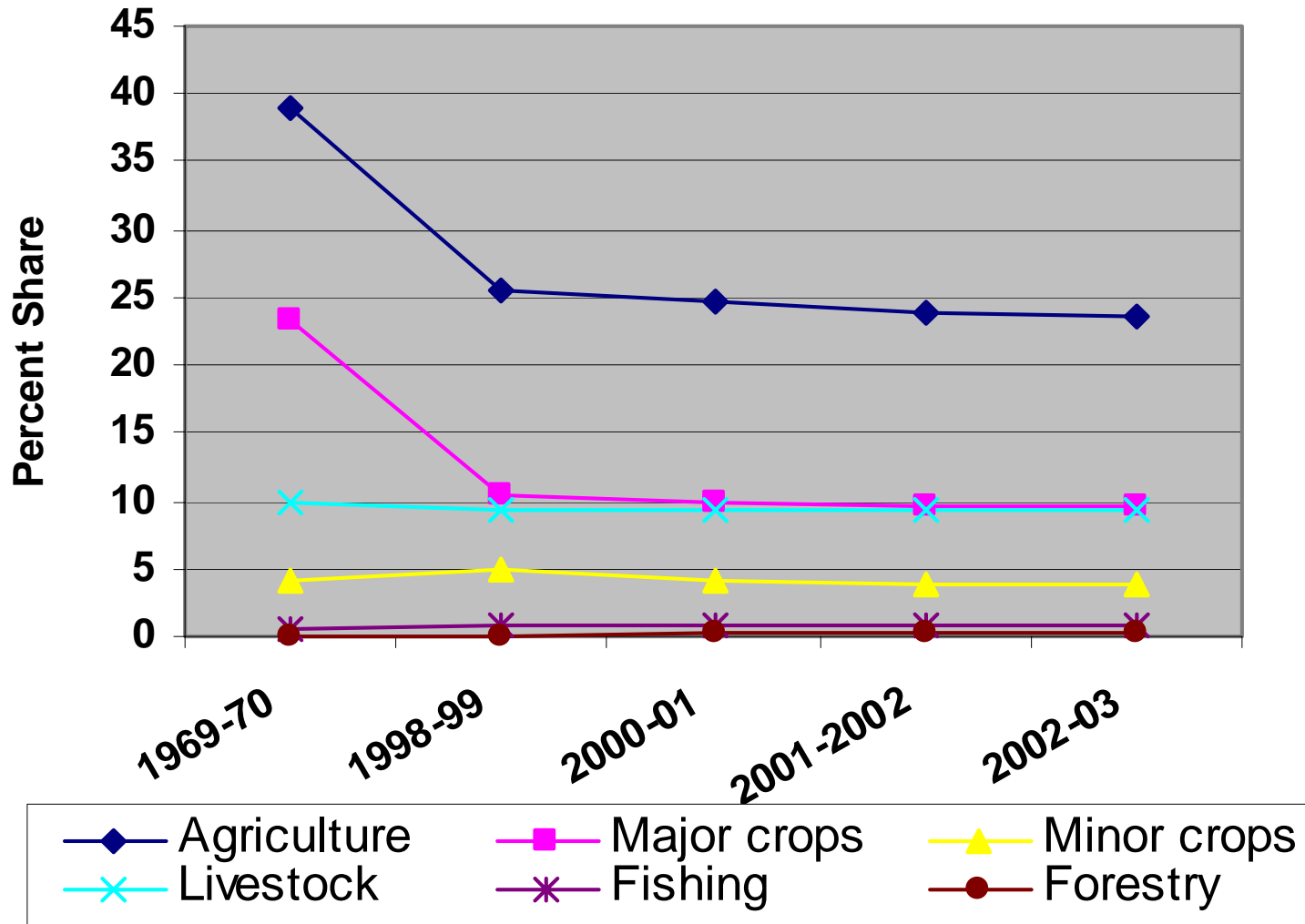


Land utilization statistics (million ha)

| | |
|-----------------------------------|--------------|
| Geographical area | 79.61 |
| Forest area | 4.01 |
| Not available cultivations | 24.32 |
| Culturable waste | 9.00 |
| Cultivated area | 22.15 |
| Current fallow | 6.61 |
| Net area sown | 15.54 |
| Area sown more than once | 6.97 |
| Total cropped area | 22.51 |

Source: GOP, 2005

Share of Agriculture in GDP



Land utilization over time (%)

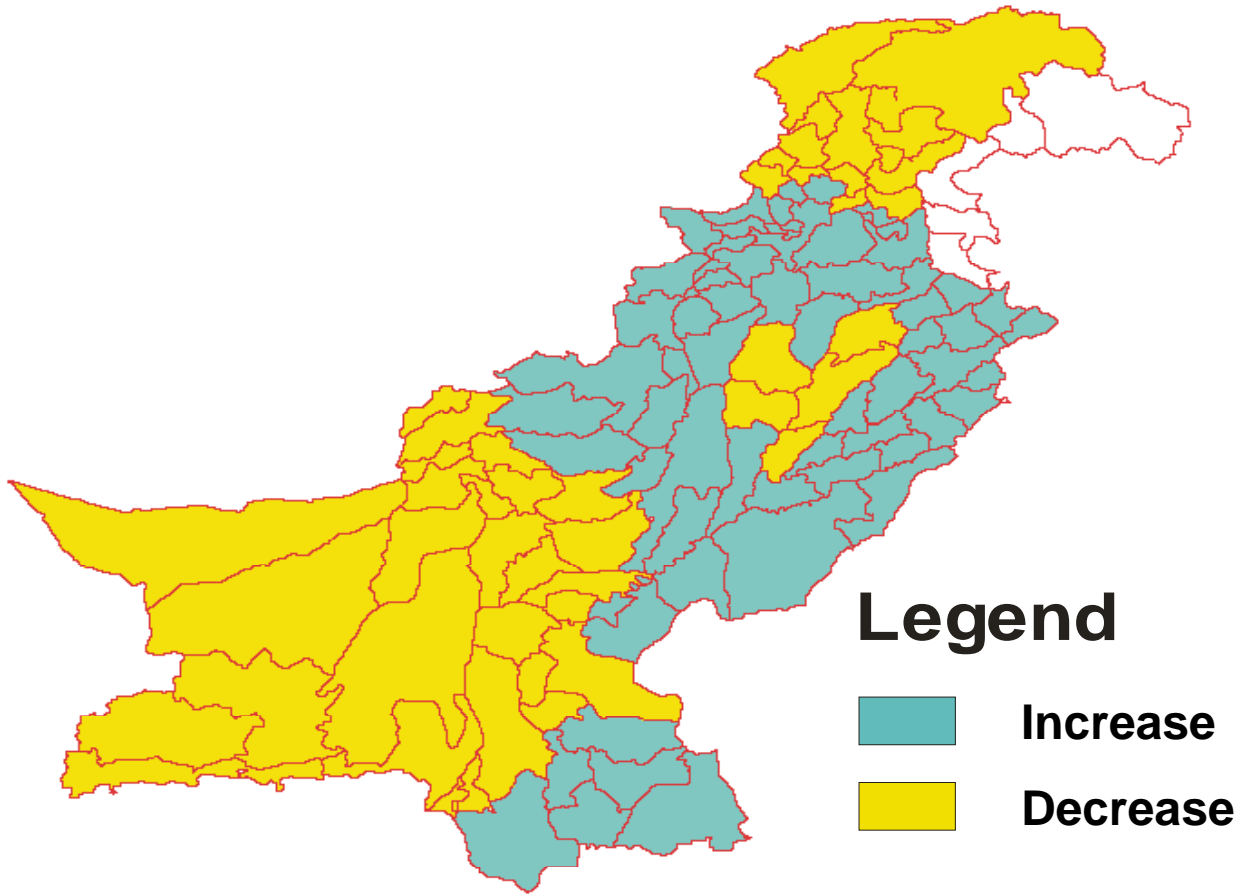
| Land use | 1960 | 1972 | 1980 | 1990 | 2000 |
|-----------------------|------|------|------|------|------|
| Farm area cultivated | 76 | 83 | 83 | 82 | 81 |
| Area net sown | 86 | 92 | 95 | 96 | 94 |
| Intensity of land use | 84 | 89 | 89 | 87 | 85 |
| Cropping intensity | 103 | 111 | 122 | 137 | 142 |

Source: GOP, 2005



Climatic Trends

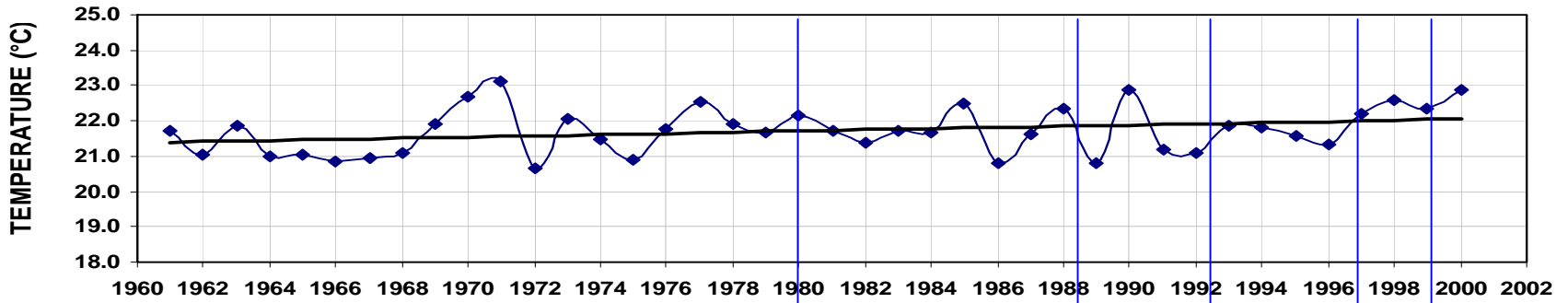
- **Increasing concentration of CO₂ in the atmosphere**
 - **Pre-industrial revolution (1789) 280 ppm**
 - **Present (2004) 383 ppm**
 - **Expected level (2050) 550 ppm**
- **Rising surface temperatures**
 - **Global Av. Temp. rise (20th century) 0.6 ° C**
 - **Projections for 2100 1.4 to 5.8 ° C**
- **Changing rainfall patterns**
 - Increase in monsoon rainfall in sub-humid and humid areas**
 - Decrease in winter and summer rainfall in coastal belt and hyper arid plains**



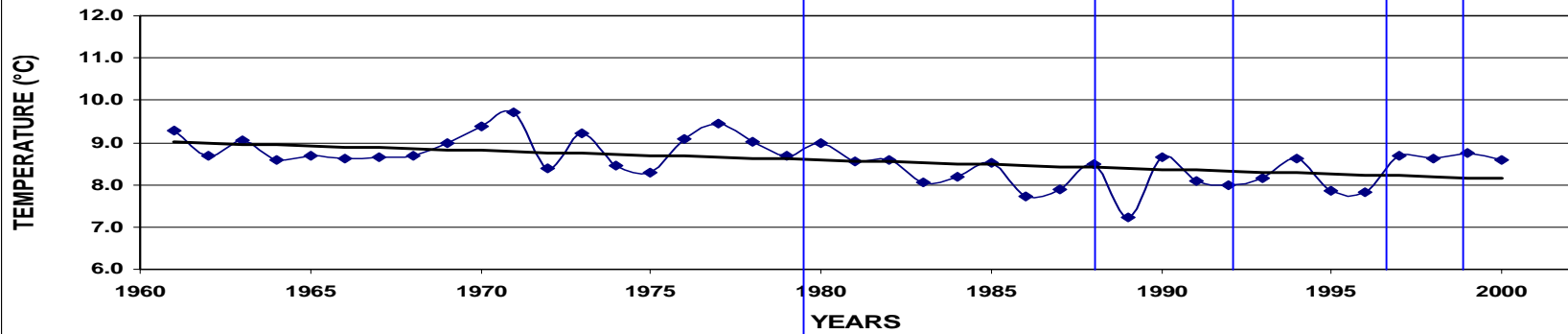
**Change in Mean Temperature during
1961-90 from that of 1931-60**

Fig-2(a)

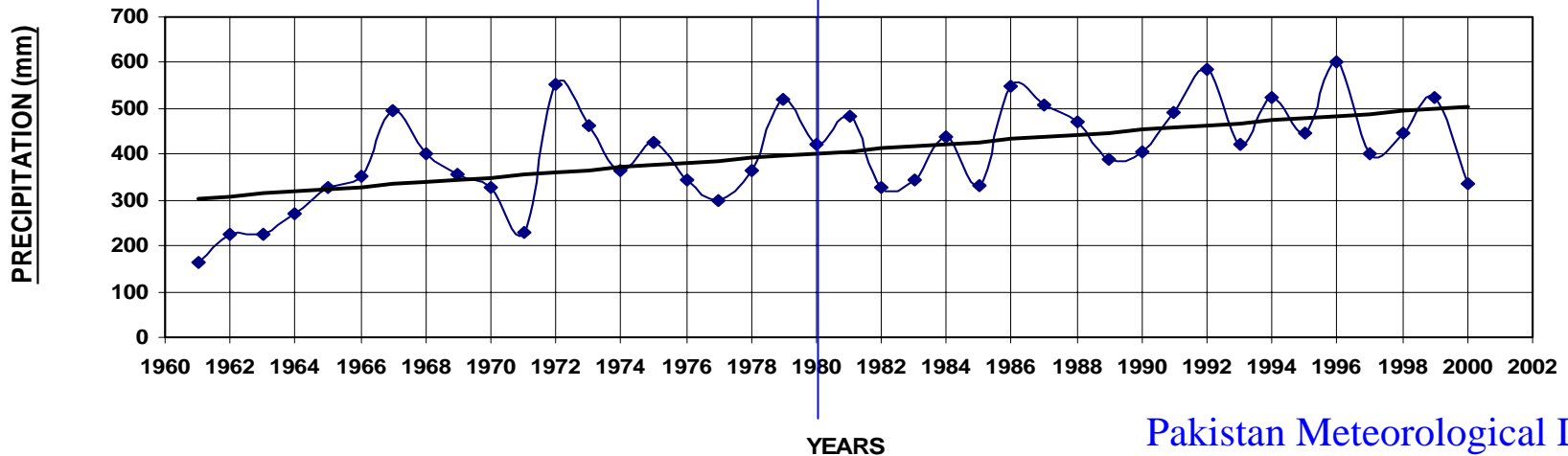
MAXIMUM TEMPERATURE PATTERN IN NORTHERN AREAS DURING (1961-2000)



MINIMUM TEMPERATURE PATTERN IN NORTHERN AREAS DURING (1961-2000)



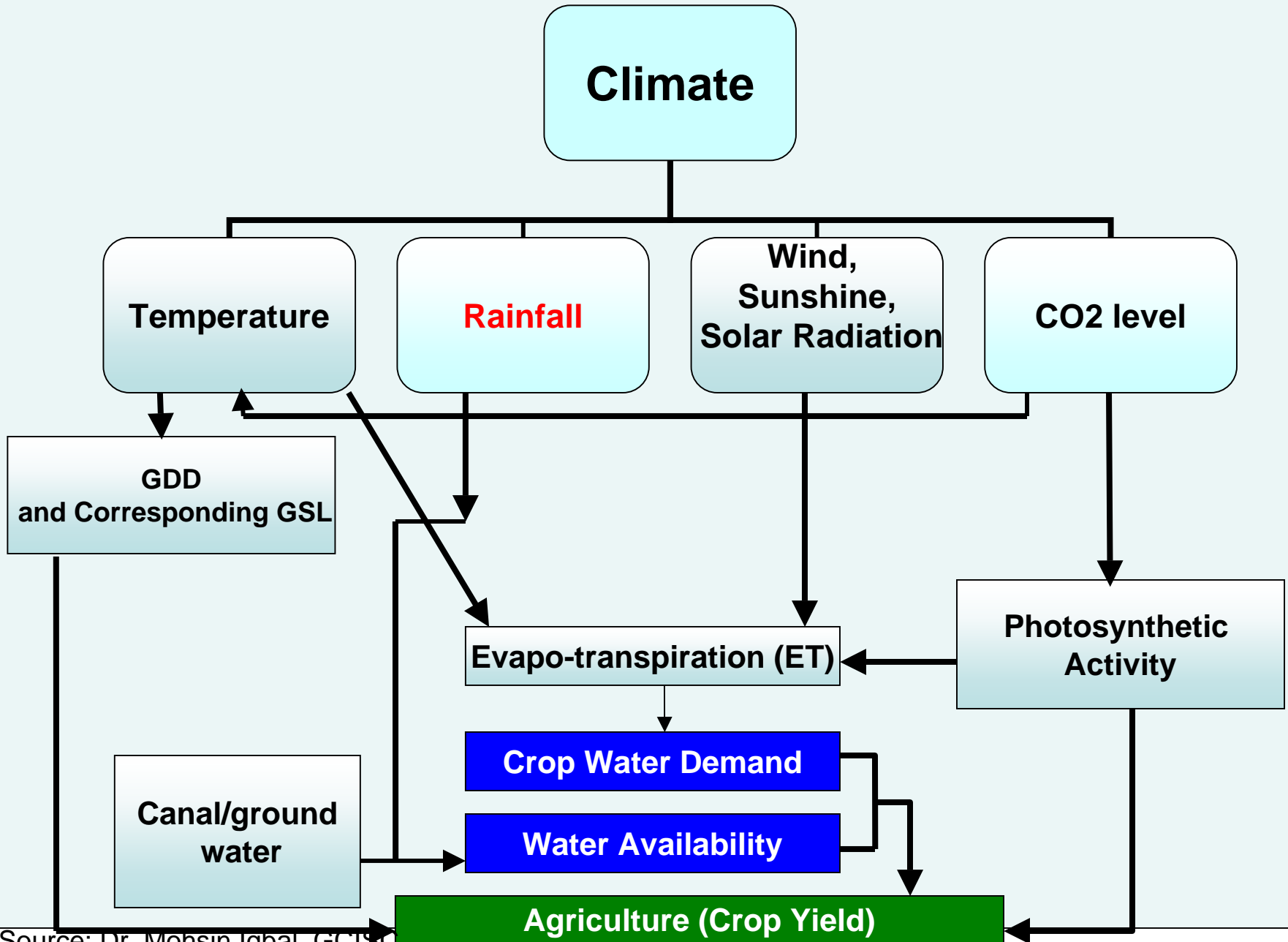
RAINFALL PATTERN IN NORTHERN AREAS DURING (1961-2000)



Annual Water Availability (Western Rivers)

| Probability (%) | Rim Station Inflows (billion m ³) | |
|-----------------|---|---------|
| | 1937-67 | 1968-96 |
| Minimum | 134.5 | 114.9 |
| 10 | 143.9 | 135.5 |
| 25 | 163.1 | 153.2 |
| 50 | 173.0 | 162.1 |
| 75 | 184.9 | 180.9 |
| 90 | 198.2 | 189.6 |
| Maximum | 231.7 | 206.0 |

Climate-Water-Agriculture Linkages



Climate change research in Pakistan

- ***Physical Indicators***

 - Water Resources**

 - **Glaciers & glacial lakes**
 - **GLOFs**
 - **River flows**
 - **Climate**

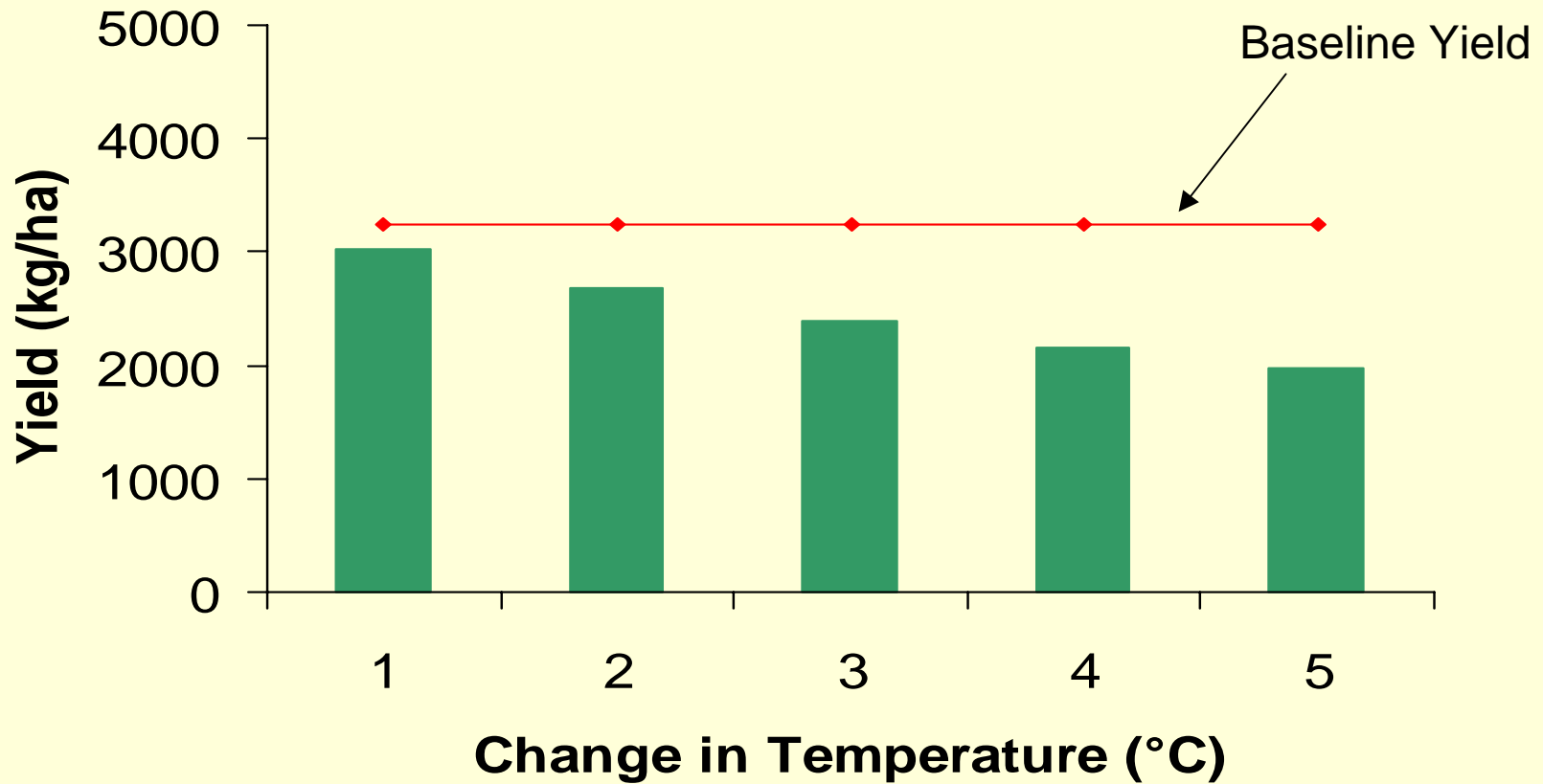
- ***Biological Indicators***

 - **Agriculture**
 - **Natural Ecosystems**

If only Temperature Changes

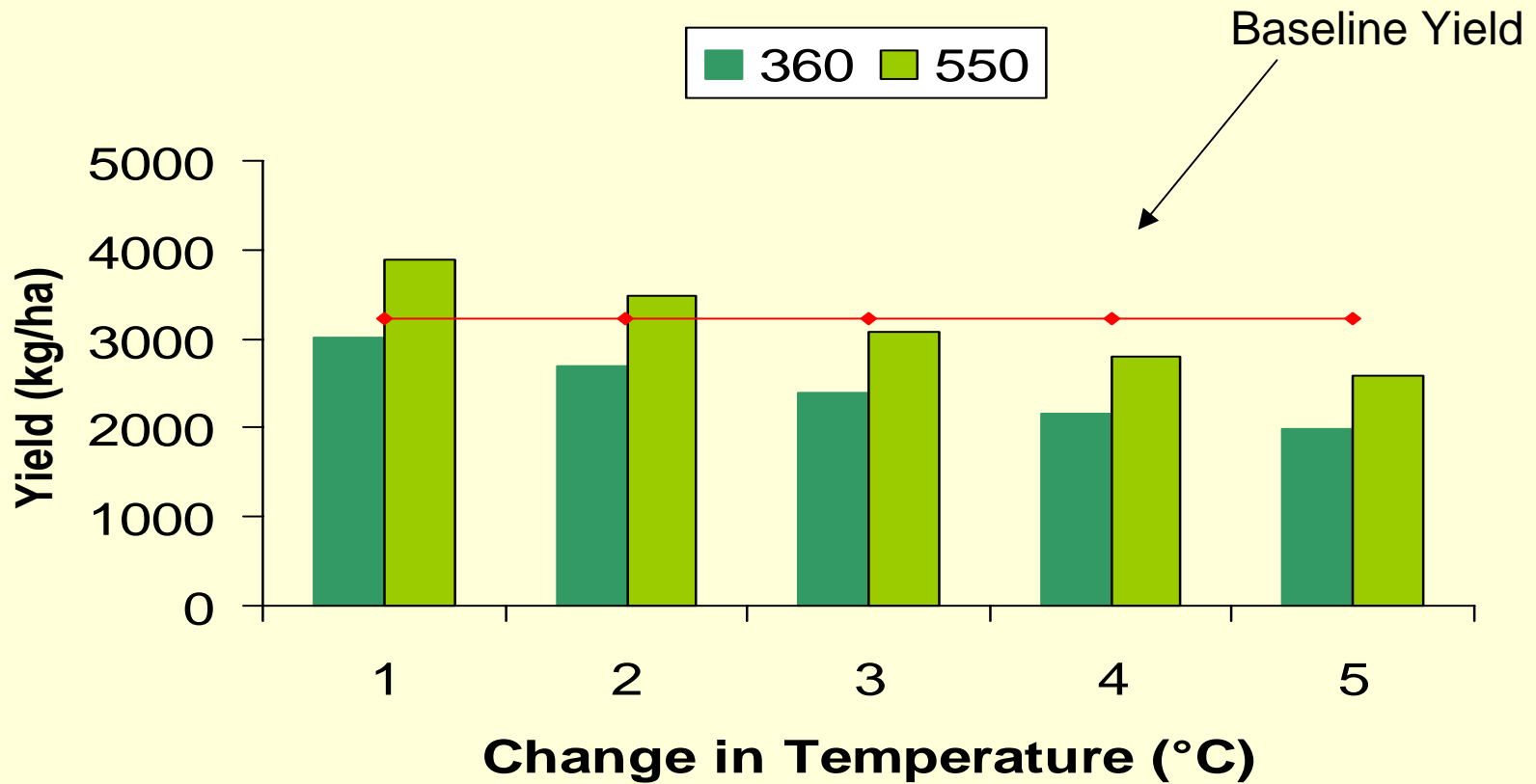
(Semi-Arid Areas)

(CO₂ Level = 360 ppm)



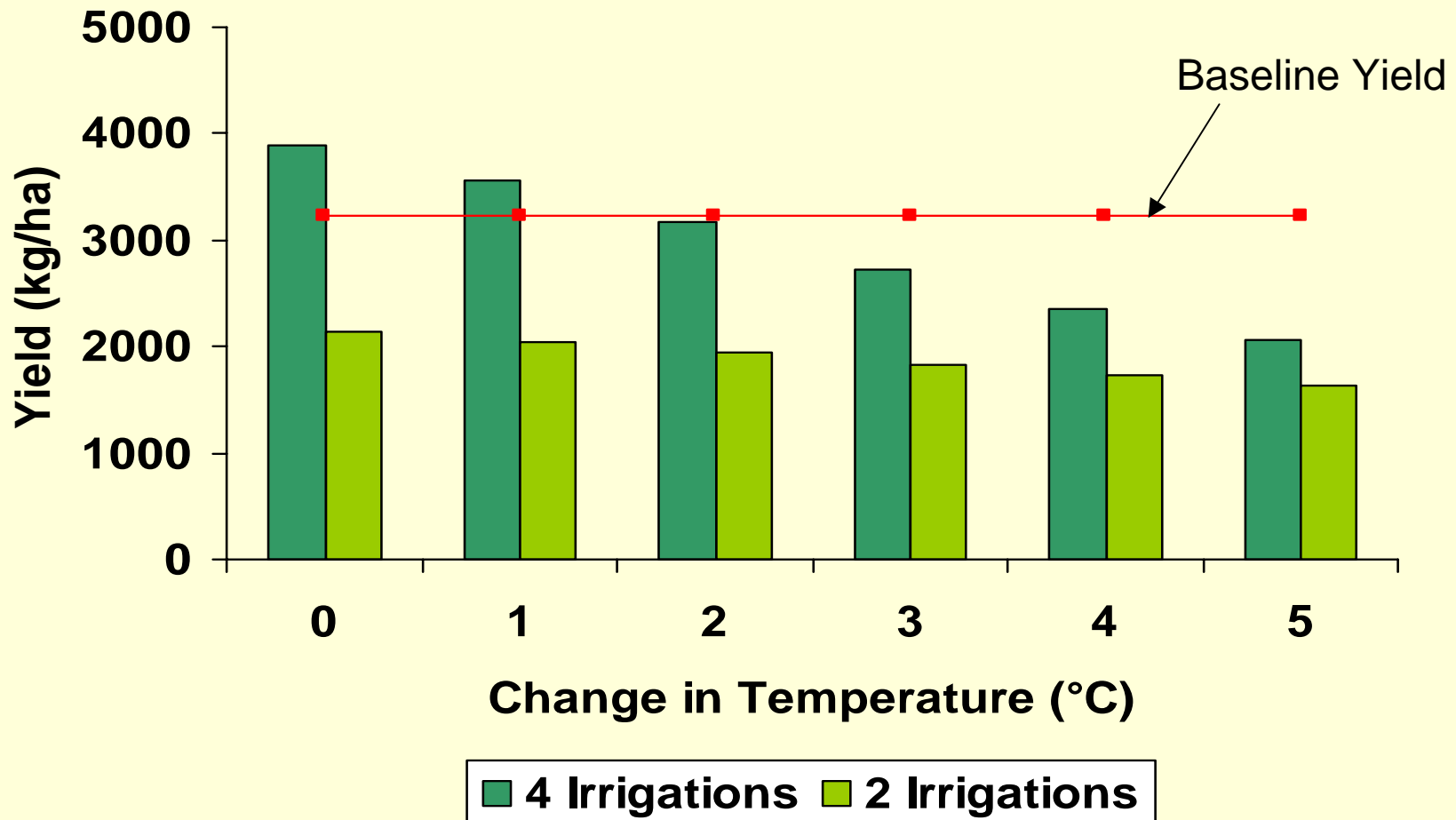
If both CO₂ and Temperature Change

(Semi-Arid Areas)



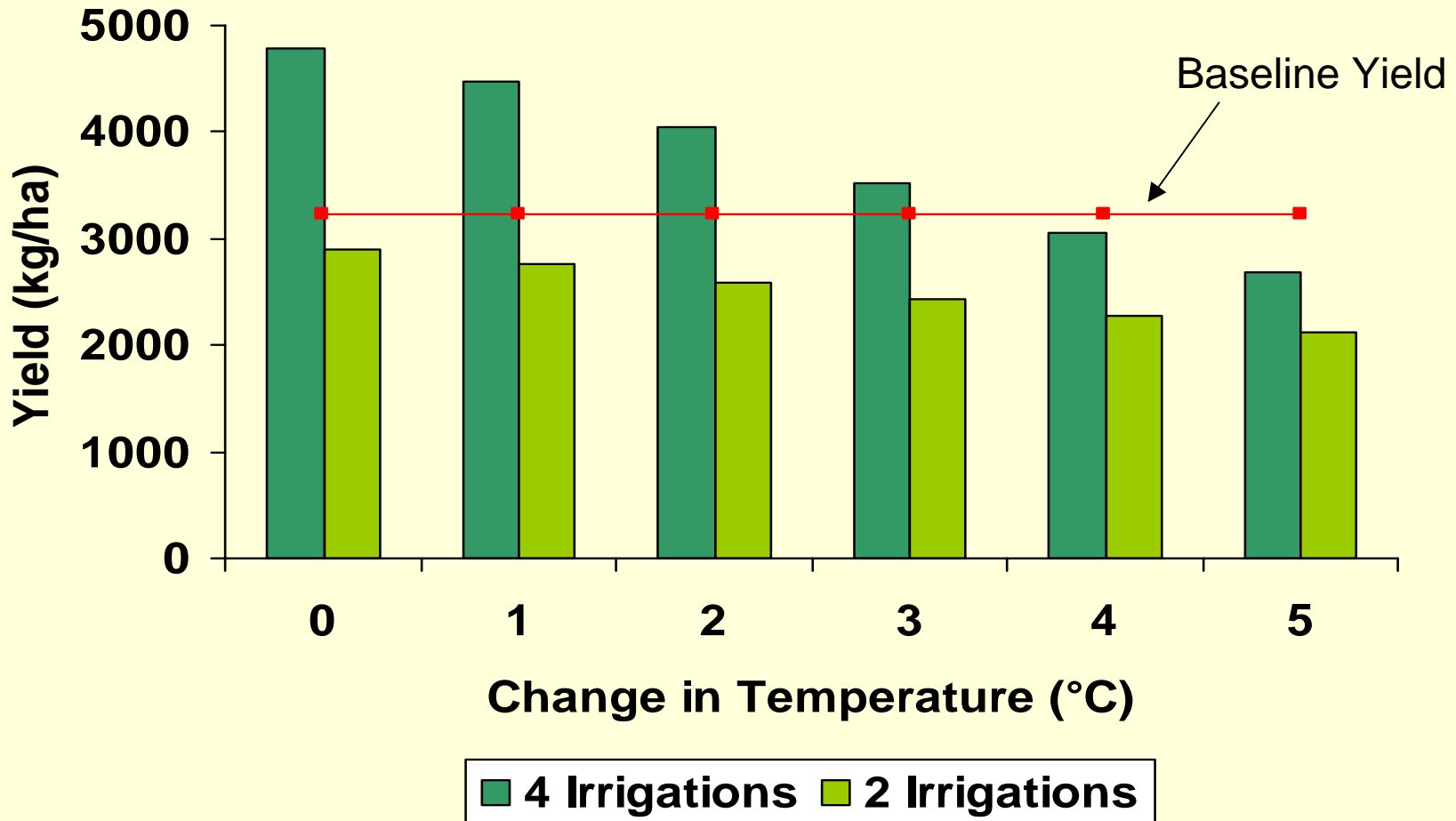
If both Water Availability and Temperature Change

(CO₂ Level = 360 ppm)



If both Water Availability and Temperature Change (Semi-Arid Areas)

(CO₂ Level = 550 ppm)

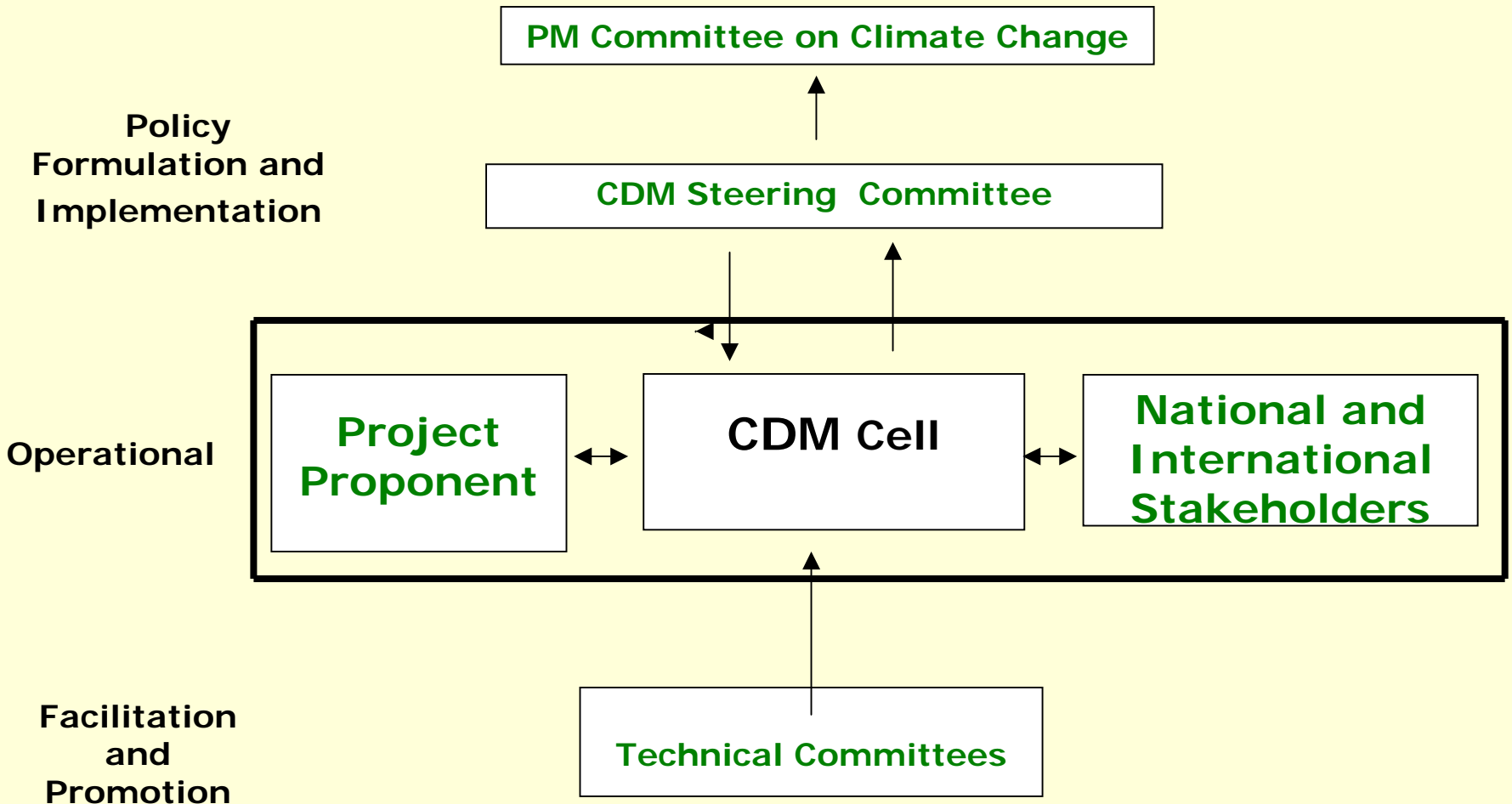


National Policy Initiatives

- **Pakistan Environment Protection Act-1997**
- **Pakistan Environmental Protection Ordinance - 1983**
- **Enactment of National Conservation Strategy - 1992**
- **Forestry Sector Master Plan and NCS plan of Action and the finalization of a National Environmental Action Plan (NEAP) -February 2001**
- **Establishment of Global Change Impact Studies Centre-2002**
- **Establishment of Alternate Energy Board**

**Climate Change
&
Clean Development
Mechanism
(CDM)**

Institutional Set-up for CDM



Farm Machinery Institute NARC

Promotion of agricultural mechanization in the country through designing, performance evaluation and commercialization of appropriate farm machinery

- crop establishment engineering**
- harvesting and threshing engineering**
- post harvest engineering**
- industrial and mechanization research**
- farm machinery testing and standardization.**

Developed and commercialized

- **paddy transplanter**
- **zero-till drill**

Working on

- **pneumatic row crop planter**
- **hold-on paddy thresher**
- **solar dryer for fruits and vegetables**
- **dual mode drill**

Needs for Adjustment in AE & FM

- **Energy**
 - Improvement in fuel efficiency in agricultural machinery
 - Commercialization of wind/Solar power potential
 - Development and commercialization of cost effective solar panels
 - Biofuel
 - Biogas production units

- **Farm Operations**
 - Low cost laser leveler
 - Minimum/zero tillage
 - Furrow-Bed plantation to save water

Continued...

• **Water Resources**

- **Better techniques for determining crop water requirements or irrigation demand preferably using RS/GIS techniques**
- **Efficient Irrigation systems like sprinkler, trickle or Central Pivot systems**
- **The water injection cum fertilizer drill can be one of the solutions for timely sowing, particularly rainfed crops**
- **To address the low Irrigation efficiency**
 - Development and commercialization of low-cost geo-membrane liners for lining of canals and watercourses**
- **On-farm rainwater harvesting and storage structures**

Continued...

- **Livestock**
 - **Environmental management systems and preventing pollution for intensive animal production units**
 - **Animal housing and storage structures with ventilation systems, temperature and humidity controls, and on-farm waste management**
- **Nursery & Greenhouse Engineering**
 - **For off season vegetables and nursery development cost effective greenhouse/plastic tunnel structures need to be developed**
 - **Equipment for hydro-ponic cultivation??**

Recommendations

- **Strengthen international partnerships to address the expected threats of climate change**
- **The regional information/data sharing should be encouraged**
- **Education in climate change**
- **System approach is required to integrate the entire farm activities**

• Continued....

- **Water management and cost effective efficient irrigation systems**
- **Tapping renewable energy sources and improving fuel efficiency in agricultural machinery**
- **Use of new tools and techniques like GIS, RS & simulation modeling for characterization and system analysis under changing climate**
- **Facilitate greater adoption of scientific and economic pricing policies, especially for water**
- **CDM Projects for small scale enterprise**

Thank you



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