

Climate Change Impact Assessment and Adaptation in Pakistan

Nazim Ali

nazim.ali@gcisc.org.pk



Global Change Impact Studies Centre
1st Floor, Saudi-Pak Tower, Islamabad
Pakistan, (<http://gcisc.org.pk>)

Outline of Presentation

- Climate Change: Global Overview
- Climate Change Pakistan Country Experience
 - Impact Assessment on Natural Resources
 - Adaptation
- Global Change Impact Studies Centre (GCISC)
Work on Climate Change Impact Assessment
and Adaptation Measures

Changes in Human and Natural Drivers of CC

- CO₂ concentrations have increased from 280 ppm (since 1750) to 368 ppm in 2000 (31.4%) to 379 in 2005 (35.4% rise)
- CH₄ concentrations have increased from a pre-industrial value of about 715 ppb to 1732 ppb in early 1990s (142% rise) and is 1774 ppb in 2005 (148% rise). The rise since 1990s is only 2.4%. Growth rates have declined since early 1990s
- N₂O concentrations have increased from a pre-industrial value of about 270 ppb to 319 ppb in 2005 (18% rise). The growth rate has been approximately constant since 1980s. More than a third of all N₂O emissions are anthropogenic and are primarily due to agriculture

Changes in the Climate System

- **Temperature**

- 11 of the last 12 years (1995-2006) except 1996 rank among the 12 warmest years in the instrumental record of global surface temperature (since 1850).
- Widespread changes in extreme temperatures have been observed over the last 50 years. Cold days, cold nights and frost have become less frequent, while hot days, hot nights, and heat waves have become more frequent

Impact of Climate Change on Pakistan (Climate Change Studies)

- Study on Climate Change Impact Assessment and Adaptation Strategies Study for Pakistan, 1998, Ministry of Environment, Local Government and Rural Development & UNEP & GEF
- Developing Strategies for Climate Change: The UNEP Country Studies on Climate Change Impacts and Adaptations Assessment, Center for International Climate and Environmental Research & UNEP, 2000-02
- Pakistan's Initial National Communication on Climate Change, Government of Islamic Republic of Pakistan, Ministry of Environment Islamabad-Pakistan , 2003
- Water Resources in South Asia: An Assessment of Climate Change Associated Vulnerabilities and Coping Mechanism, 2002

Scenarios For Climate Change Impact Assessment in PINCCC, 2003

Variables

Limits/Periods

Temperature

+0.3 °C/decade

Rainfall

±1.0% /decade

Carbon dioxide

360, 550 ppm

Climatic data baseline

1961-90

Prediction scenario

+0.9 °C and +1.8 °C in
2020 and 2050

Rainfall

0%

±3% rainfall

±6% rainfall

Prediction periods

2020, 2050

Impacts on Hydropower Generation at Main Dams (PINCCC)

<i>Scenarios Changes in Percent</i>	<i>Years</i>			
	<i>2000</i>	<i>2010</i>	<i>2020</i>	<i>2050</i>
0.3 °C & +0% PPT	0	0.04	0.03	0.22
0.3 °C & +1% PPT	0.02	0.86	1.98	4.32
0.3 °C & -1% PPT	-0.01	-0.83	-1.46	-3.85

Impacts on Agriculture (PINCCC,2003)

- Fourteen crops were considered for impact assessment (at 0.3°C per decade). All the selected crops were found to be suffering due to heat stress.
- significant increase in growing degree days reduces the growing season length for the crop.
- 8% and 15% increase in GDD in 2020 and 2050.
- With rainfall decreases by 6%, net irrigation water requirements could increase by 29%.

Impact on Forest (PINCCC,2003)

- Cold and temperate conifers will show a northward shift, pushing against the cold conifer/mixed woodland,
- The increase in temperature scenario tended to increase NPP in all biomes in the year 2020 and 2050. Under increase or decrease in rainfall scenarios, the NPP of all biomes did not show much increase in the years 2020 and 2050.
- The average Net Primary Productivity (NPP) increase of different biomes, over the base year of 1990 is estimated as 12% in the year 2020 and 19% in the year 2040-50 (calculated) under the climate change scenarios.

Adaptation: Water Resources (PINCCC)

- Measures to Improve System Efficiency
- Watershed Management
- Urban Water Use
- Water Quality and Environmental Protection
- Flood Control
- Weather Forecasting and Information Network for Farmers
- Adaptations in Policy Planning

Adaptation: Agriculture (PINCCC)

- Changes in Cropping Patterns
 - Sugar beet instead of sugarcane
- Adjusting Cropping Pattern with Water Availability
 - More share of cropped area under oil seed crops
- Improved Productivity and Production Management
 - Farm forestry

Adaptation: Forests (PINCCC,2003)

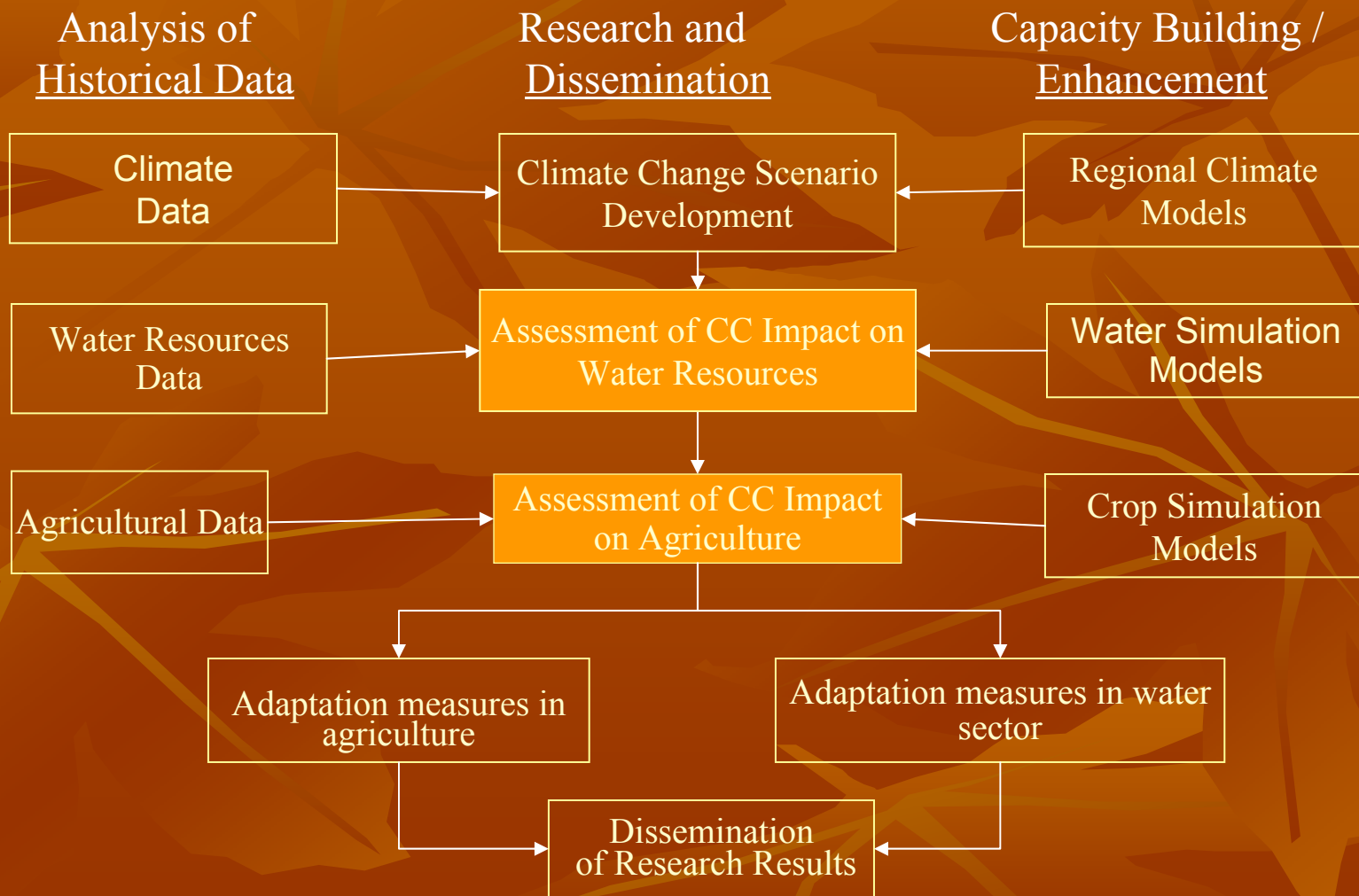
- **Pest Control:** The biological control of forest pests is a very important adaptation measure.
- **Change in Species:** Special attention shall have to be given to those tree species which have poor seed production and dispersal, which occupy ecological niches, have small populations and restricted ranges and are peripheral.
- **Preservation of Watersheds:** to control sediments towards downstream
- **Control of Wastage:** Use of Waste wood to produce composite wood

Global Change Impact Studies Centre

The main objectives of the Centre are:

- to keep a track of the current and likely future trends of global change (climate change, technological change etc.);
- to analyse and evaluate their likely impacts on the socio-economic development in Pakistan;
- to identify how science and technology may be called upon to cope with the adverse impacts, if any, and to advise national planners on the appropriate strategic approaches;
- to enhance national capacity for Climate Change research;
- to raise public awareness of Climate Change related issues.

GCISC Research and Capacity Building Activities at a Glance



Scenarios of temperature and precipitation change in Northern and Southern parts of Pakistan as worked out by GCISC Climatology Section from an ensemble of six GCM outputs

Time Horizon	CO ₂ Concentration (ppm)	Northern Pakistan		Southern Pakistan	
		ΔT (°C)	(ΔP/P)%	ΔT (°C)	(ΔP/P)%
Scenario A2					
2025	430	1.00	1.03	1.03	36.84
2055	545	2.69	2.74	2.48	41.30
2085	720	4.98	1.95	4.34	52.54
Scenario B2					
2025	415	1.14	-0.33	1.24	37.50
2055	485	2.50	1.16	2.37	45.84
2085	565	3.75	3.61	3.47	44.91

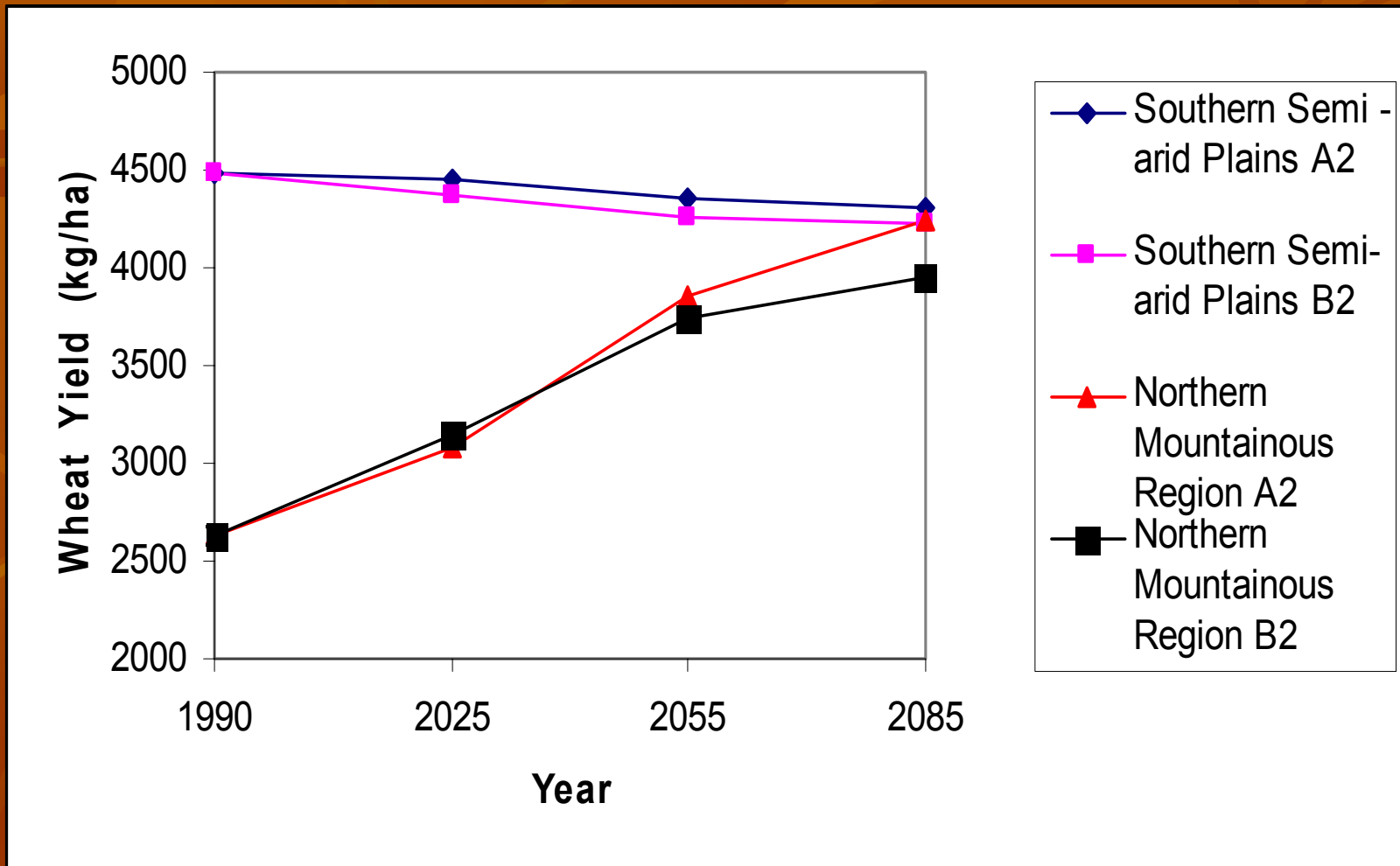
Climate Change Impact on Wheat Production in Pakistan by 2085 under A2 and B2 Scenarios

Region	% Share in National Production	Baseline Yield (kg/ha)	% Change in Yield in 2085	
			Scenario A2	Scenario B2
I-(Northern mountainous)	2	2626	+ 61	+ 50
II-(Northern Sub-mountainous)	9	4606	- 10	- 10
III-(Southern Semi arid Plain)	42	4490	- 4	- 6
IV-(Southern Arid Plain)	47	4309	- 5	-6
Pakistan	100	4378	- 3.55	- 5.20

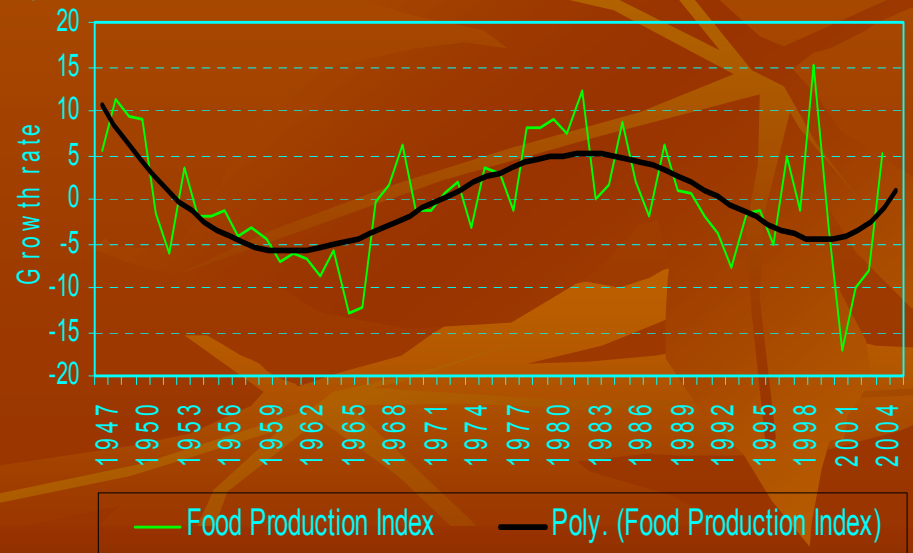
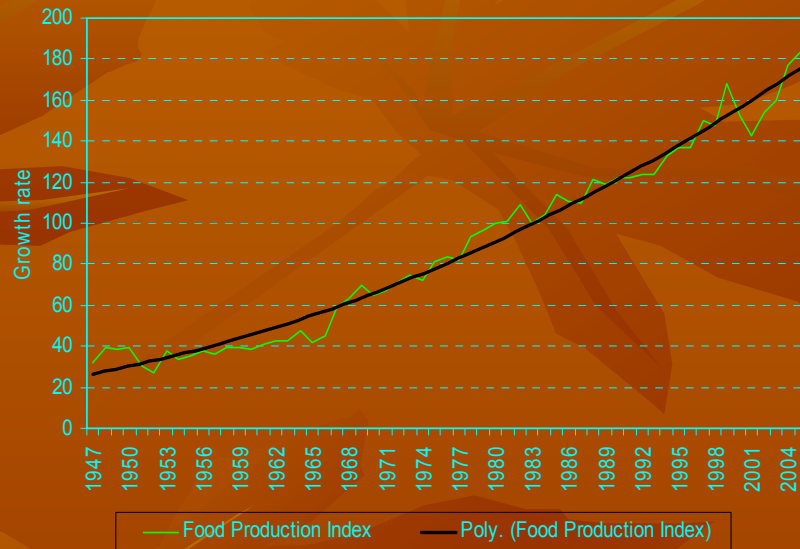
A Hypothetical Well-being Function



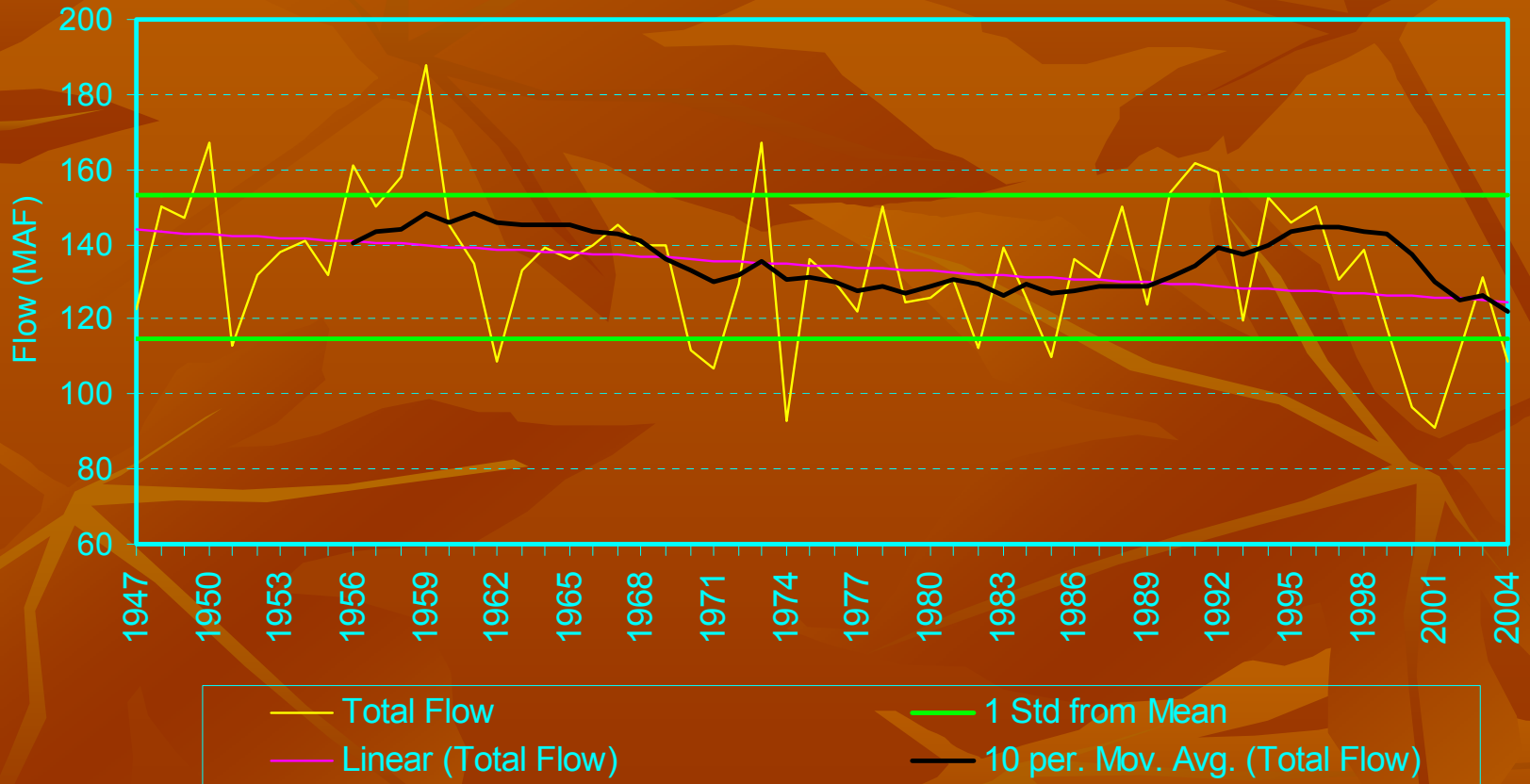
Wheat Yield in Northern mountainous region and Southern Semi-arid Plains of Pakistan under A2 and B2 Scenarios



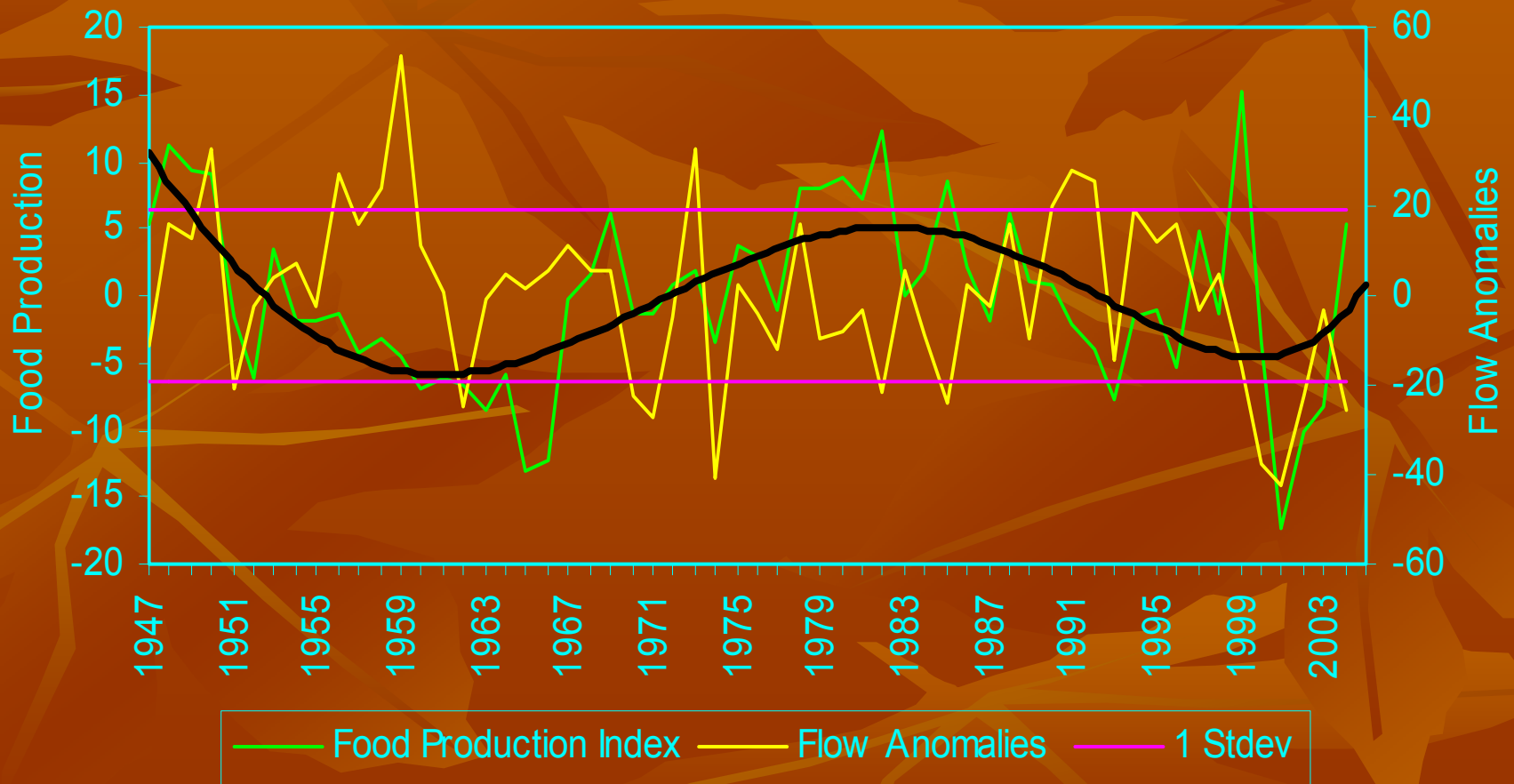
Trends in Food Production Index



Trends in Flows



Food Production Index and Total Flows



Ongoing Adaptation Studies to counter adverse impacts of climate change

- Effect of change in number of irrigations keeping total quantity of irrigation water the same.
- Effect of change in number of irrigations keeping the quantity of water per irrigation the same.
- Change in sowing window of crops.
- Change in planting technique e.g. transplanting versus direct sowing in the case of rice.
- Changes in other agricultural practices.

Collaboration with MOE

- Present Vulnerabilities and Adaptation Measures for agriculture sector of Pakistan
- Aim of these studies to investigate the vulnerabilities and impacts on agricultural sector of Pakistan
- Based on these vulnerabilities and impacts propose adaptation measures for agriculture sector of Pakistan
- Based on this study provide inputs for the adaptation strategies of Agriculture Sector of Pakistan.