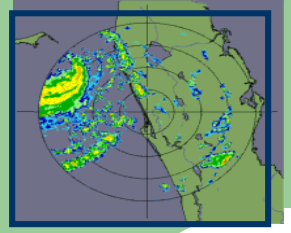
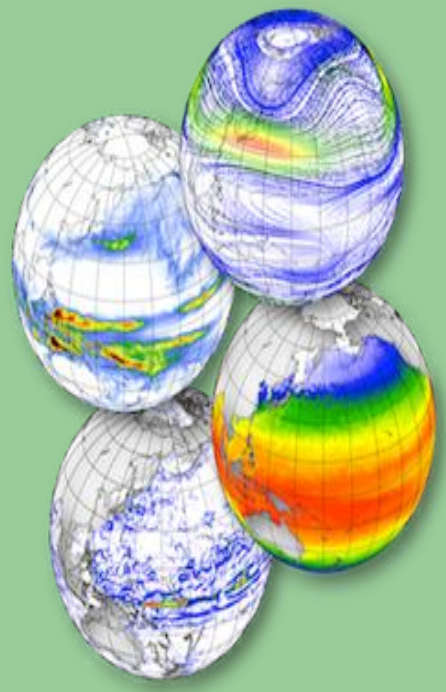


Courting Catastrophe through GEOSS-AWCI Program



Mr Hazrat Mir

Chief Meteorologist PMD

PMD

Pakistan Meteorological Department

SERVICES

Meteorology

Hydrology

Agrometeorology

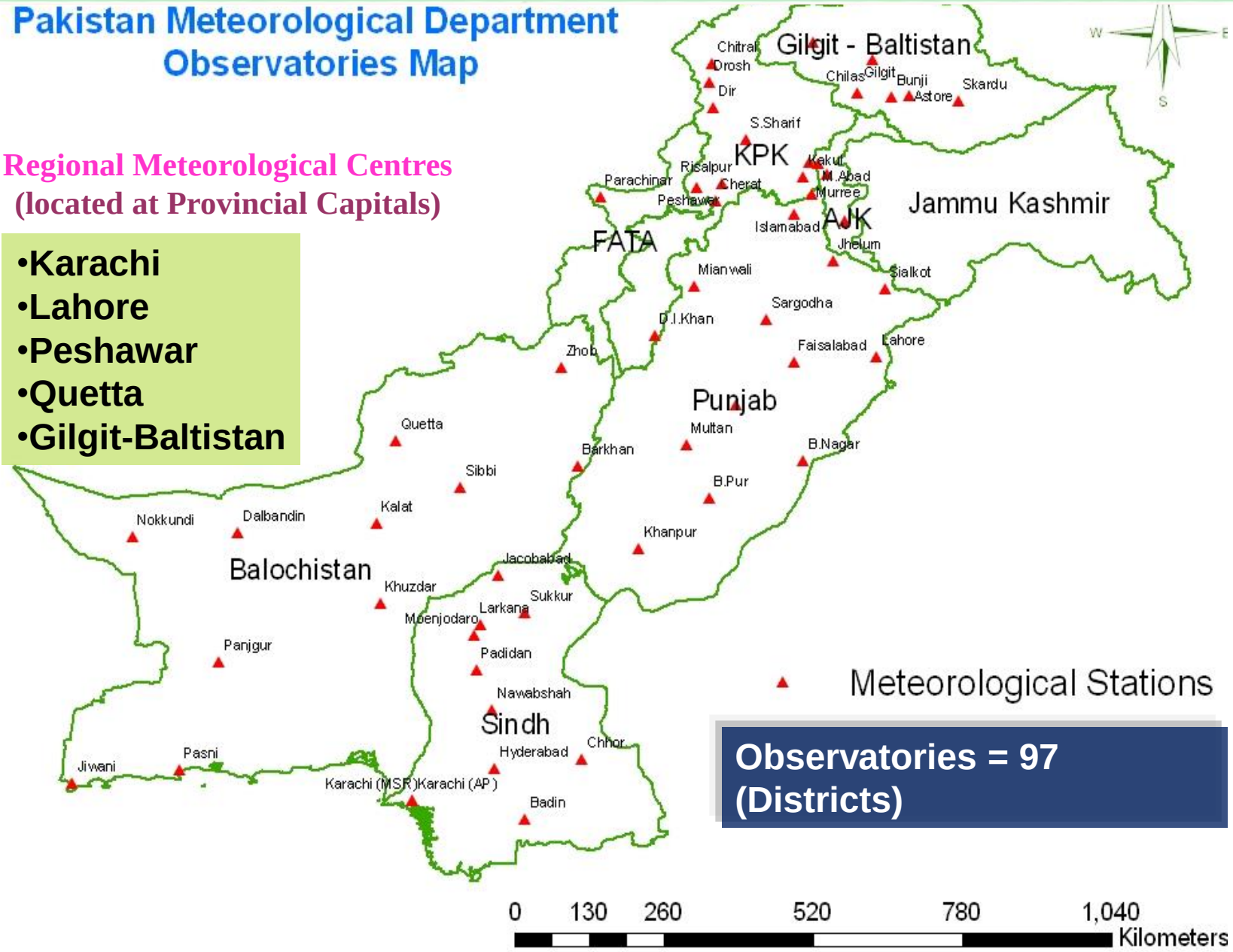
Drought

Seismology

Pakistan Meteorological Department
Observatories Map

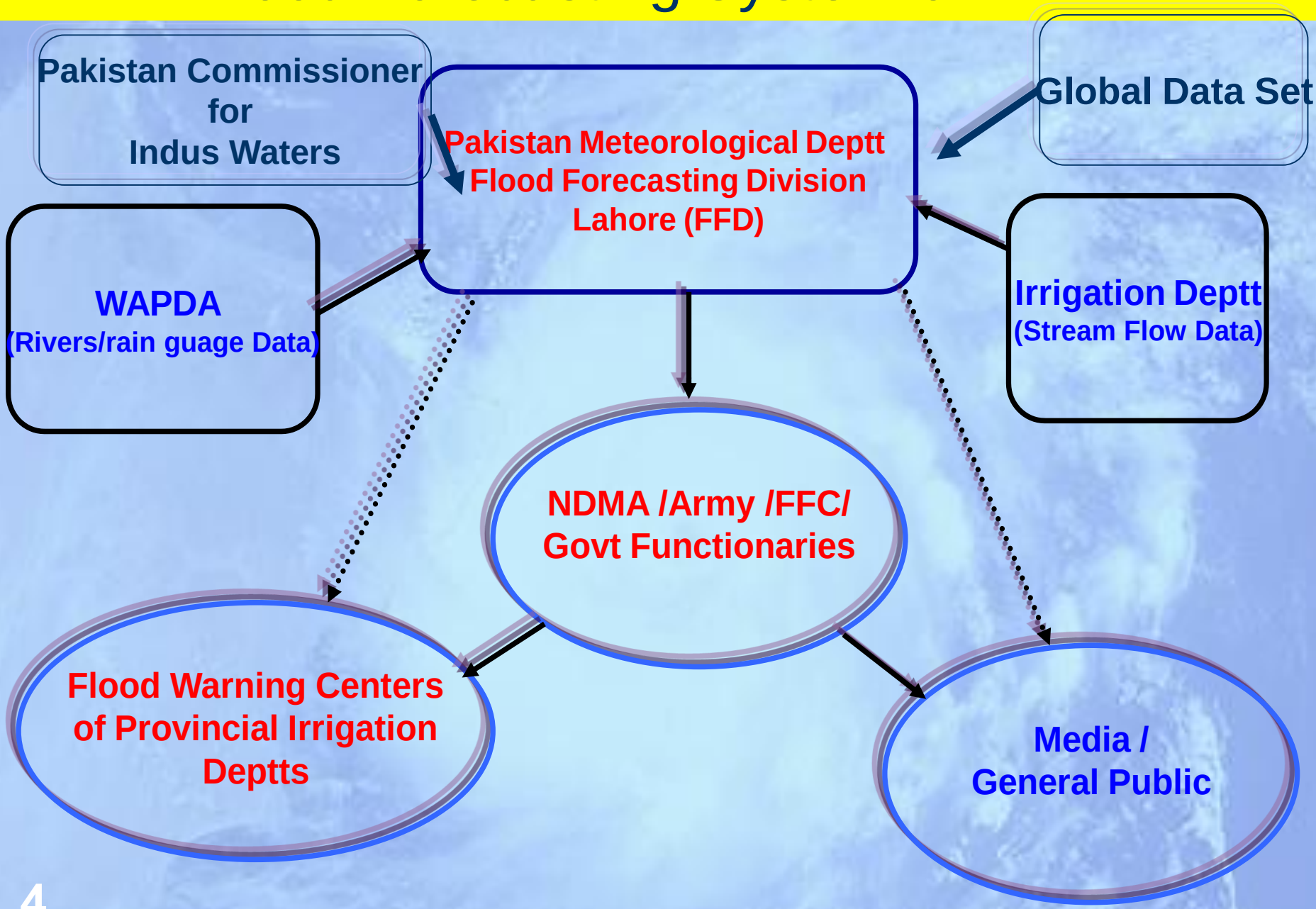
Regional Meteorological Centres (located at Provincial Capitals)

- **Karachi**
- **Lahore**
- **Peshawar**
- **Quetta**
- **Gilgit-Baltistan**



Observatories = 97 (Districts)

Flood Forecasting System of PMD



Projects related to Water Sector

- ✓IFAS Project Phase I
- ✓IFAS Project Phase II
- ✓GLOF Project Phase I
- ✓GLOF Project Phase II
- ✓Specialized Medium Range Forecasting Center (SMRFC) Project
- ✓Drought Monitoring & Early Warning Project

OPERATIONAL HYDROLOGICAL SERVICES OF PMD

Flood Forecasting Division (FFD) Lahore is a specialized unit of PMD for this purpose.

Responsibilities

i. **Flood Forecasting**

ii. **River stream flow forecasting**

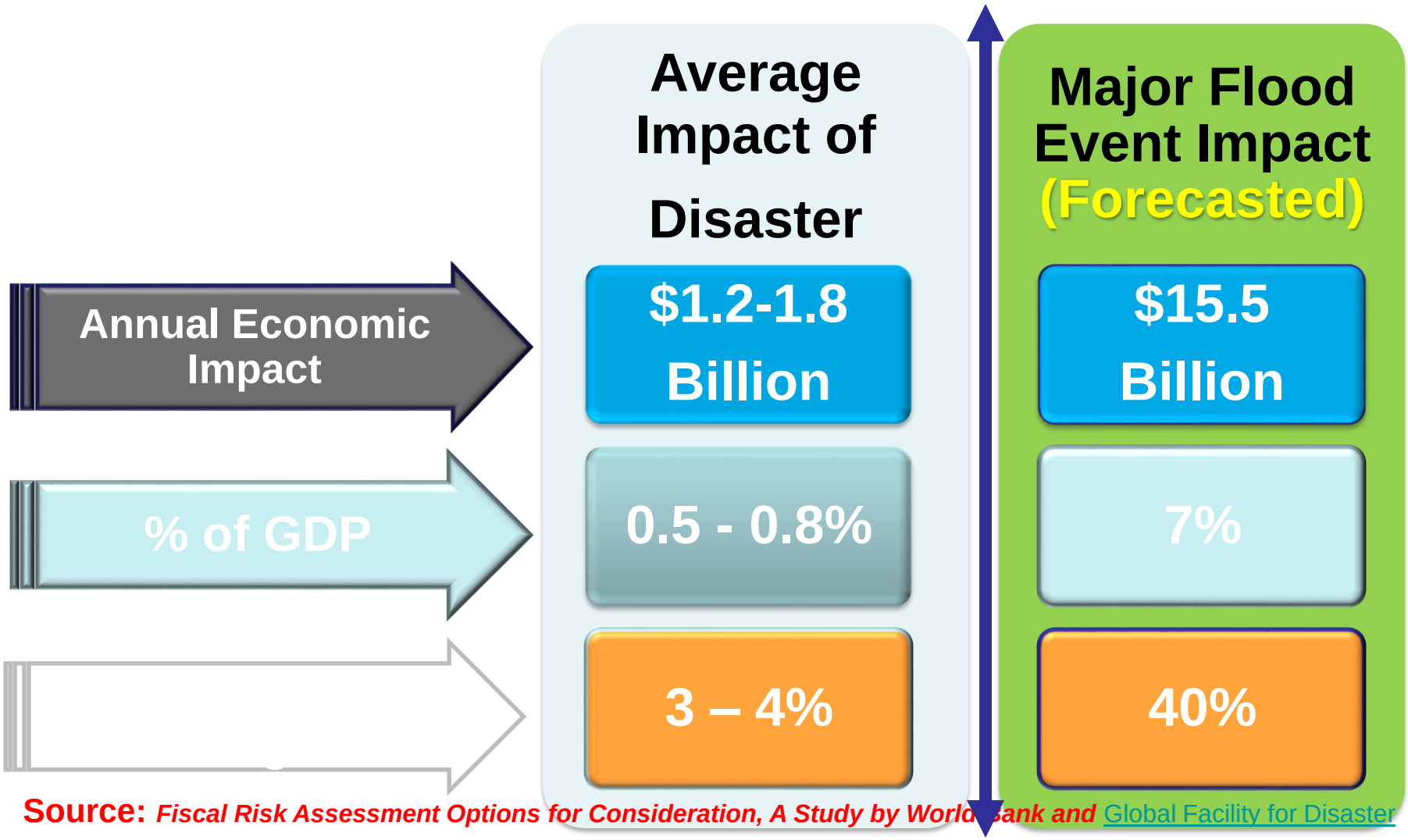
iii **Water availability Forecast for Dams**

iv. **Assisting Water Management at Dams specially during Monsoon**

Floods - 2010

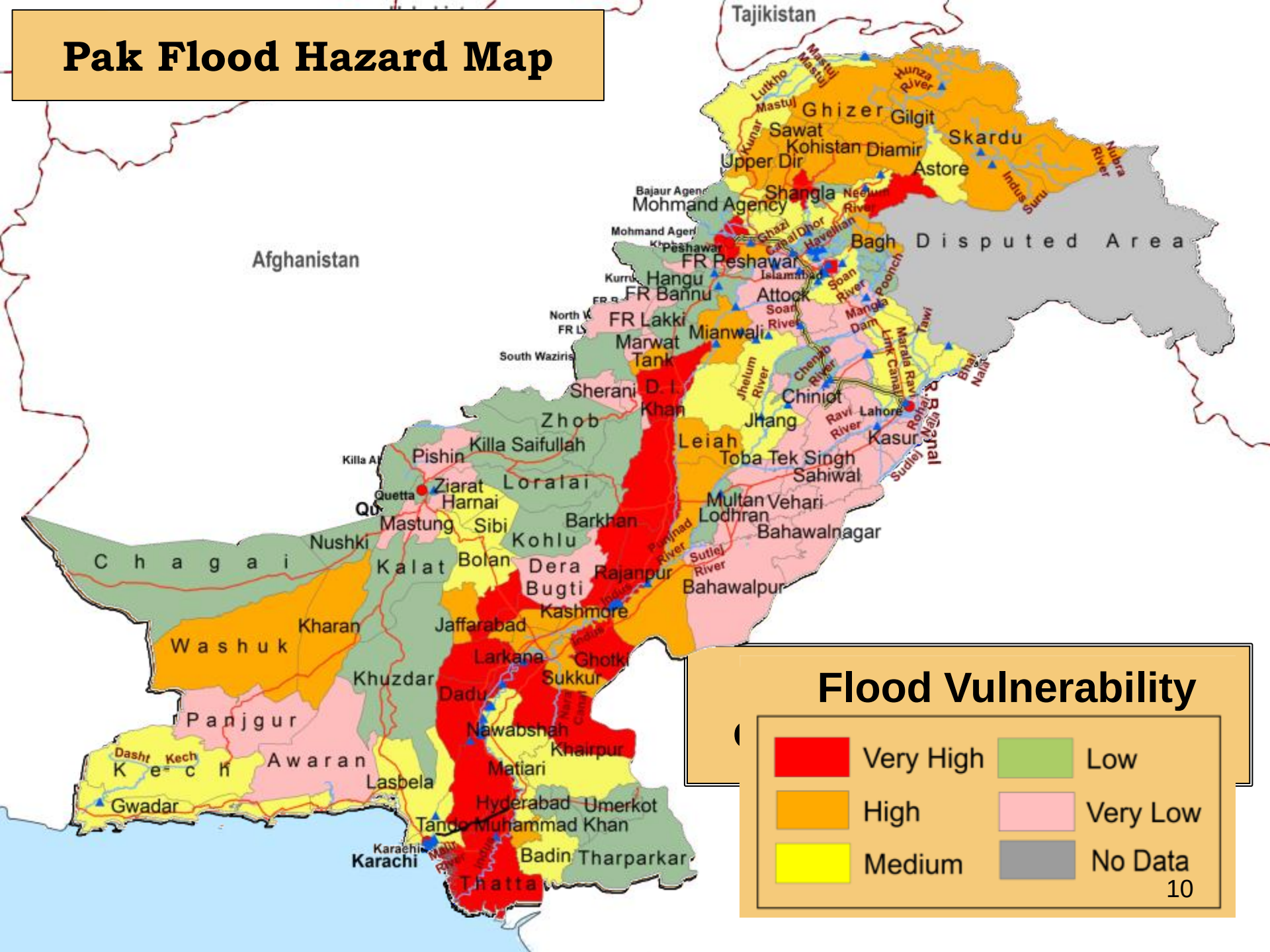
Floods - 2011

Economic Impact of Major Disasters Since 2005



Source: ***Fiscal Risk Assessment Options for Consideration, A Study by World Bank and*** Global Facility for Disaster Reduction and Recovery (***(GFDRR,) 2015***

Pak Flood Hazard Map



Preparation and Dissemination of Flood Forecast

(15th June to 15th October)

Analysis of Meteorological Condition

- Analysis of different Wx Charts, (Surface, upper, 0000UTC to onward as desire)
- Study analyzed Wx charts and different models through their websites
- Study the HRM Model products(PMD website)
- Study the GFS Model & other models

Analysis Hydrological Condition/Parameter

- Rainfall data from PMD stations
- Rainfall, Discharge data, WAPDA, Irrigation, PCIW
- Rim Station and below Rim Station data of all rivers(Hydrological Form)
- Out put of FEWS & CLS Model
- Out put of PMD developed Model
- GFS Model
- Latest all Wx/Doppler Radar Data
- Latest Satellite Imagery

Further Technique
Statistical Technique & Empirical Technique

Conference

Group discussion of 6-7 Meteorologist and Hydrologist

Issuance of Flood Forecast Bulletins

- Bulletin A & Bulletin B (For next 24-hours)
- Early Warning: different Significant Warning/Advisory as and when required for a particular area

Dissemination
Dissemination Through

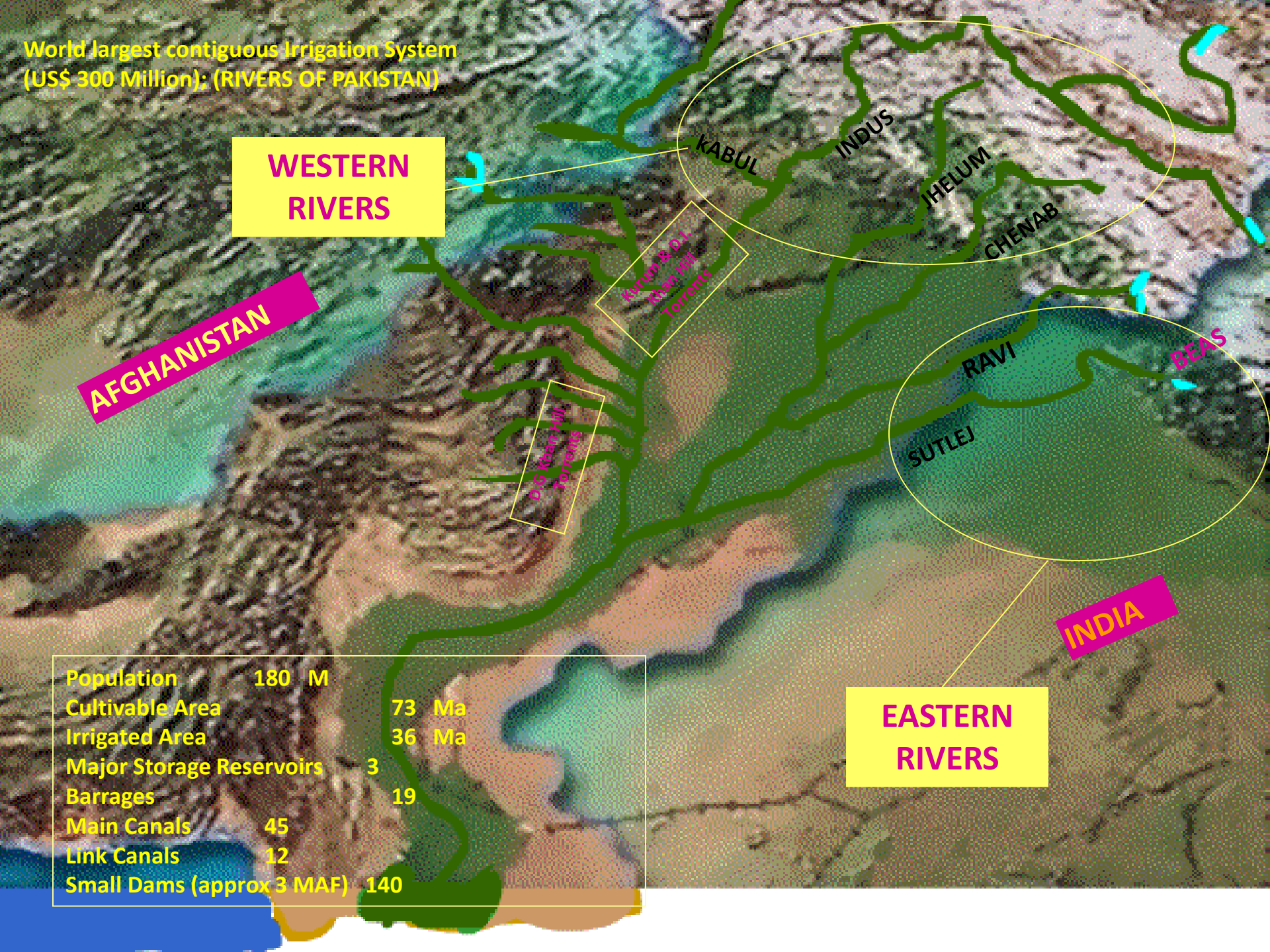
- Uploaded on website
- 5-fax machines
- PMD's website (Click Flood Update)
- Most concerned persons informed on telephones
- SMS to very Concerns
- Live beeper on Television and Radio
- In Camera interview on TV etc
- Daily Press Conference
- Attended meeting with local Govt. on Critical Situations

Media for Public & Concerned Authorities also

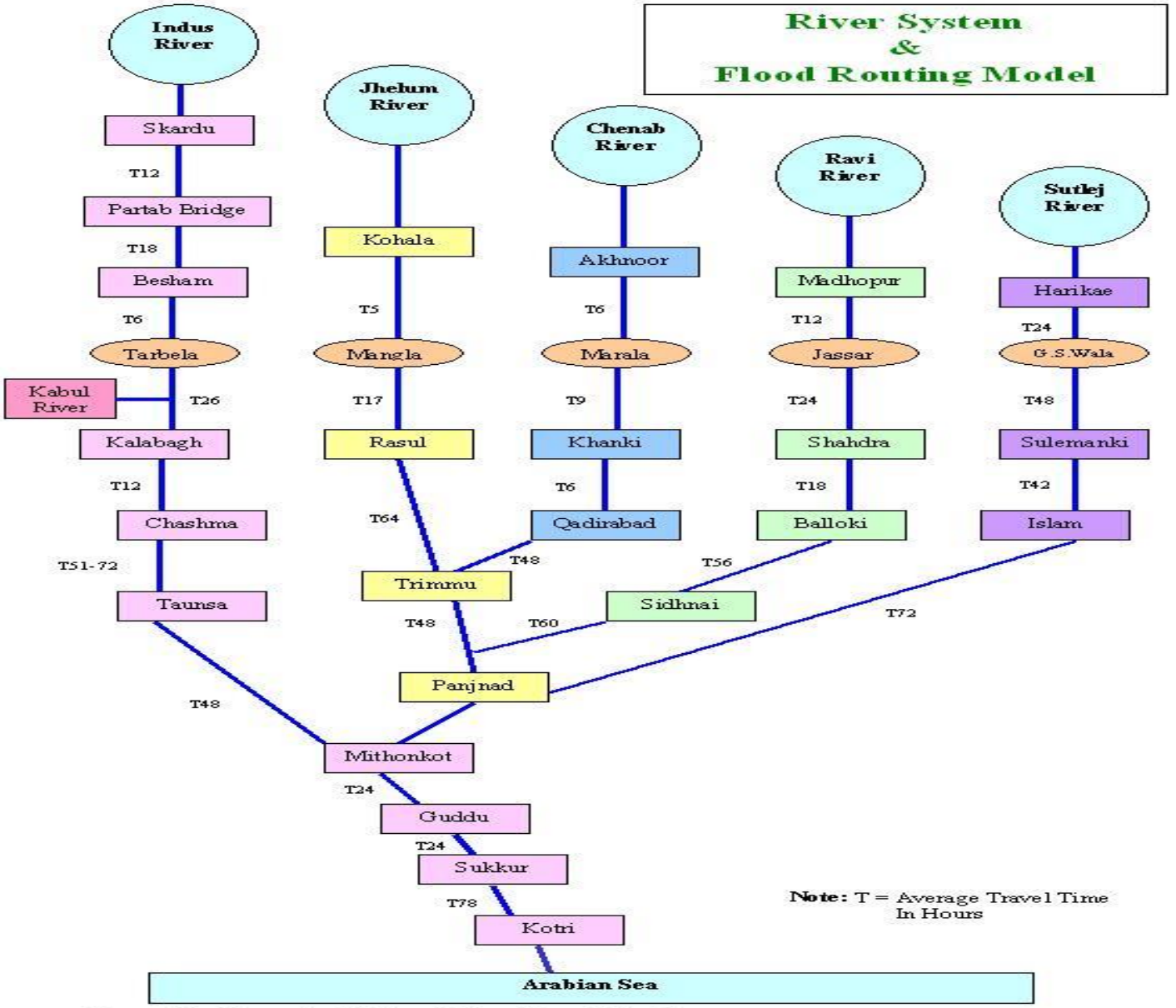
- Electronic Media
- Print Media
- Radio

Concerned Agencies

- FFC (Federal Flood Commission)
- NDMA(National Disaster Management Authority)
- Prime Minister/President Relief
- Commissioner
- Irrigation Department
- WAPDA
- Pak. Army
- All Provincial Govt. etc and 300 agencies


World largest contiguous Irrigation System
(US$ 300 Million): (RIVERS OF PAKISTAN)
WESTERN RIVERS
KABUL
INDUS
JHELUM
CHENAB
AFGHANISTAN
Kurum & O.t. Khan Hill Torrents
D.G Khan Hill Torrents
RAVI
BEAS
SUTLEJ
INDIA
EASTERN RIVERS
Population 180 M
Cultivable Area 73 Ma
Irrigated Area 36 Ma
Major Storage Reservoirs 3
Barrages 19
Main Canals 45
Link Canals 12
Small Dams (approx 3 MAF) 140

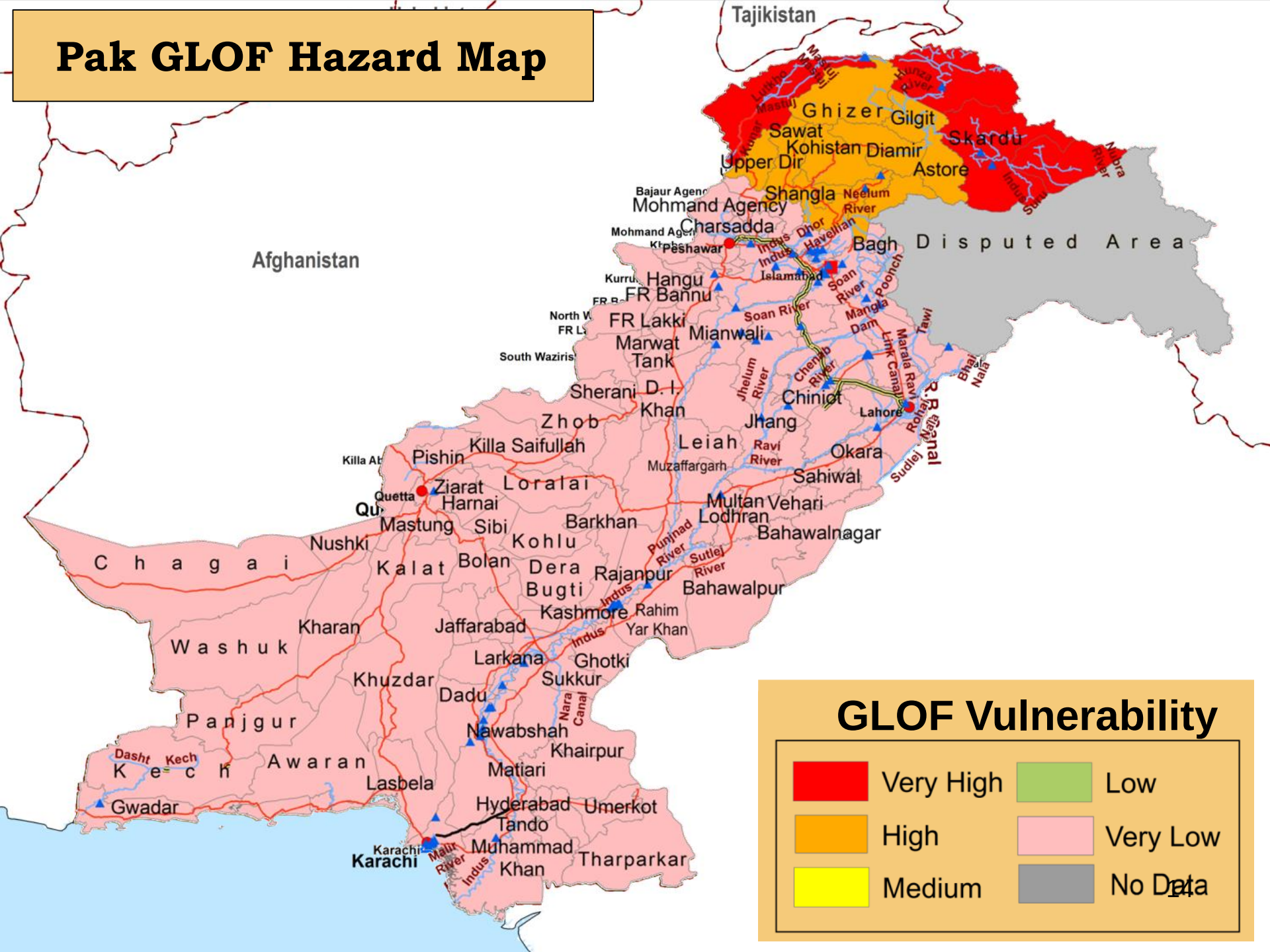
River System & Flood Routing Model



Note: T = Average Travel Time In Hours

Source: Flood Forecasting Division, Pakistan Meteorological Department

Pak GLOF Hazard Map

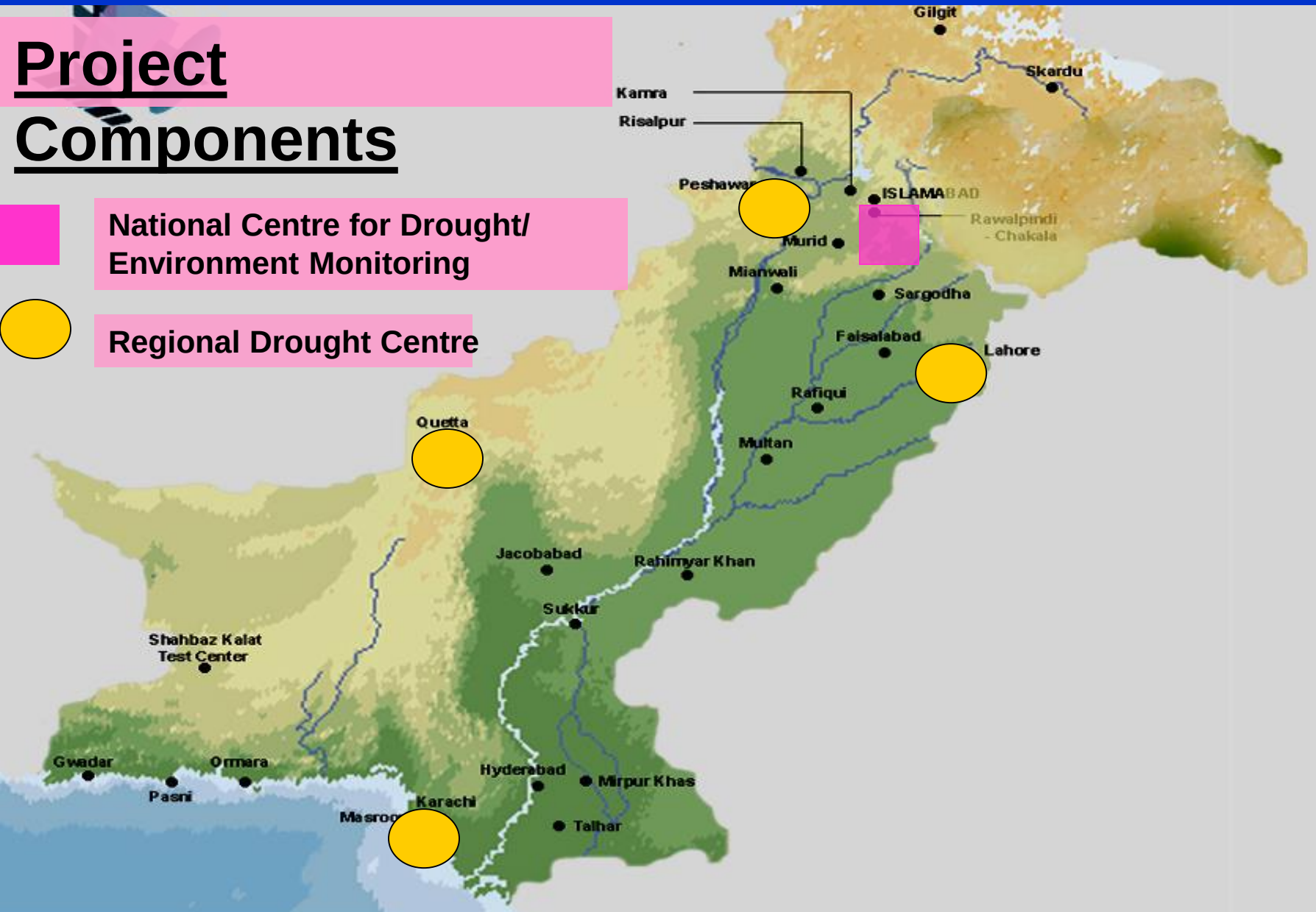


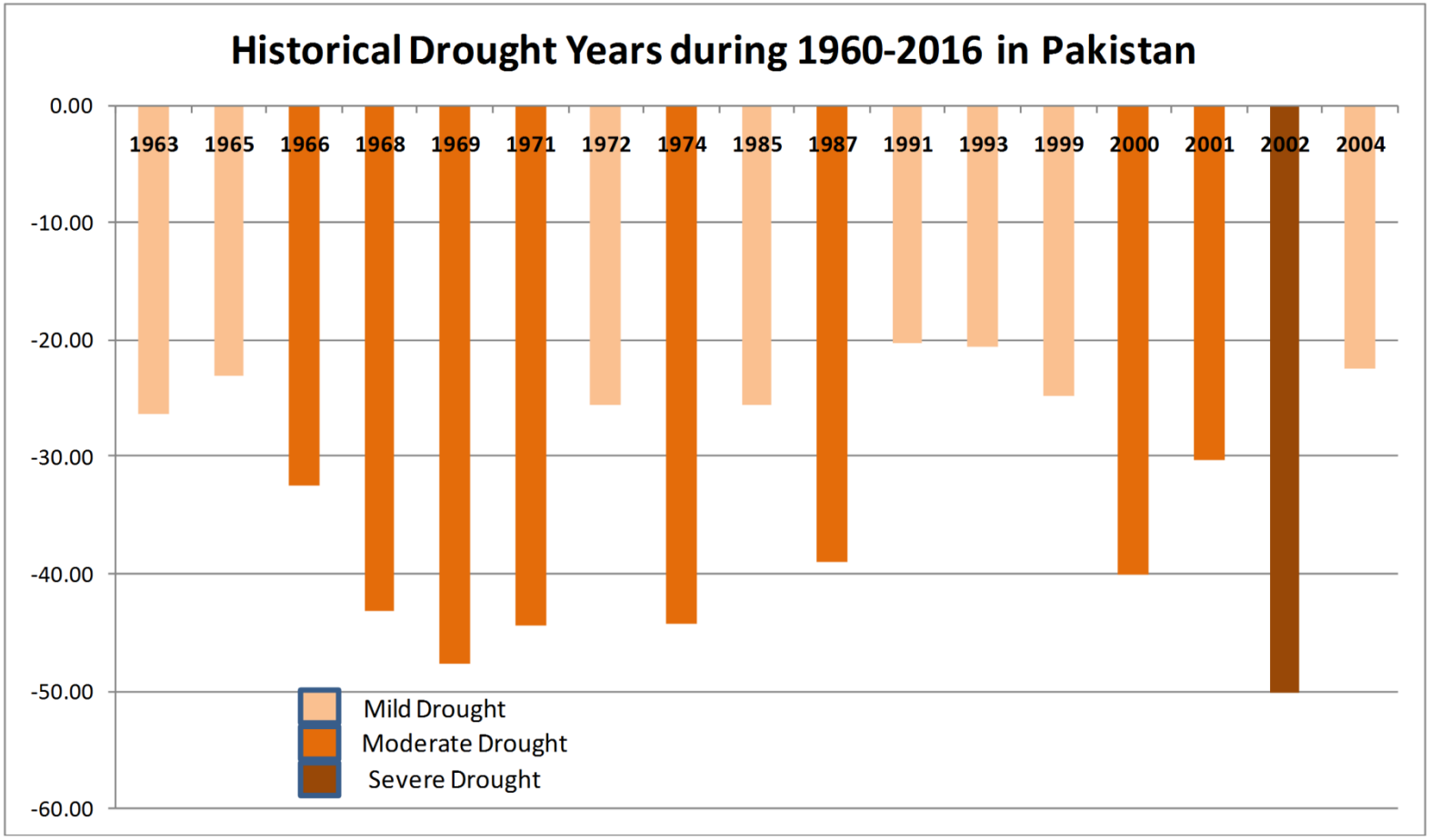
Drought/Environment Monitoring & Early Warning Centre

Project Components

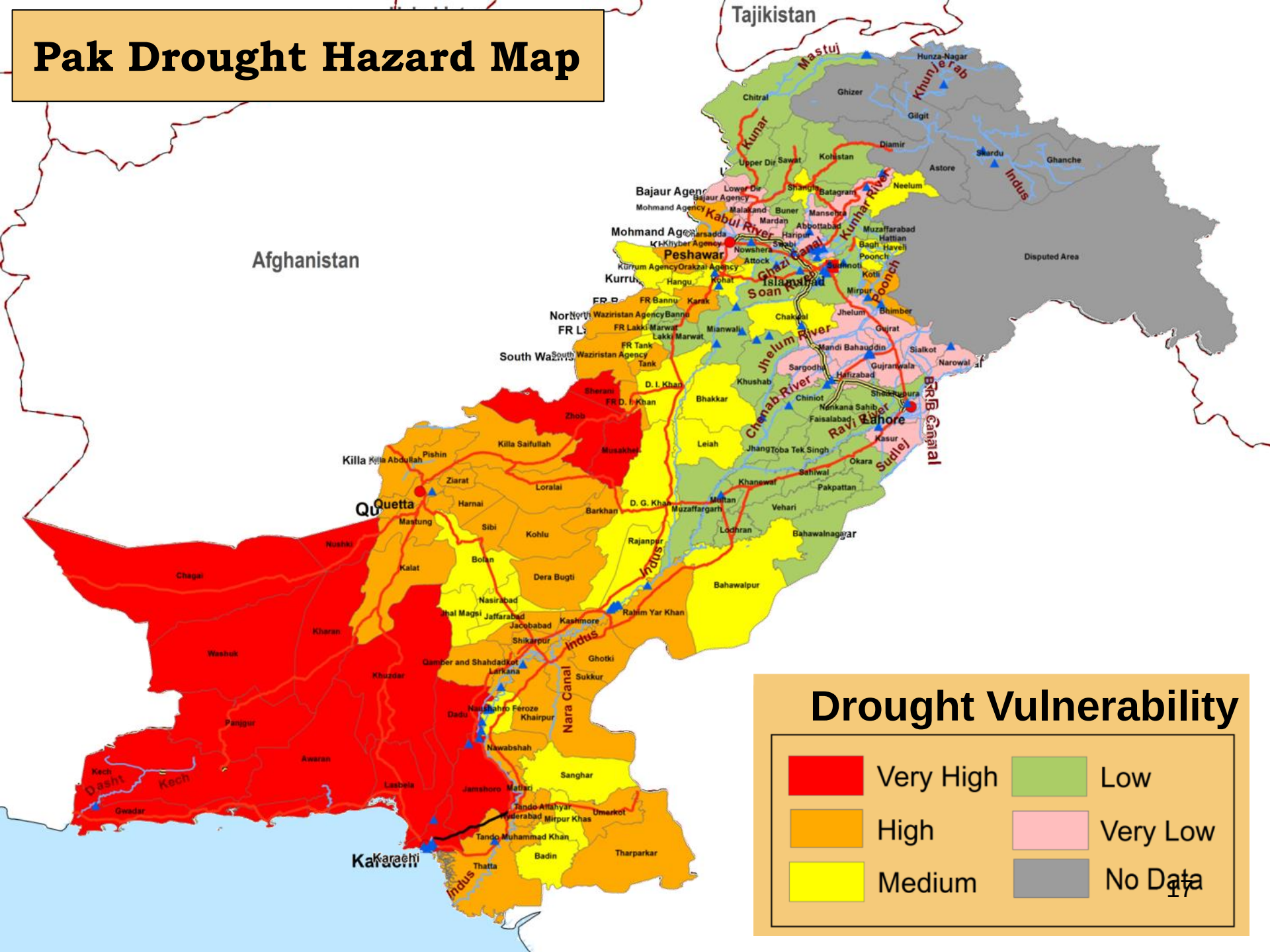
National Centre for Drought/ Environment Monitoring

Regional Drought Centre

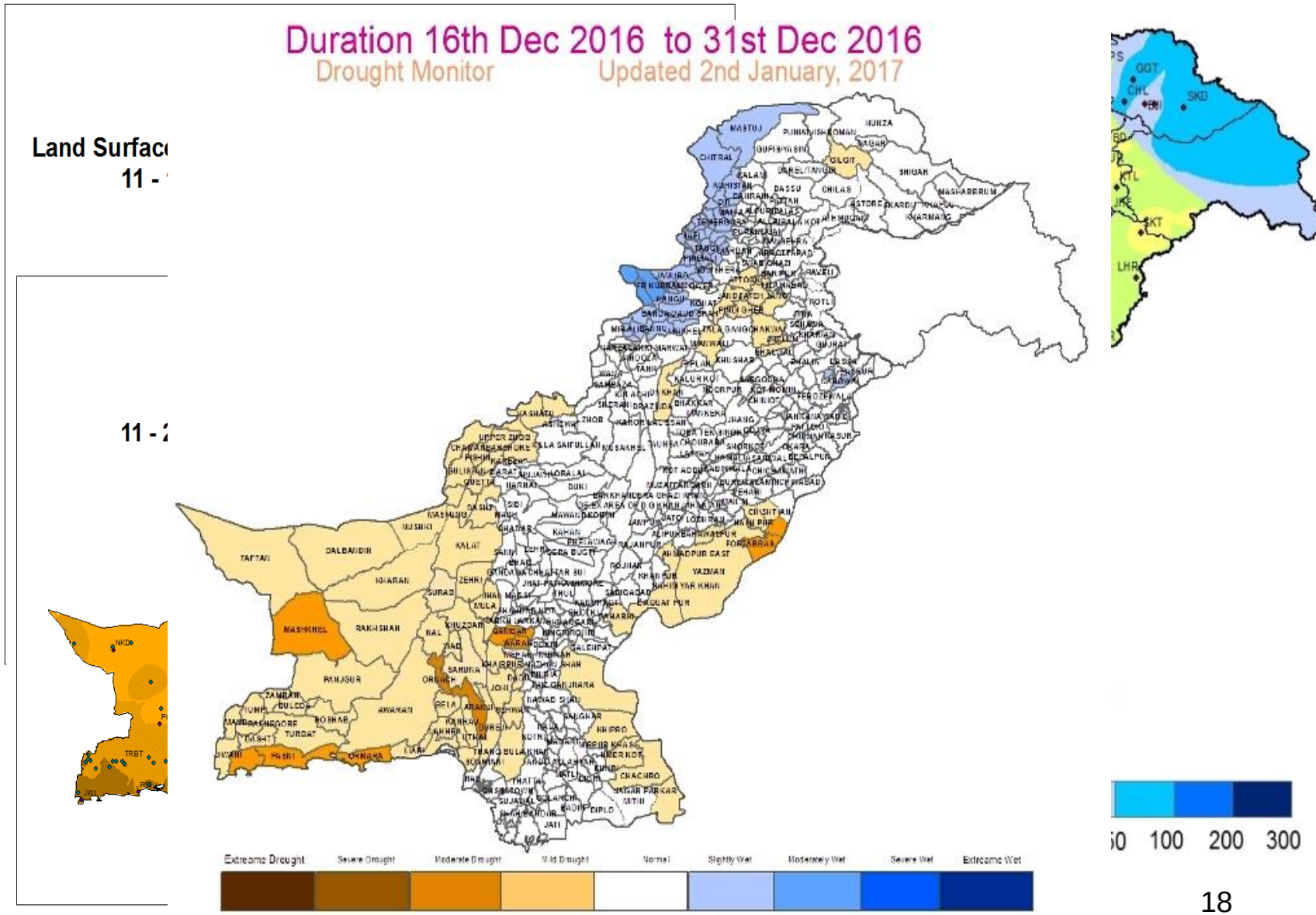



Historical Drought Years during 1960-2016 in Pakistan
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
1963
1965
1966
1968
1969
1971
1972
1974
1985
1987
1991
1993
1999
2000
2001
2002
2004
Mild Drought
Moderate Drought
Severe Drought

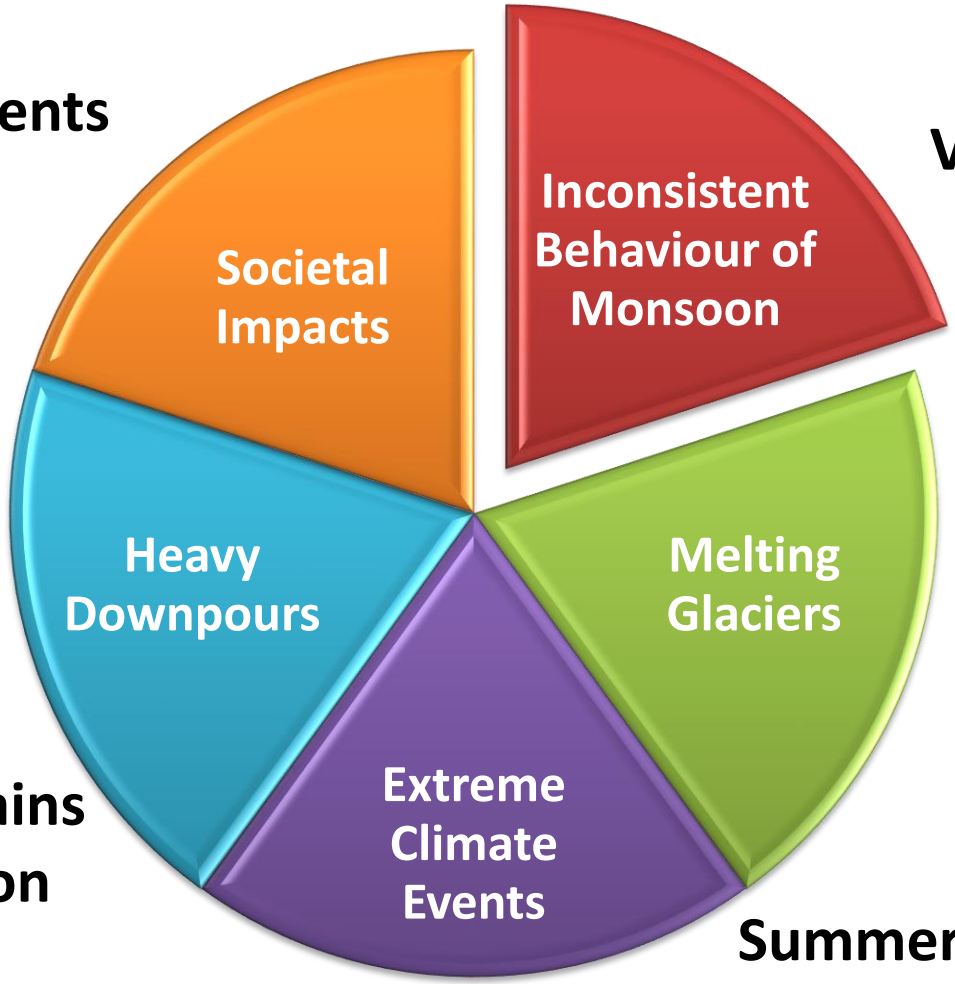
Pak Drought Hazard Map



Satellite Products being used for Drought Monitoring



Global Climate Impact on Pakistan



Displacements

Variable Intensity

Northern Areas

Summers are Becoming Hotter

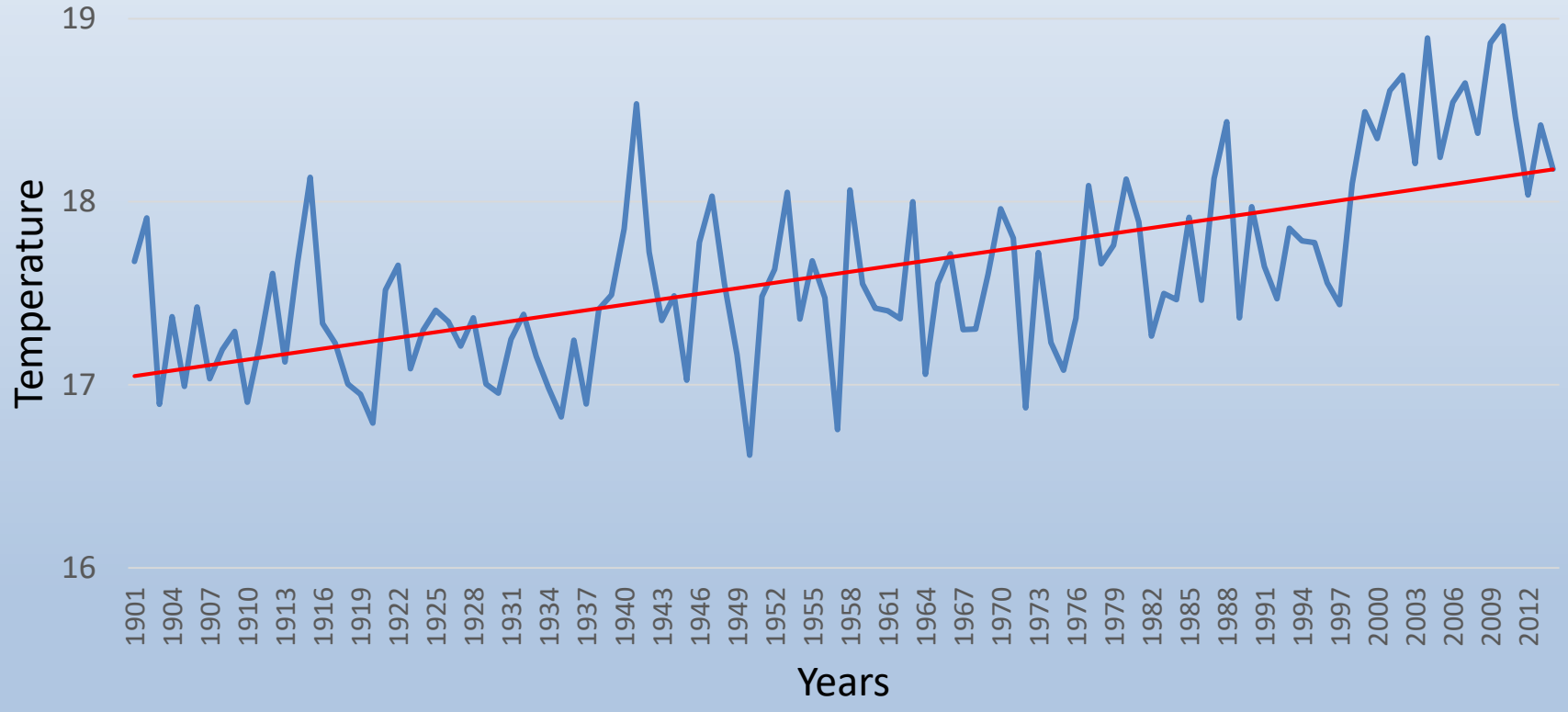
High Intensity Rains in Short Duration

Climate Change In Pakistan

Annual Mean Temperatures (°C) Trends

- 1901-2014

Pakistan



Rate of Change = 0.10°C per Decade

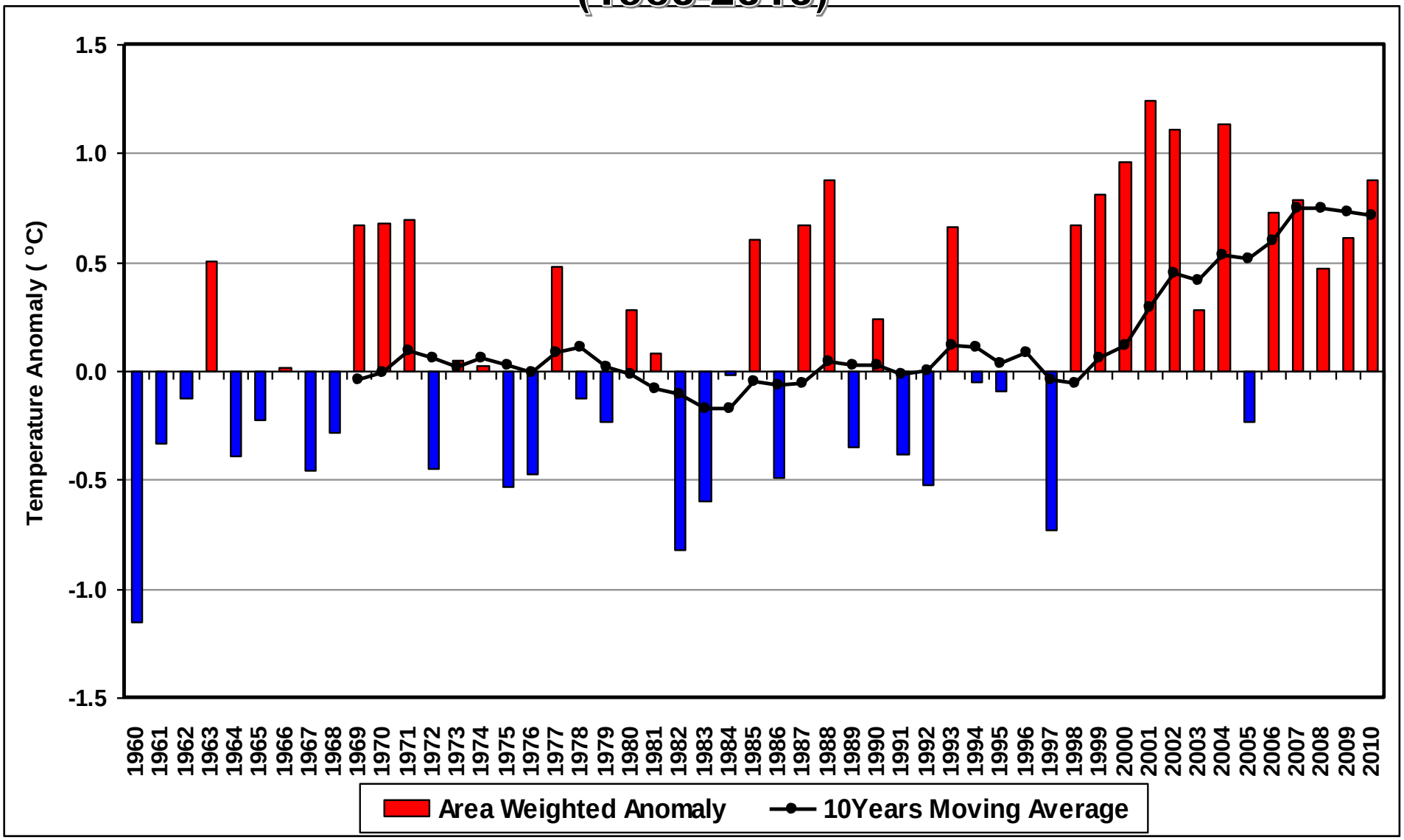
Climate Change Trends over Pakistan

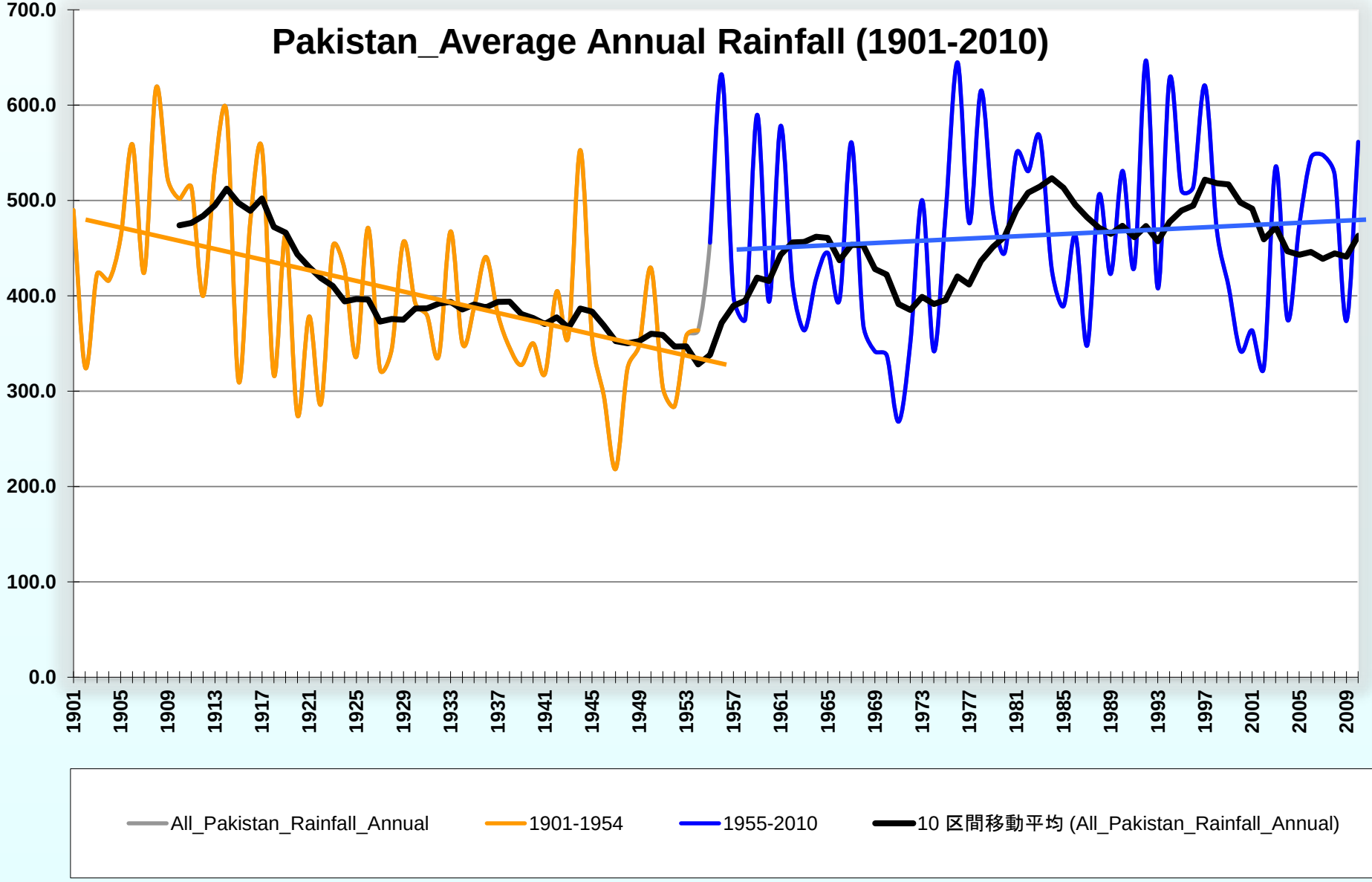
- **The slope of the mean annual temperature over Pakistan during the 48-year period 1960-2007 was found as:**

1901-2000	0.06 °C per decade
1960-2007	0.24 °C per decade

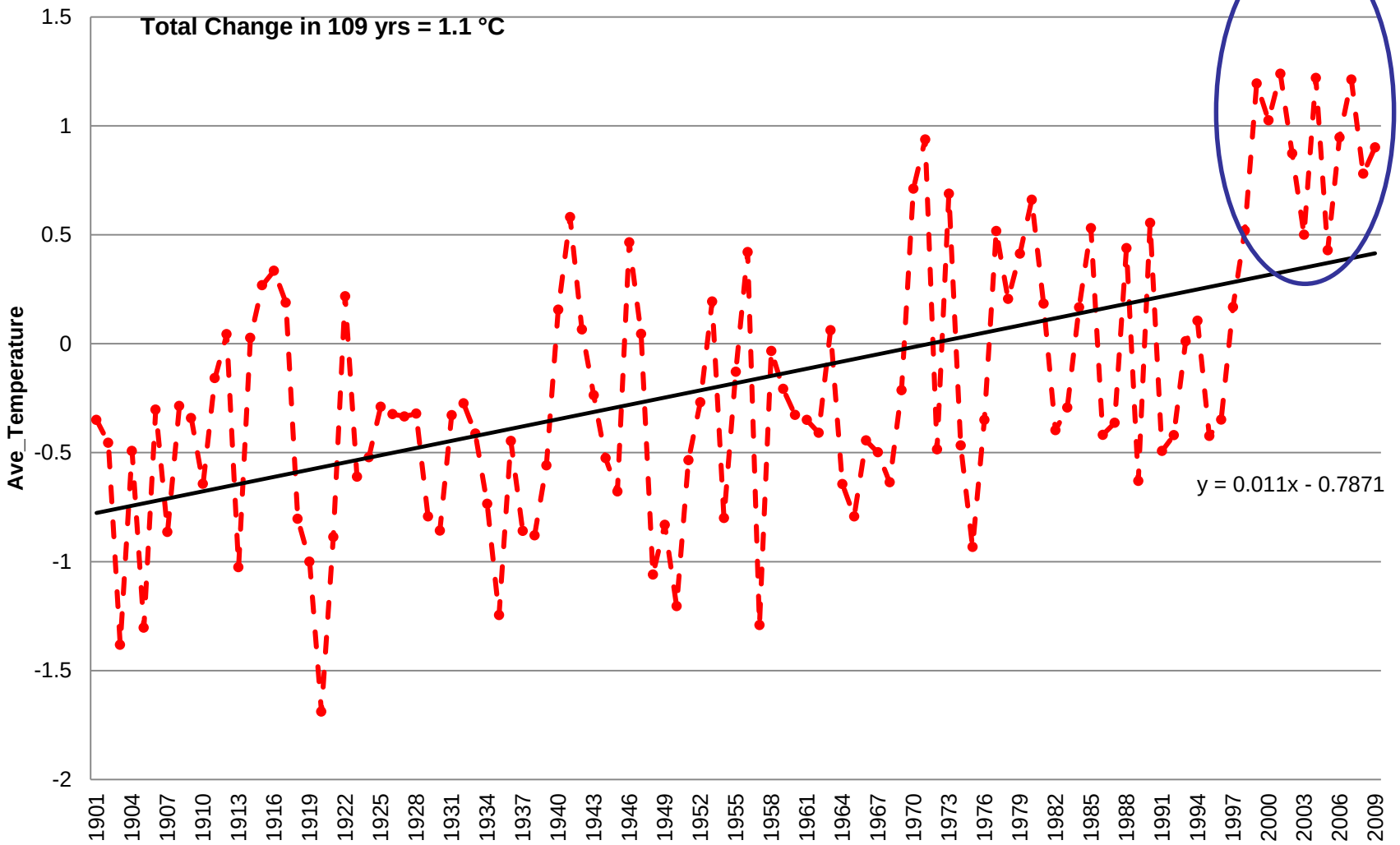
- **The rate of increase is higher than the rate of increase observed globally**

Area Weighted Mean Temperature Anomaly of Pakistan (1960-2010)

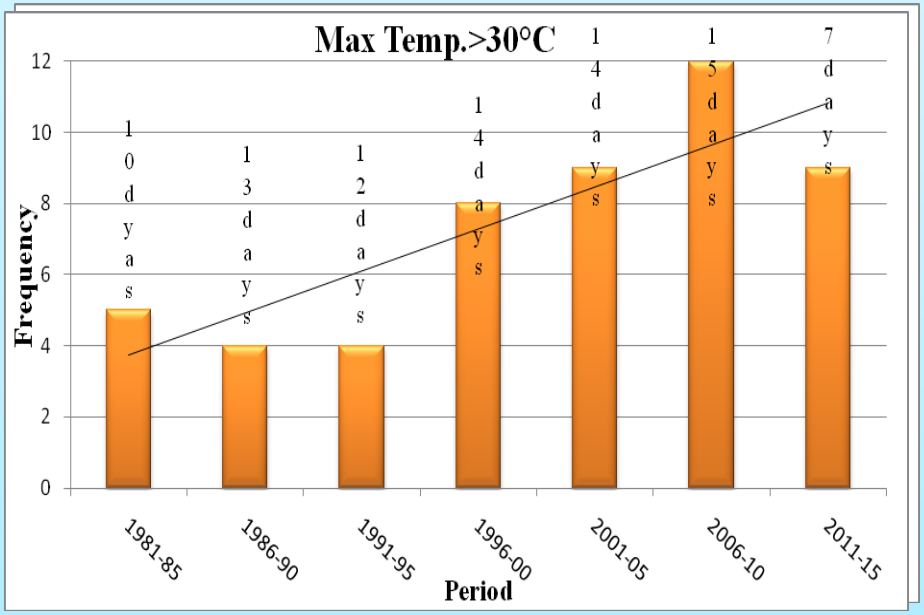


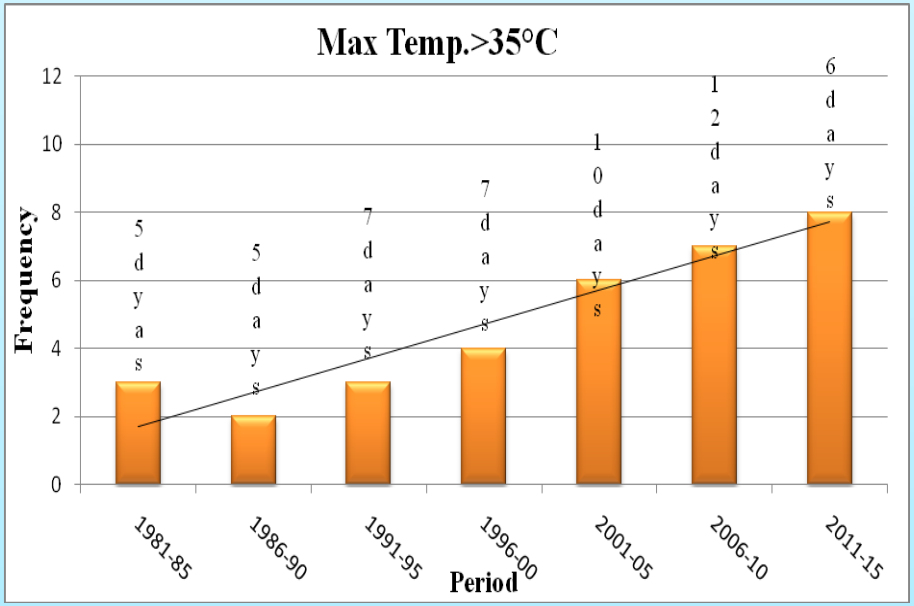

Pakistan_Average Annual Rainfall (1901-2010)
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
1901
1905
1909
1913
1917
1921
1925
1929
1933
1937
1941
1945
1949
1953
1957
1961
1965
1969
1973
1977
1981
1985
1989
1993
1997
2001
2005
2009
All_Pakistan_Rainfall_Annual
1901-1954
1955-2010
10 区間移動平均 (All_Pakistan_Rainfall_Annual)

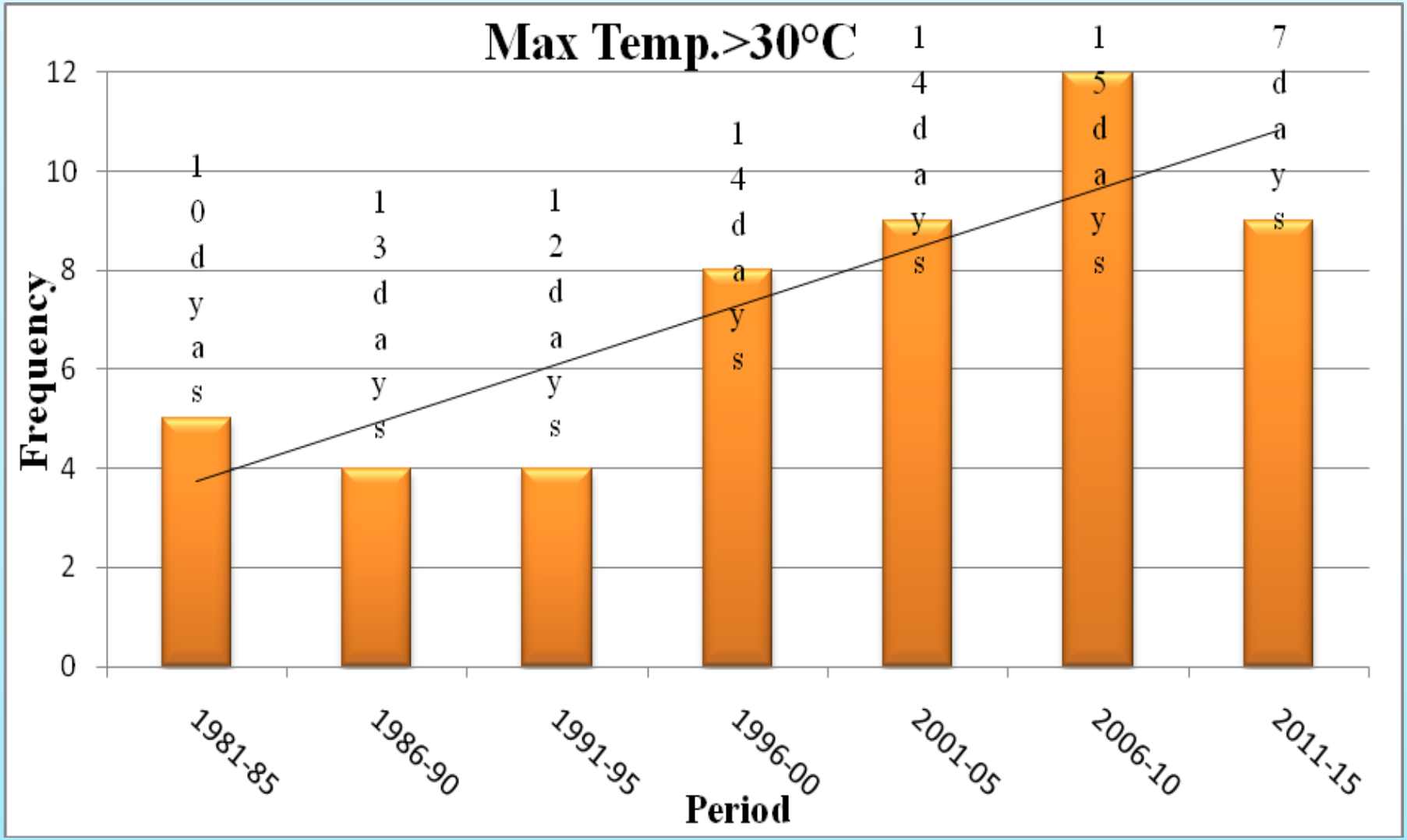
Average Temperature of Northern Areas of Pakistan (1901-2009) based on Climate Research Unit (CRU data

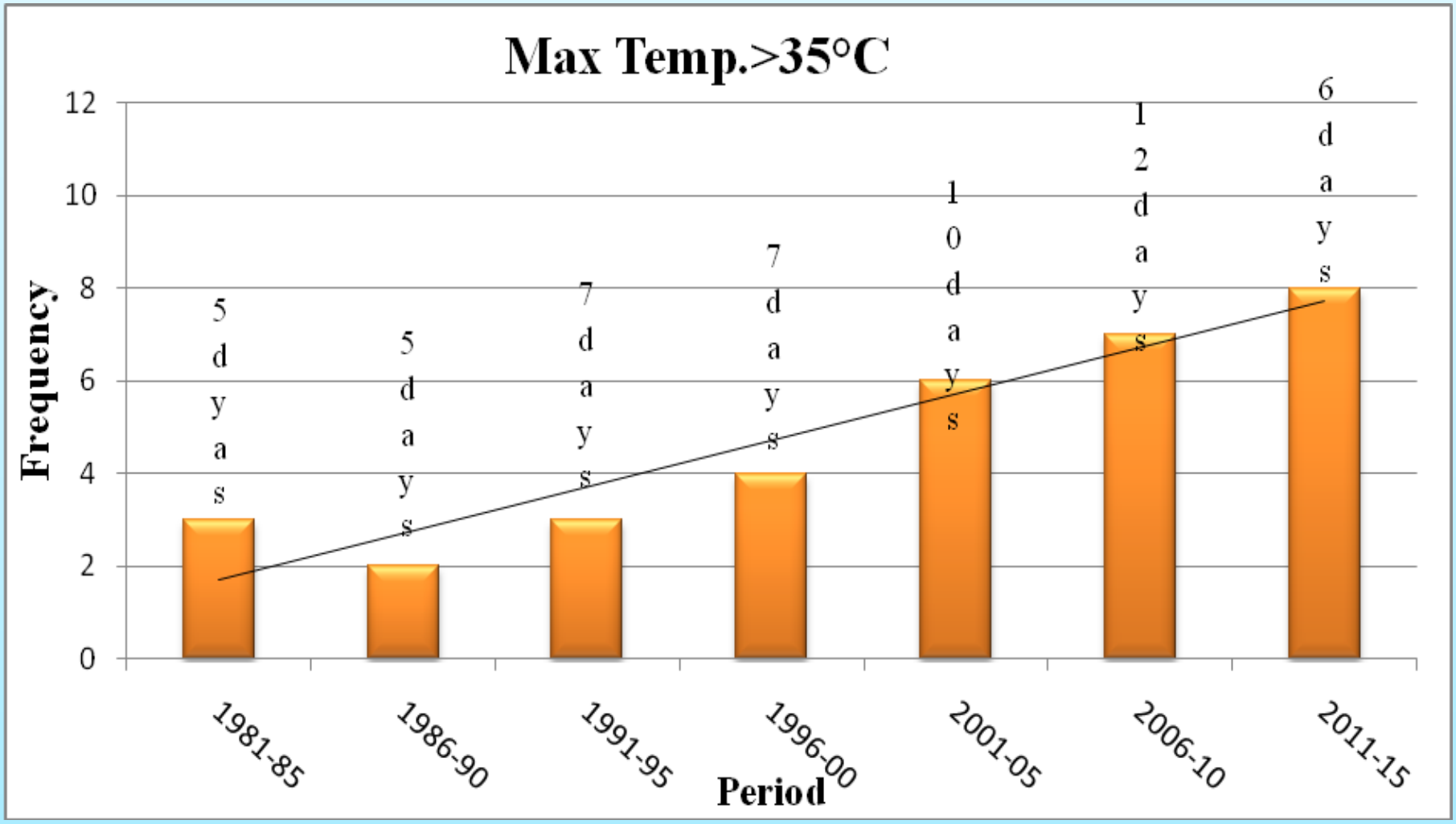


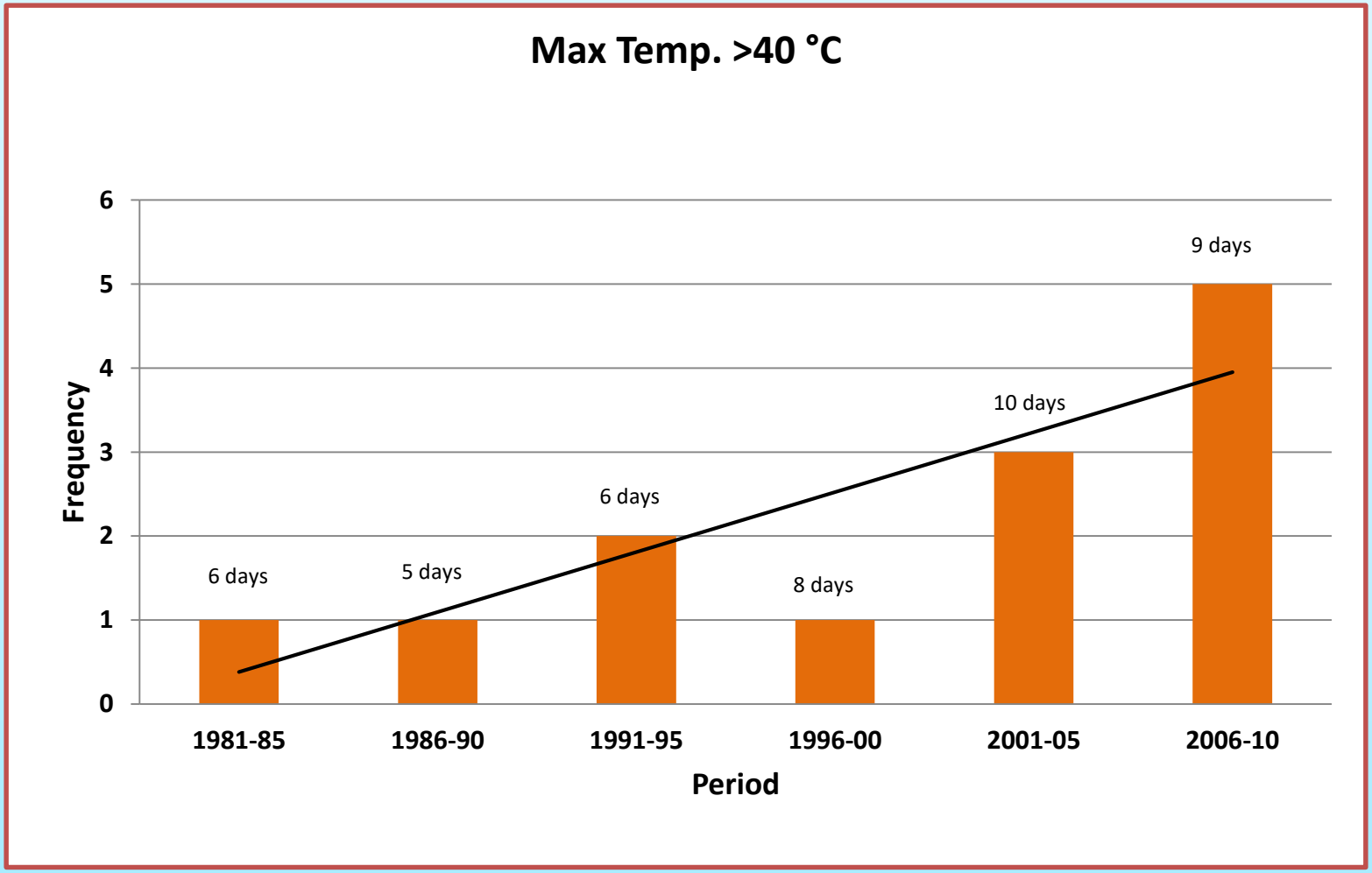
Heatwave Frequency in Upper KP and GB





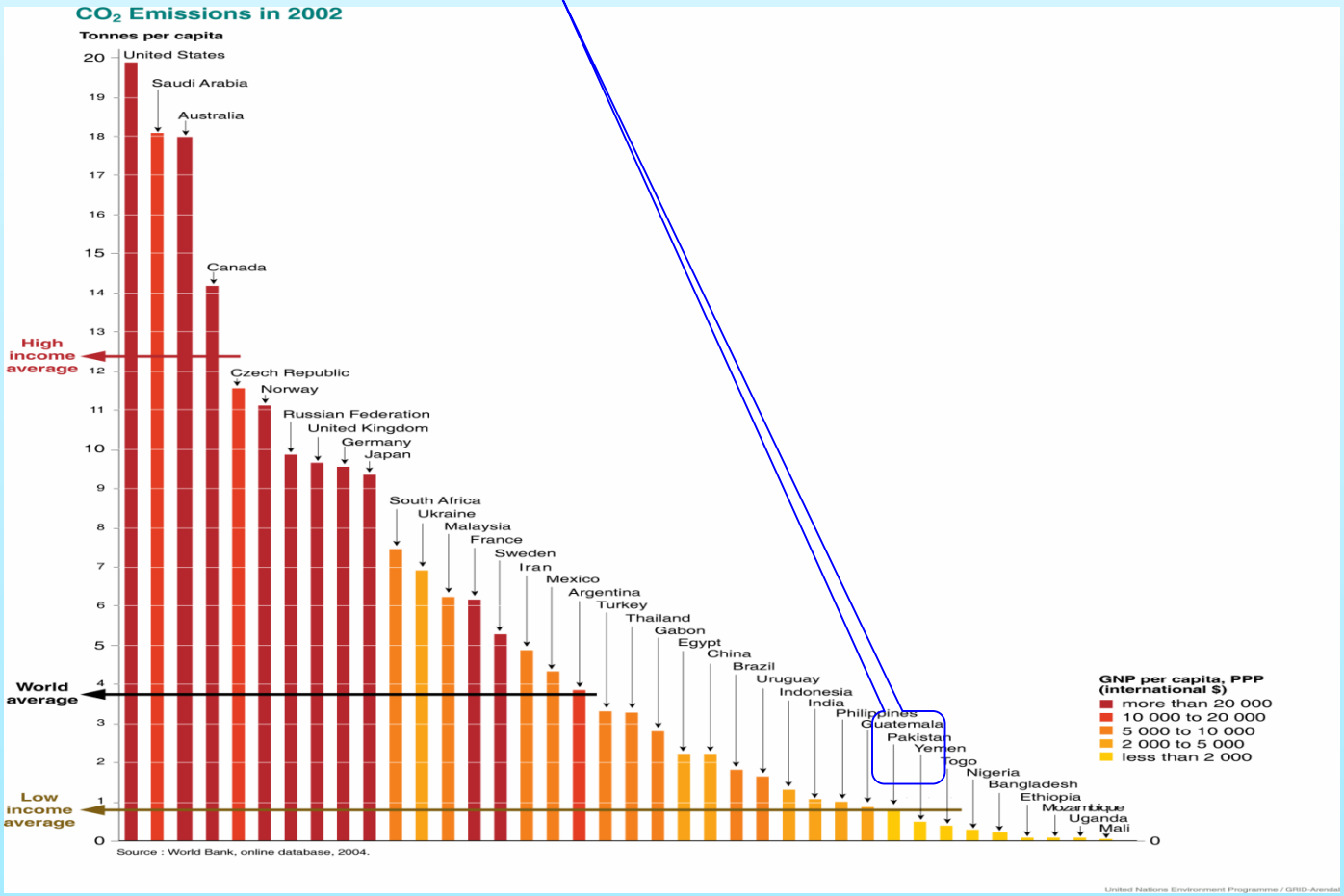

Max Temp.>30°C
Frequency
Period
0
2
4
6
8
10
12
10 days
13 days
12 days
14 days
14 days
15 days
7 days
1981-85
1986-90
1991-95
1996-00
2001-05
2006-10
2011-15


Max Temp.>35°C
Frequency
Period
0
2
4
6
8
10
12
5 days
5 days
7 days
7 days
10 days
12 days
6 days
1981-85
1986-90
1991-95
1996-00
2001-05
2006-10
2011-15


Max Temp. >40 °C
Frequency
0
1
2
3
4
5
6
6 days
5 days
6 days
8 days
10 days
9 days
1981-85
1986-90
1991-95
1996-00
2001-05
2006-10
Period

Emissions – where Pakistan Stands on the climate front?

One of the lowest per capita emitters

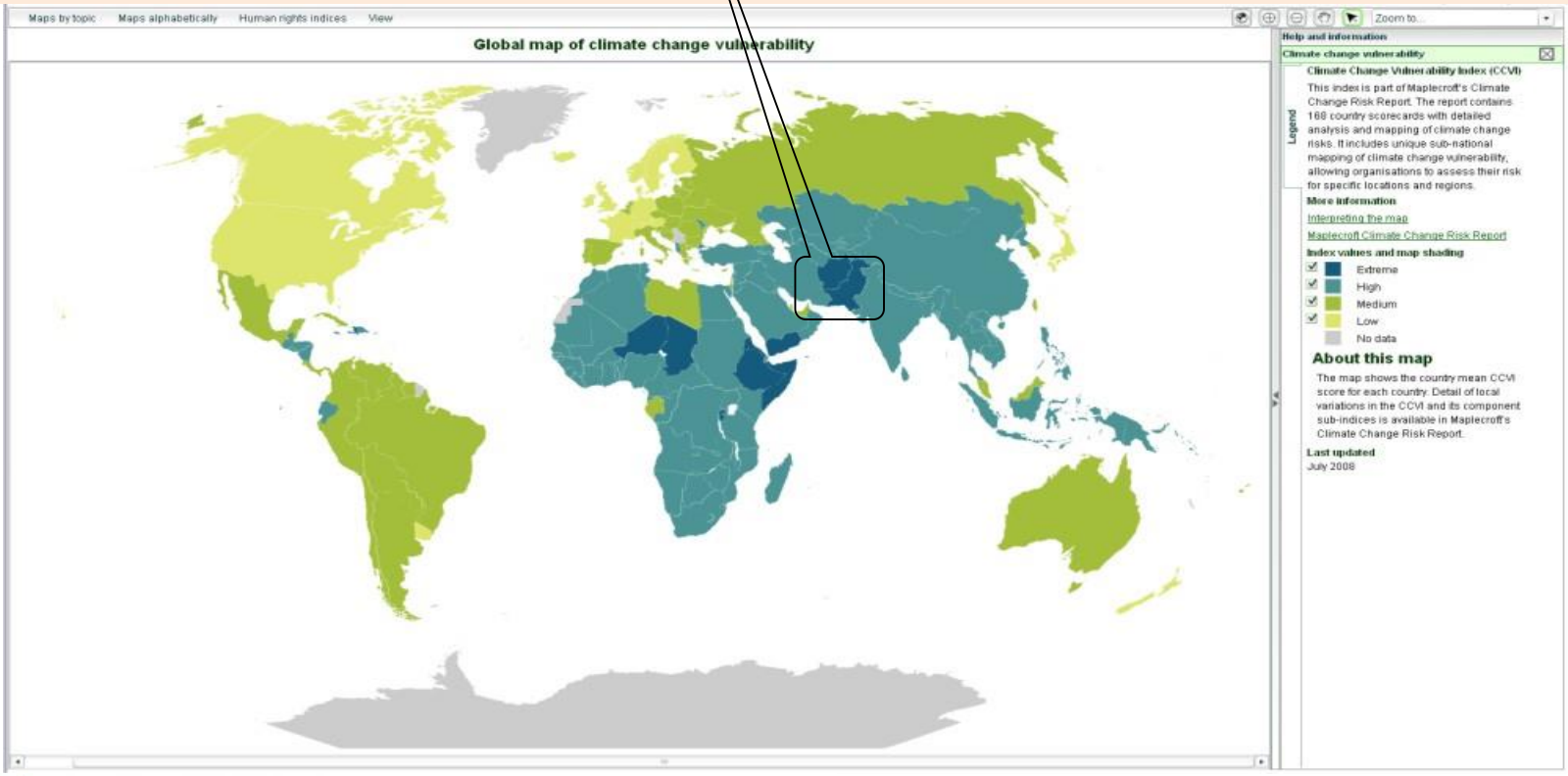


Impacts–Pakistan Vulnerabilities analysis in the context of climate impacts

Yet one of the worst victims of climate change

& best examples of climate injustice

Maplecroft vulnerability index places us in High/Extreme category /Columbia Univ indx does the same (http://ciesin.columbia.edu/data/climate)



Water is security issue

CLIMATE CHANGE

Glacier DEPLETION

Water pollution

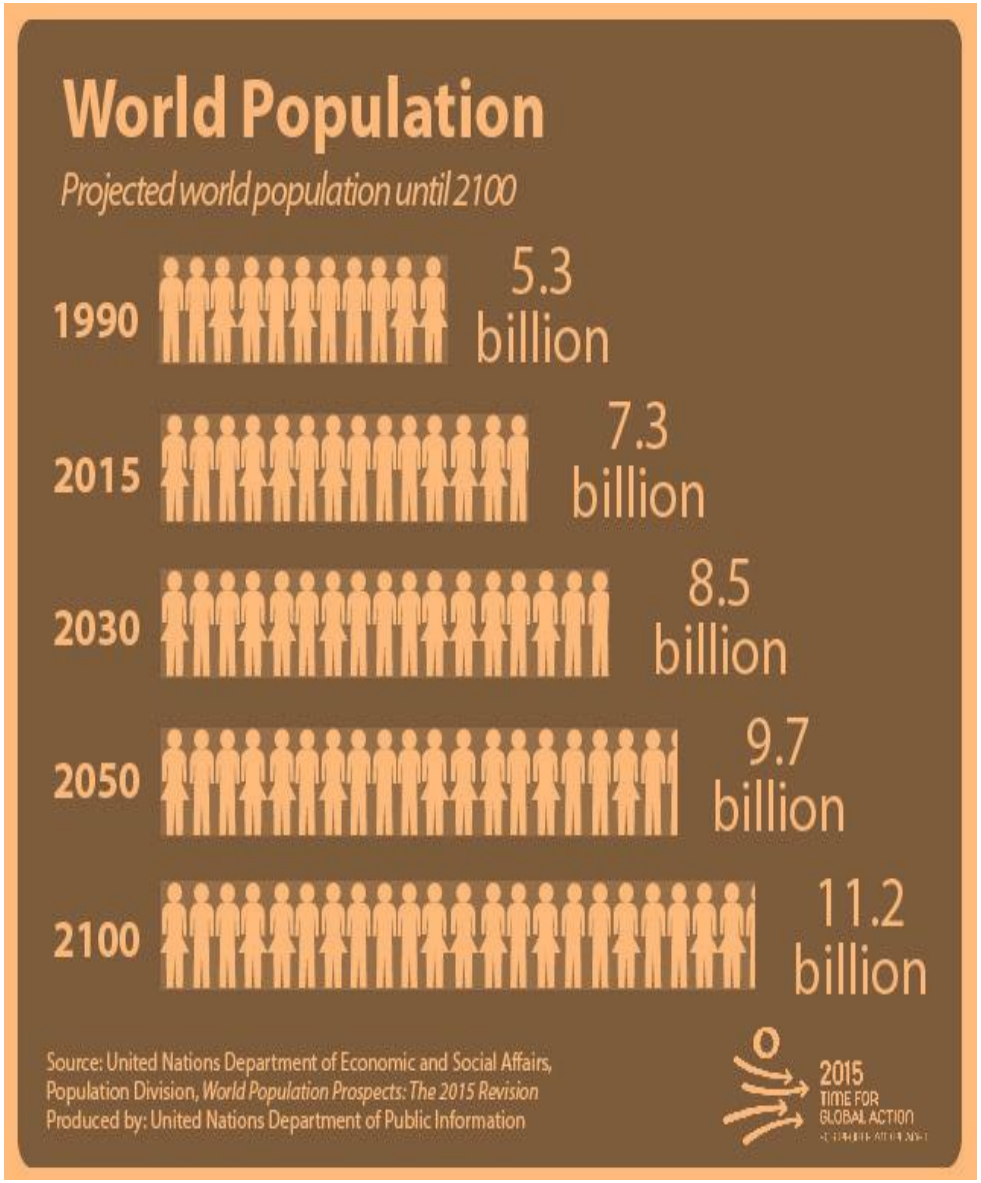
Siltation in Mega Dam

Increasing water deficit

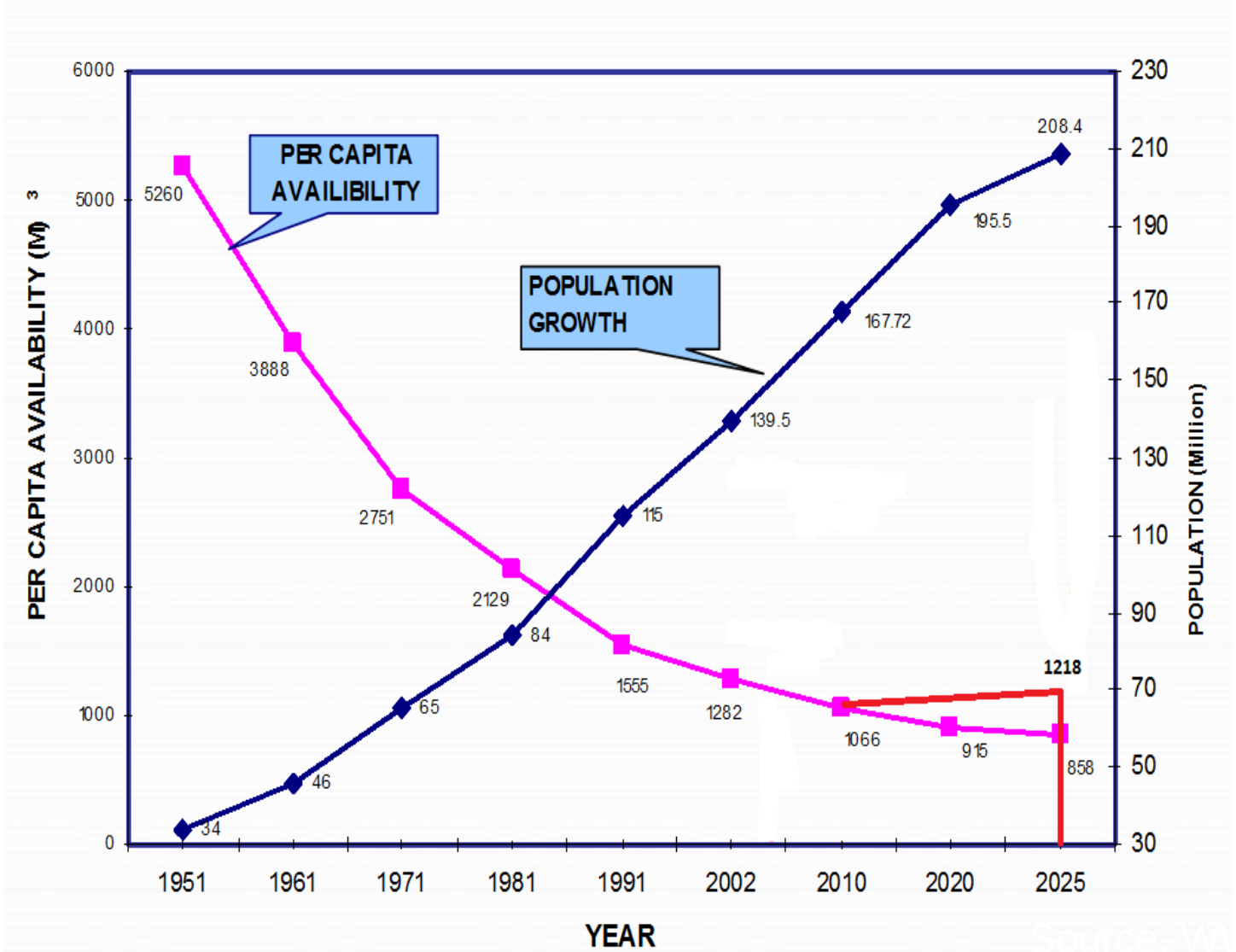
Water sharing issue

- World population is growing 80 million per year (Pakistan growing rate is 3 million per year)

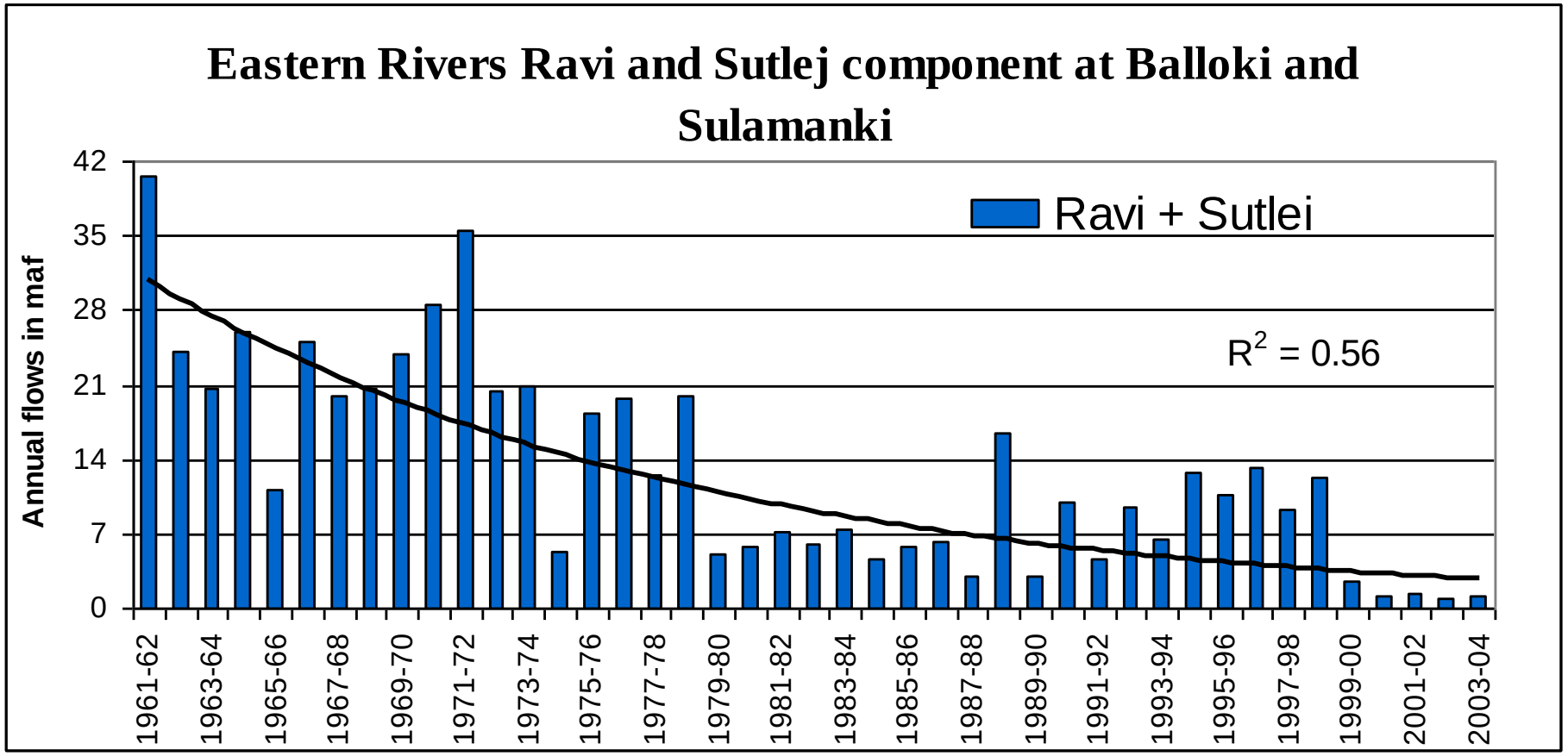
- In 2050, world population expects to be increased to 9.7 billion (expected Pakistan population is +300 million)



Condition of Per Capita Availability with expected increased Rainfall by 2025



Decrease of Eastern Inflow from India – as a result of Indus Water Treaty

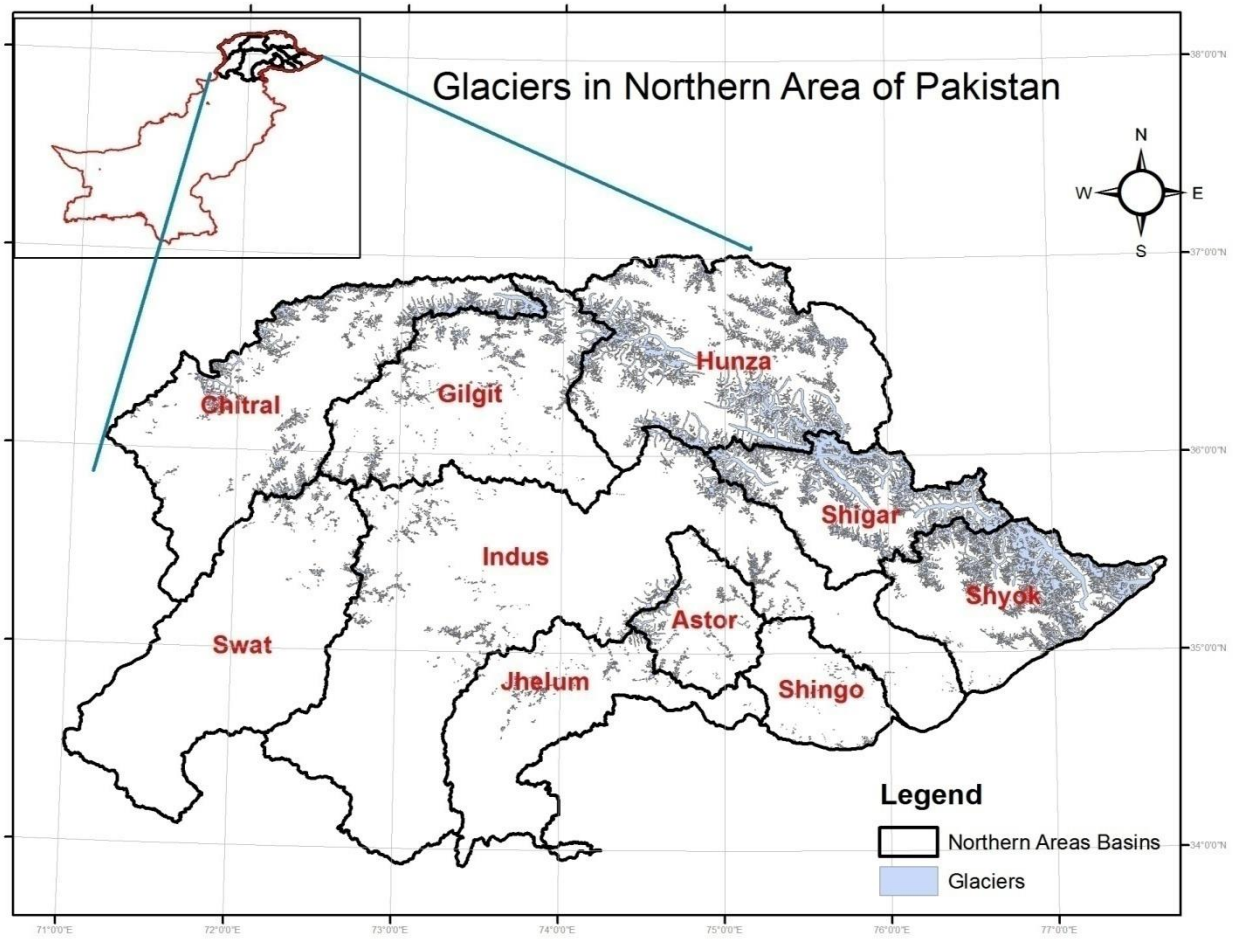


Water Security

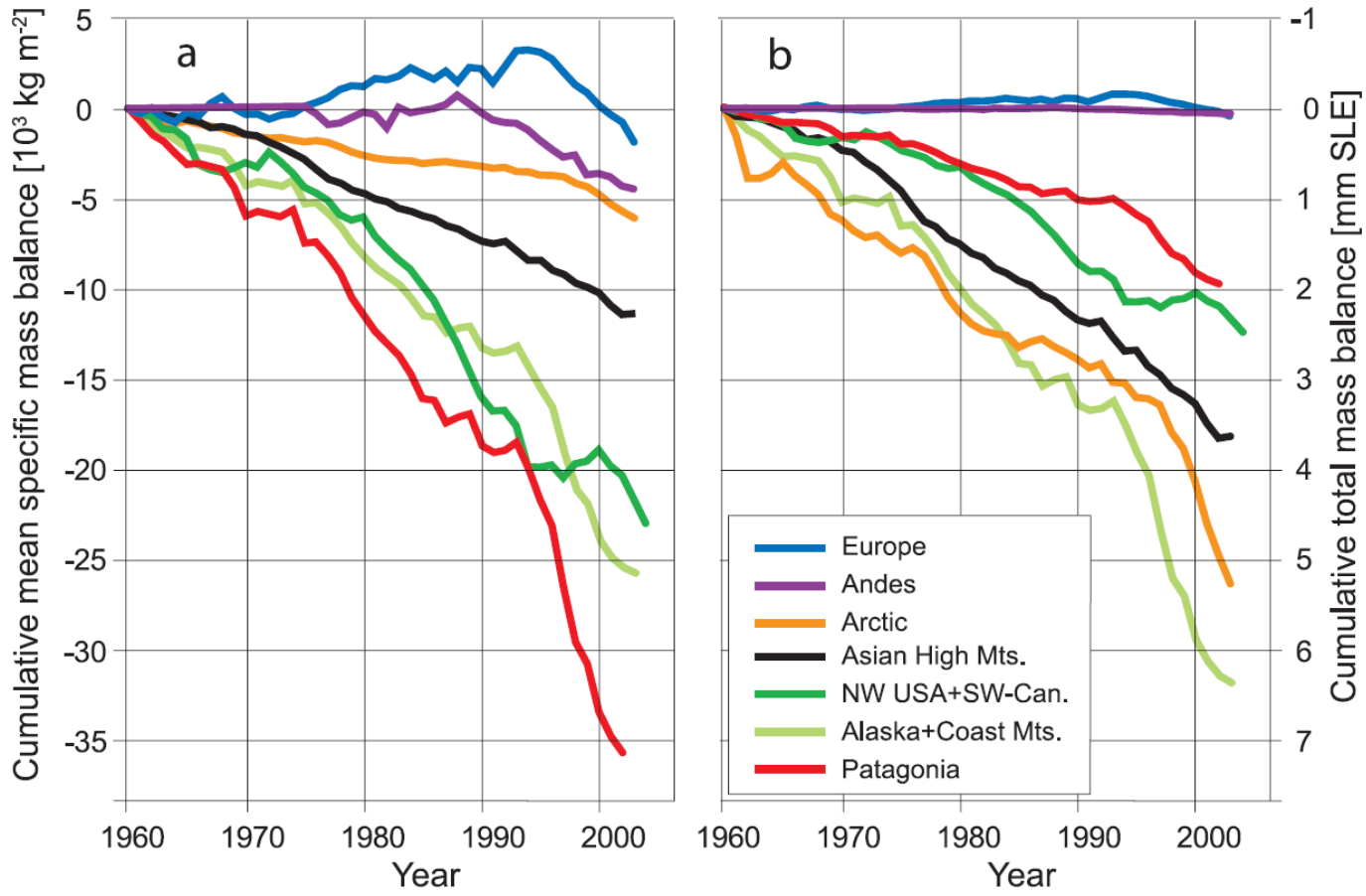
- Pakistan's rivers are predominantly fed by Hindu Kush, Karakoram and Himalyan glaciers. These are receding due to climate change

Pakistan's Cryospheric Assets

Number of Glaciers	Area of Glaciers (km2)	Volume of Ice (km3)	Ranges
7259	11780	2066	Himalaya Karakoram Hindukush



Response of Glacial Resources to Climate Change



Vulnerabilities of the region and Need for strengthening the early warning system

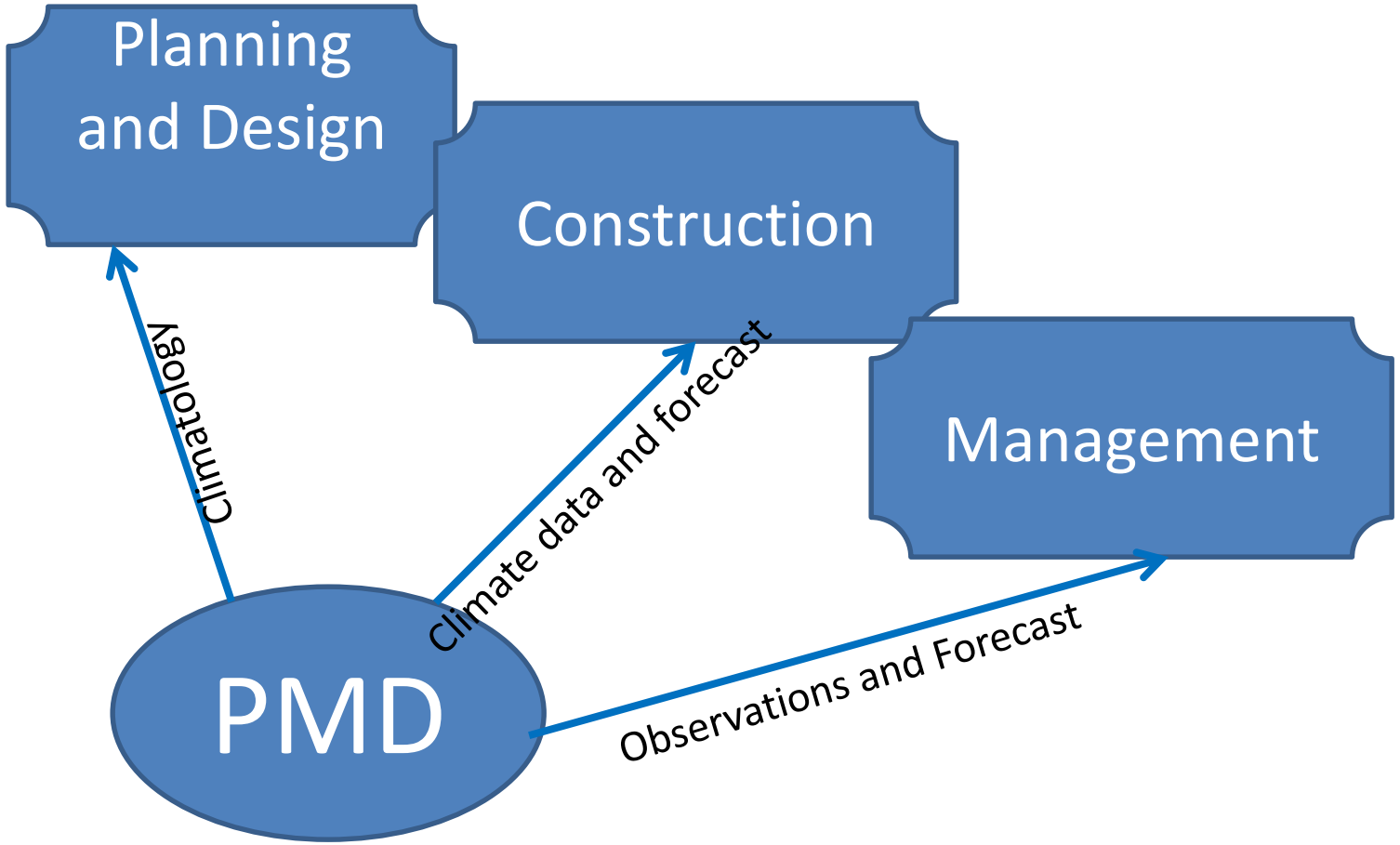
Climate of Pakistan - Extreme Weather Events

Pakistan is historically prone to Extreme Weather Events/Disasters, such as;

Snow-melt Flooding	**Extreme Heat in May/June**
Heavy Rains/River Flooding	**Extreme Rainfall (Monsoon)**
Torrential Rain/Flash Flooding	**Extreme Rainfall (Monsoon)**
Urban Flooding	**Extreme Rainfall (Monsoon)**
Cyclones/Coastal Flooding	**Tropical Cyclones (Pre & Post Monsoon)**
Water Crises/Droughts	**Dry Spell (Deficient Monsoon/Winter rain)**

In Pakistan, more than 70% Extreme Weather Events are associated with Monsoon Season

Role of PMD in Water Sector Development & Management



Climate Change Impact

Pakistan has been cited as amongst the most vulnerable group due to Extreme weather, change in temperature + rainfall.

Potential Impacts

- **Glaciers melting.**
- **Droughts.**
- **Flood Event.**
- **Change in Rainfall Pattern.**

The climate change requires the following actions e.g. Potential offsets

- Need for carry over dams
- Efficient irrigation (water conservation & demand management)
- Controlling population growth rate
- Changed cropping pattern

ISSUES

- **Existing Capability?**
  - Weather prediction capability limited due to lack of met-data and advanced technology for aviation services (wind profilers)
- **Hydrological Data?**
  - Lack of real time hydrological data (Radars, AWS, Telemetric…).
  - Trans-boundary data for eastern rivers not available.
  - Lack of GLOF monitoring & Flash Flood Warning System
- **Seismic Network?**
  - Lacking in Tsunami warning system & Seismic monitoring network
- **Human Resource?**
  - Limited Career Progression & Retention of qualified staff (PhD)
  - No capacity development with new & advanced technology
  - No incentives (SPS & Research Allowance) for Scientists and field force at remote areas
- **Awareness?**
  - Lack of awareness due to dissemination system (TV, Radio, Cell...)
- **Cost-Benefit Ratio?**
  - Climate Change - Investment of One dime in advance can save 36 dime.

Summary of Requiremen

Rs. Million

SN	Description	Remarks
Radars	•12 New •5 Replacement	Provinces
Met Data (Observation Network)	• 40 New, 430 AWS •10 Agro-met •8 Wind Profilers (Aviation)	Federal Govt
Flood Warning Centers Regional Centers **GLOF** **Flash Flood WC**	• 5 Centers (Provincial) • 20 Stations in GB & Chitral • 8 Vulnerable Sites (Hill Torrents)	Federal Govt
Seismic Data	10 Stations (Tsunami & Micro-seismicity)	Federal Govt
Awareness	TV/FM Radio/Cell	Federal Govt
Technology	HPCC (High Power Computer Clustered)	Federal Govt
Capacity Development	Scientists skill according to new & advanced technology	Federal Govt

UNDERSTAND the Climate Risk

COMMUNICATE the Climate Risk

Thank you!