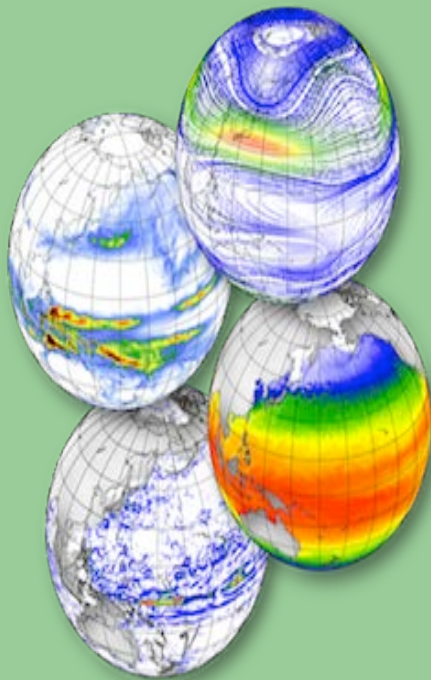


Courting Catastrophe through GEOSS-AWCI Program



Mr Hazrat Mir

Chief Meteorologist PMD



PMD

Pakistan Meteorological Department

SERVICES



Meteorology

Hydrology

Agrometeorology

Drought

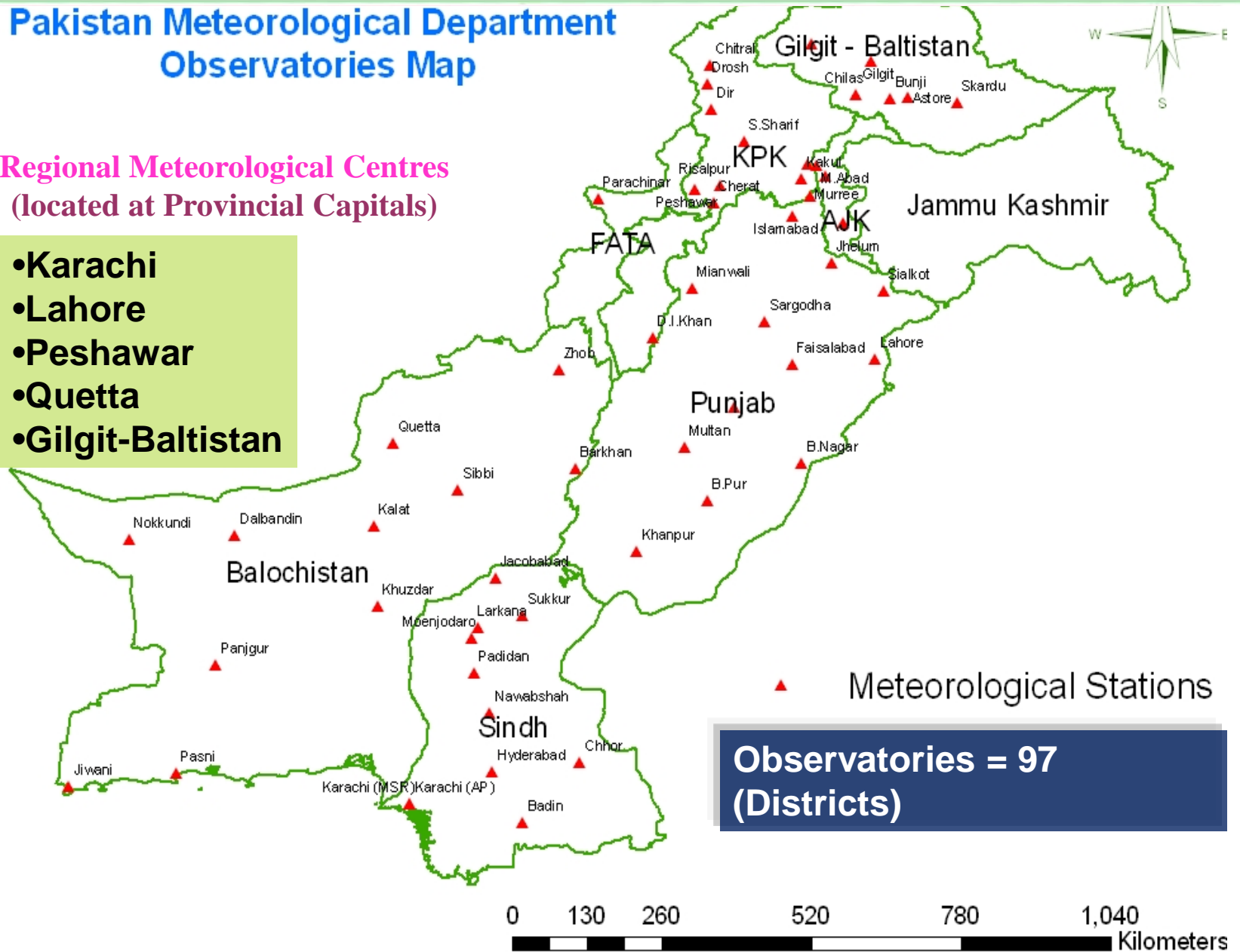
Seismology



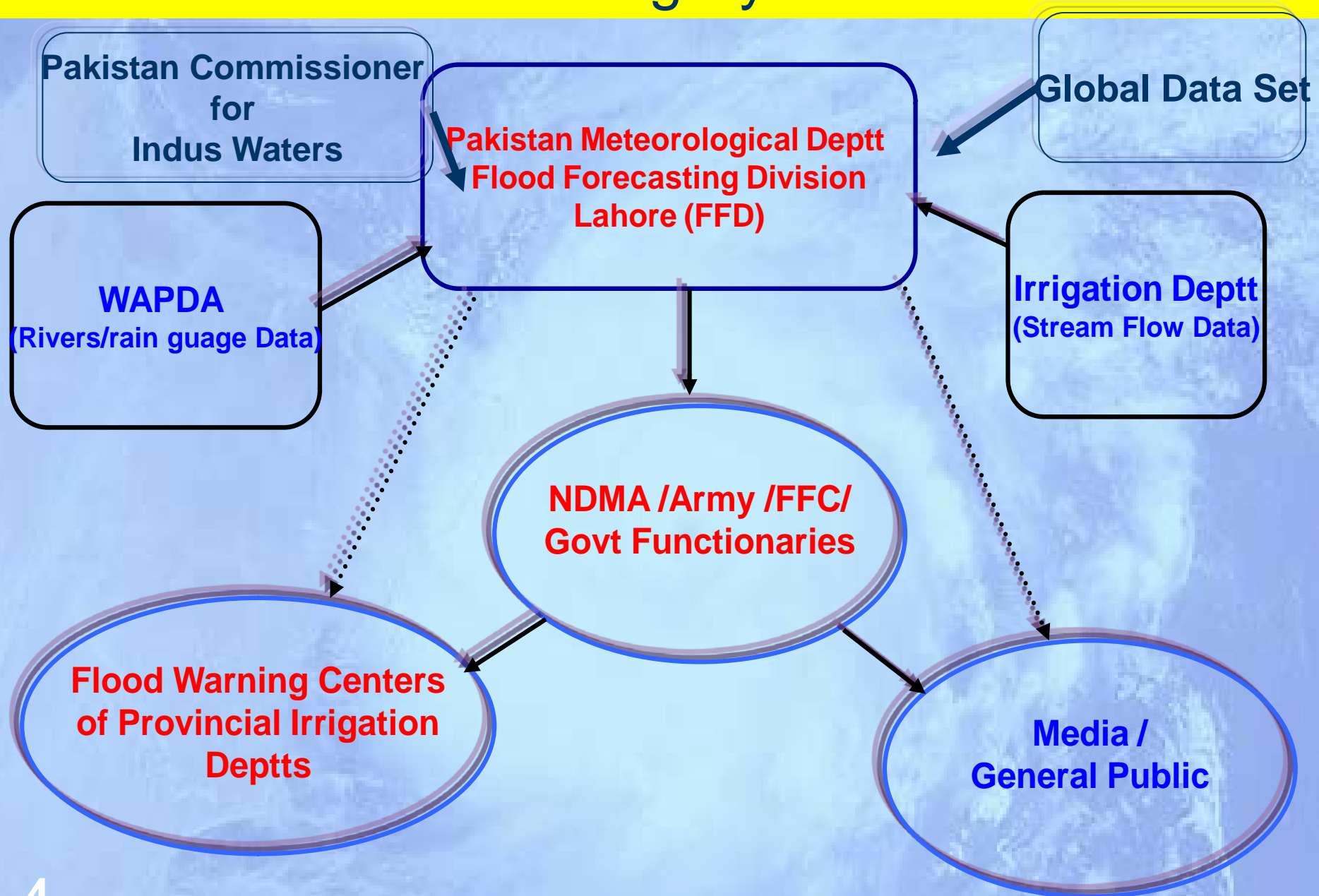
Pakistan Meteorological Department Observatories Map

Regional Meteorological Centres (located at Provincial Capitals)

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



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**

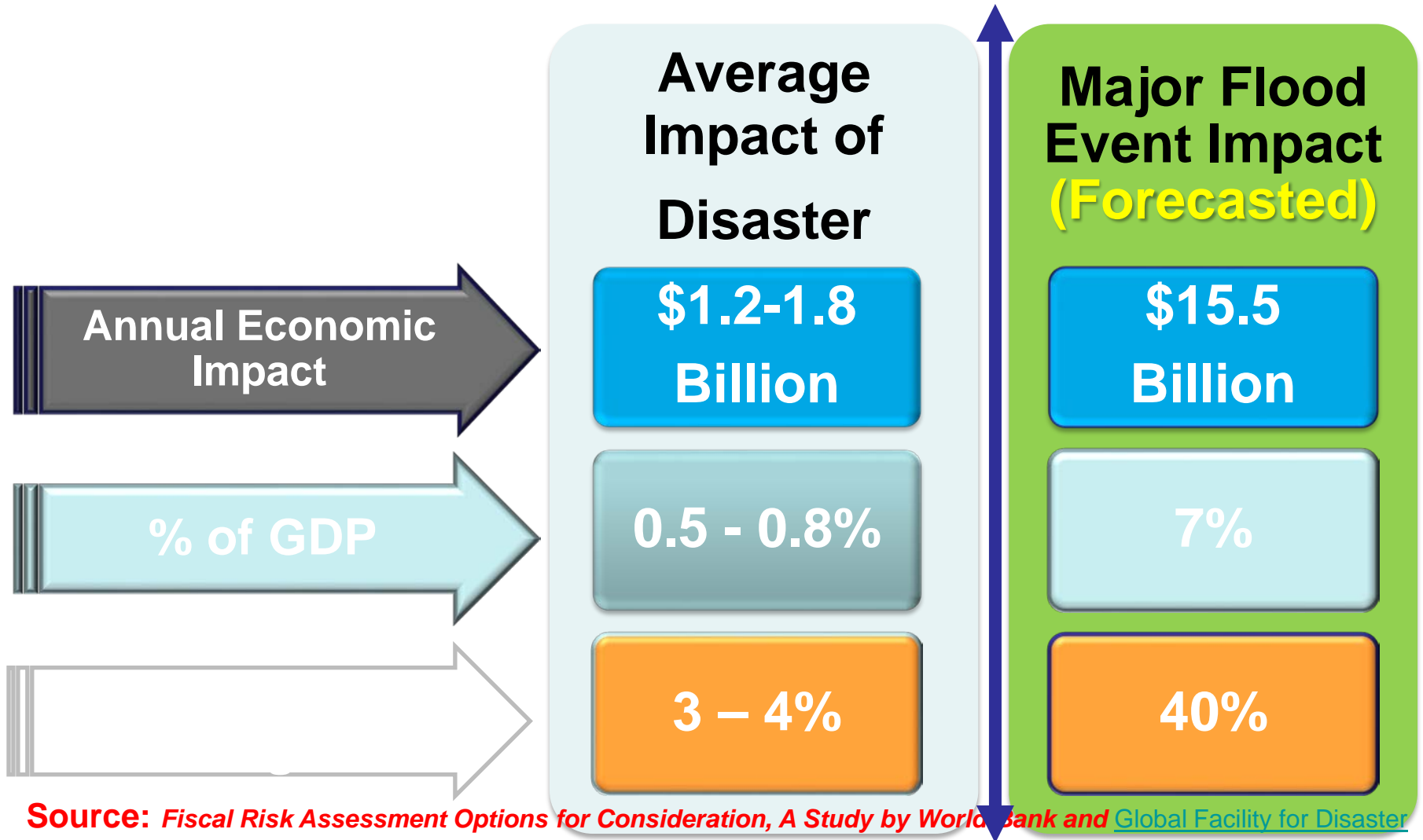
Floods - 2010



Floods - 2011

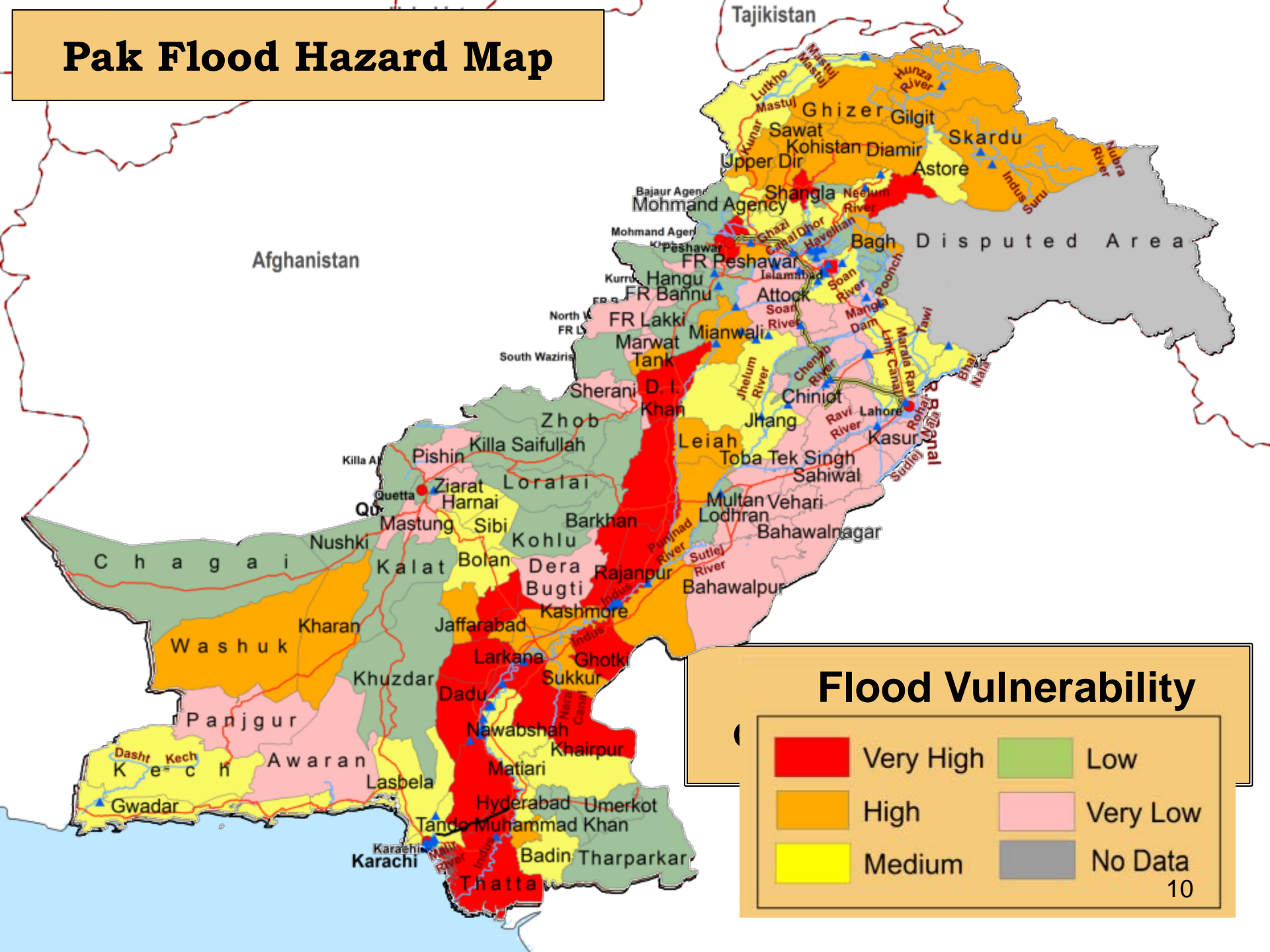


Economic Impact of Major Disasters Since 2005


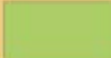






Source: *Fiscal Risk Assessment Options for Consideration, A Study by World Bank and Global Facility for Disaster*

Pak Flood Hazard Map



Flood Vulnerability

	Very High		Low
	High		Very Low
	Medium		No Data

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**

AFGHANISTAN

Atmum & D-4
Khan Hill
Torrents

D-6 Khan Hill
Torrents

KABUL

INDUS

JHELUM

CHENAB

RAVI

SUTLEJ

BEAS

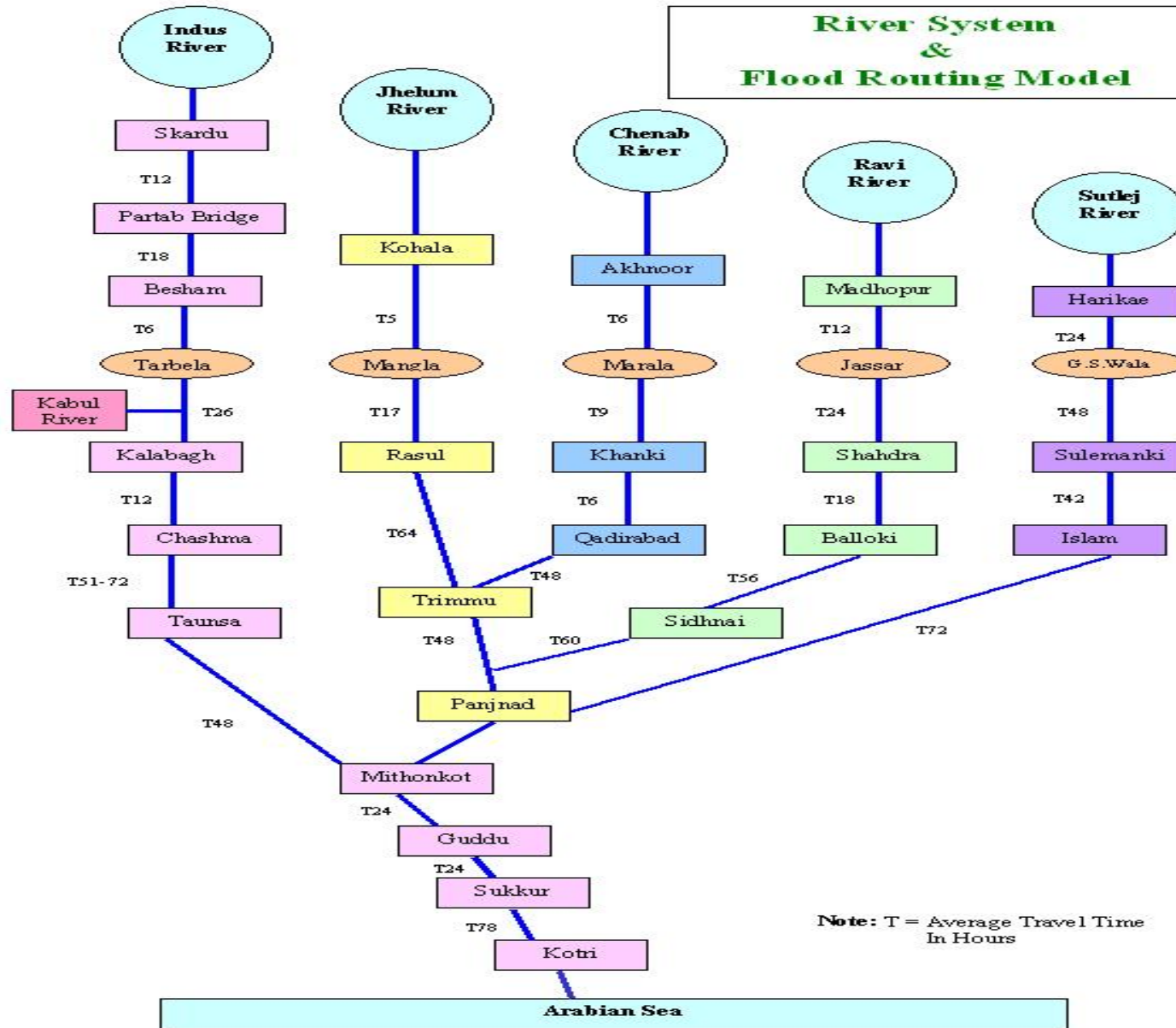
INDIA

**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

Pak GLOF Hazard Map



GLOF Vulnerability

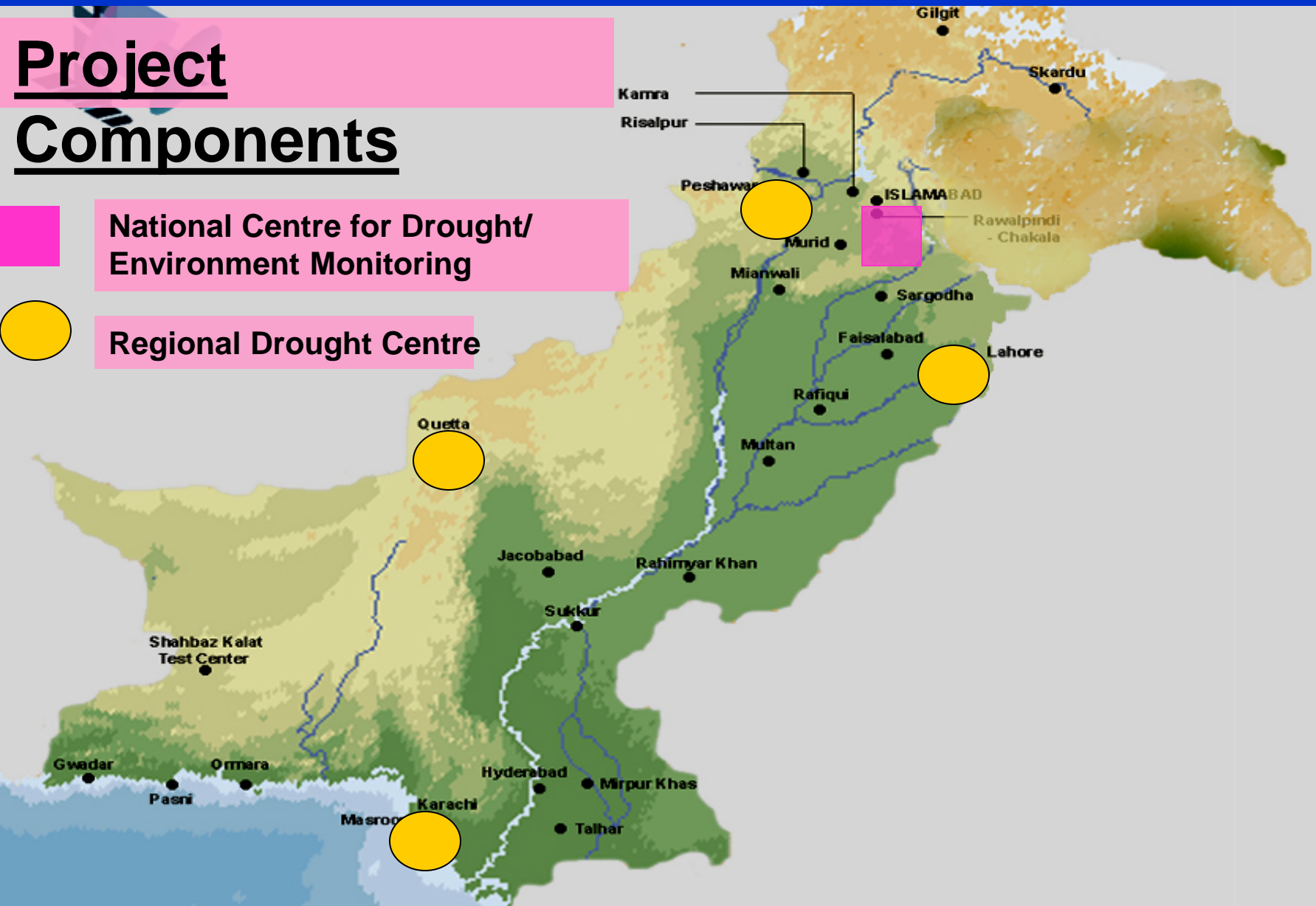
	Very High		Low
	High		Very Low
	Medium		No Data

Drought/Environment Monitoring & Early Warning Centre

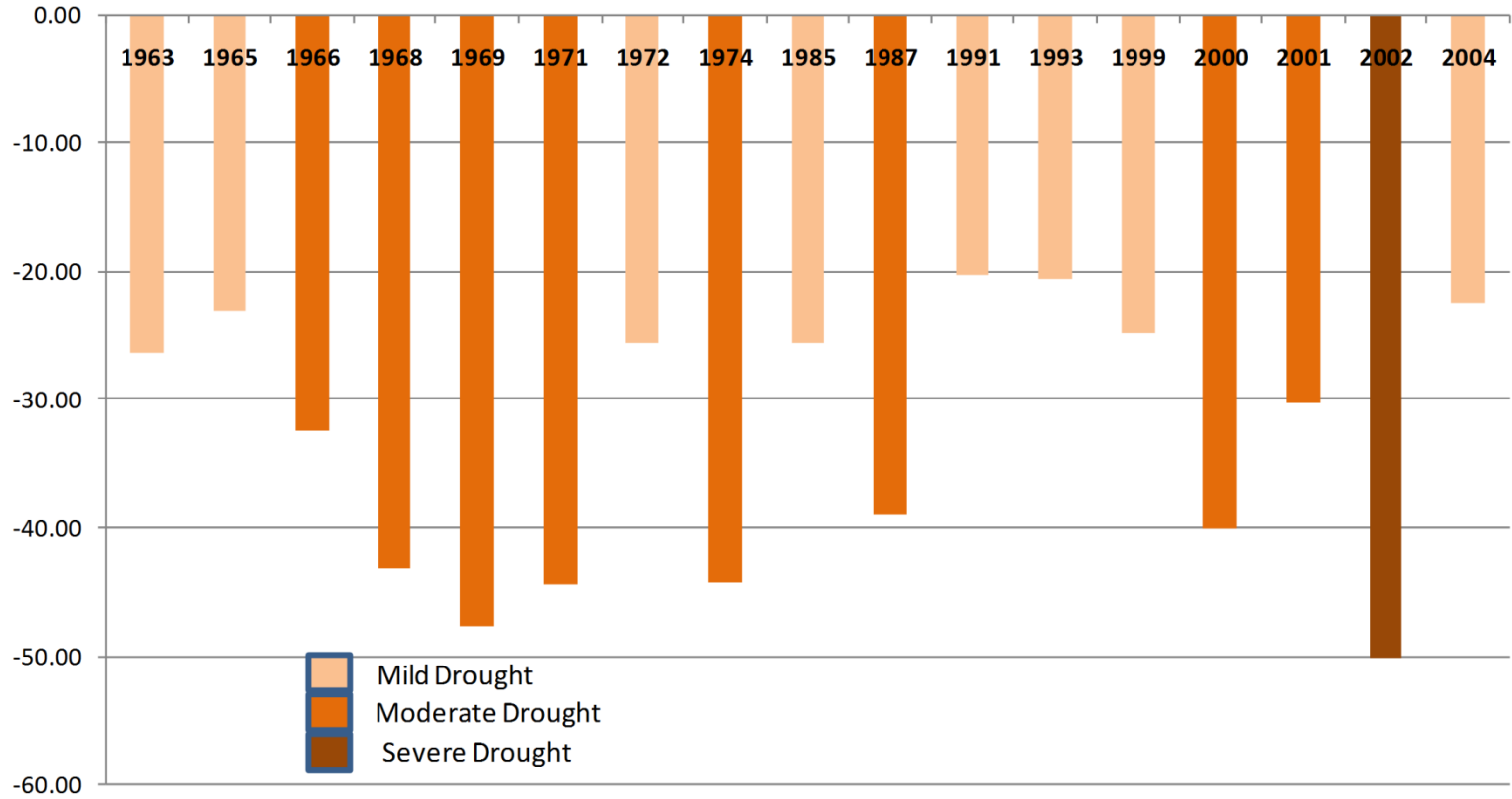
Project Components

 National Centre for Drought/Environment Monitoring

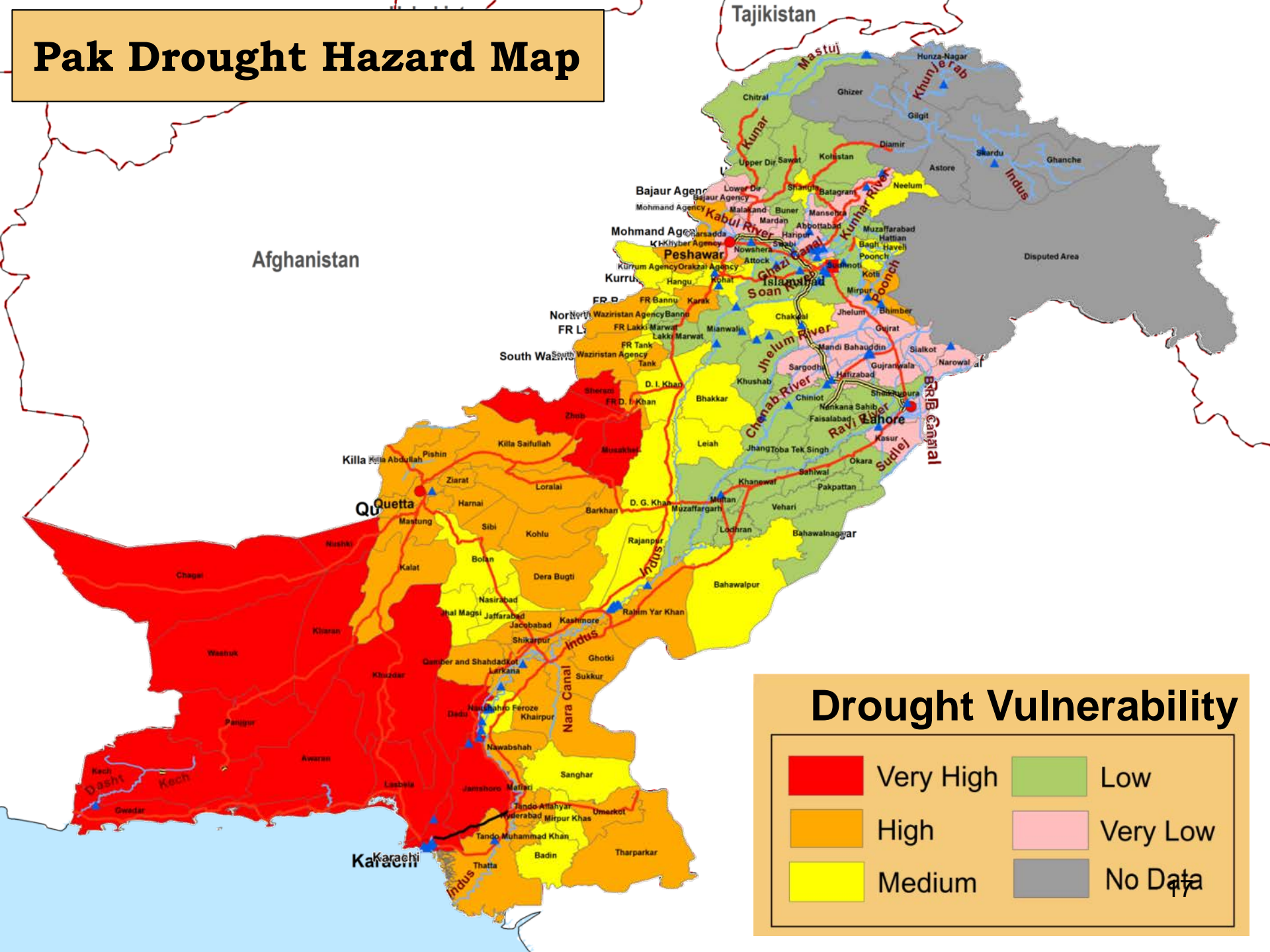
 Regional Drought Centre



Historical Drought Years during 1960-2016 in Pakistan



Pak Drought Hazard Map



Drought Vulnerability

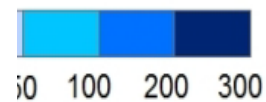
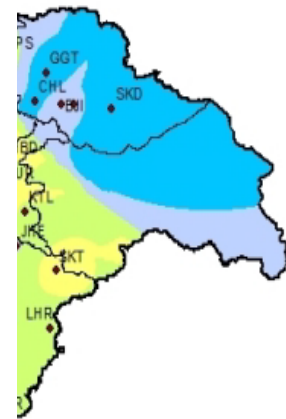
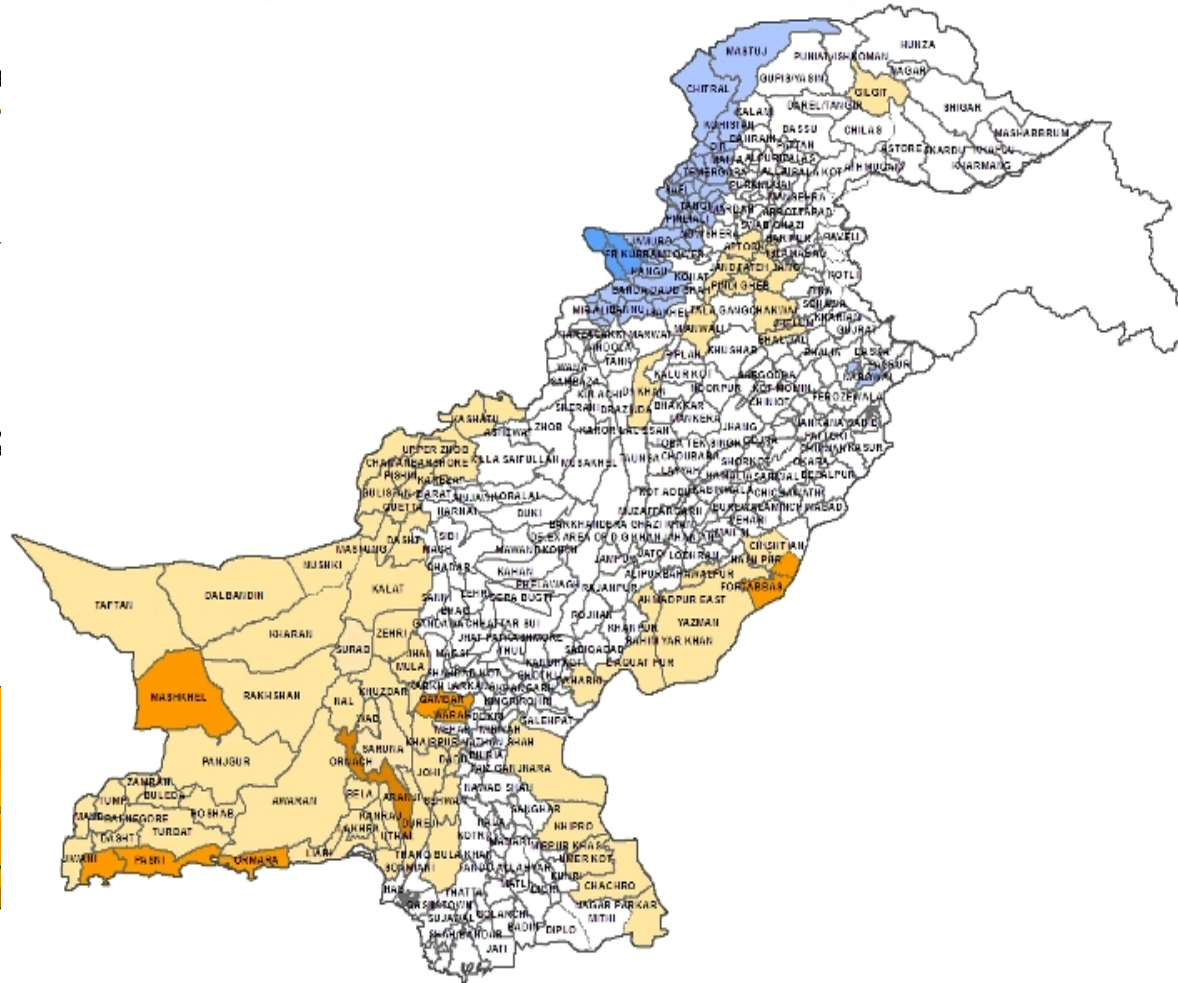
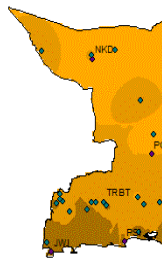
	Very High		Low
	High		Very Low
	Medium		No Data

Satellite Products being used for Drought Monitoring

Duration 16th Dec 2016 to 31st Dec 2016
Drought Monitor Updated 2nd January, 2017

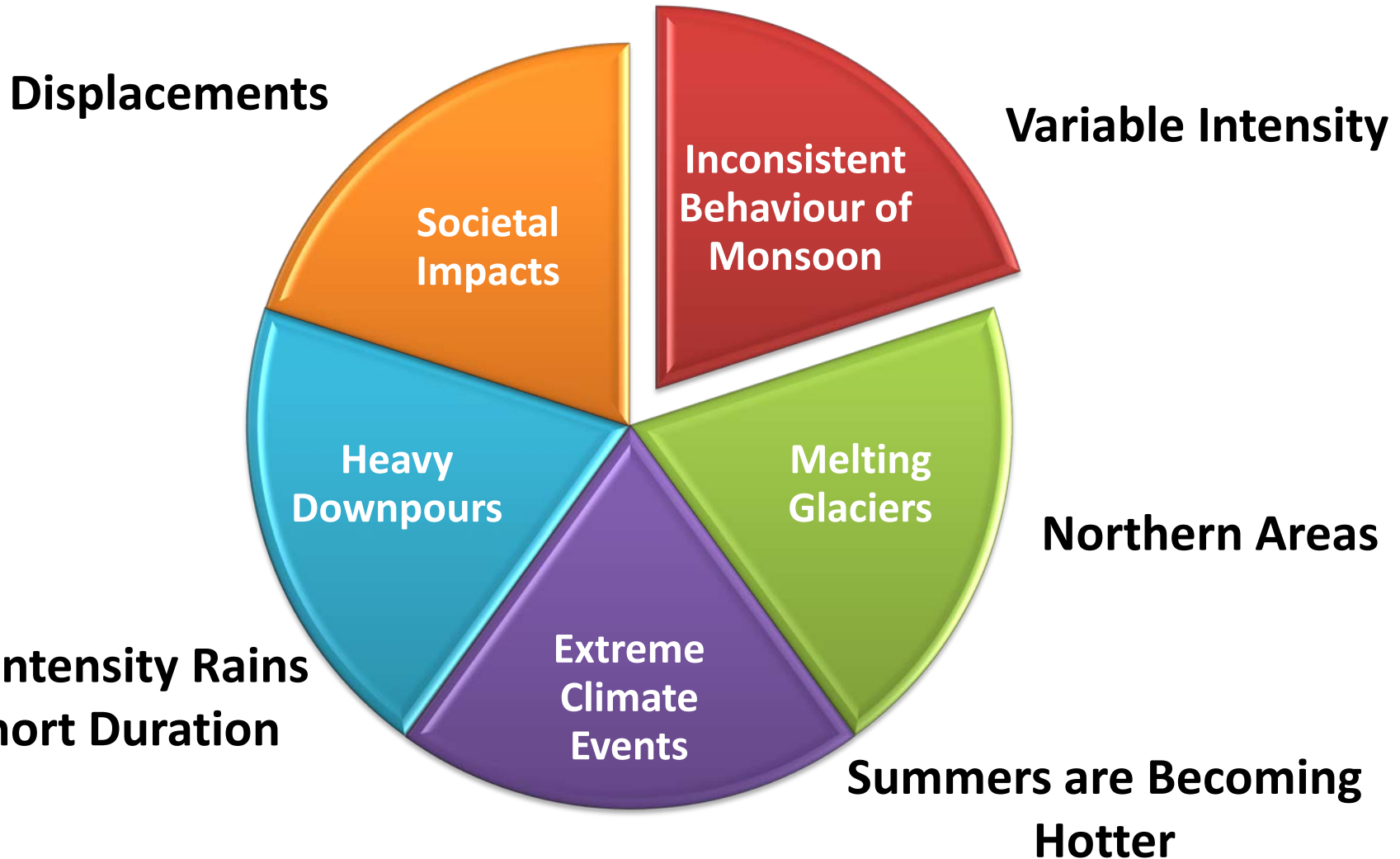
Land Surface
11 -

11 -





Global Climate Impact on Pakistan





Pakistan Meteorological Department
Government of Pakistan



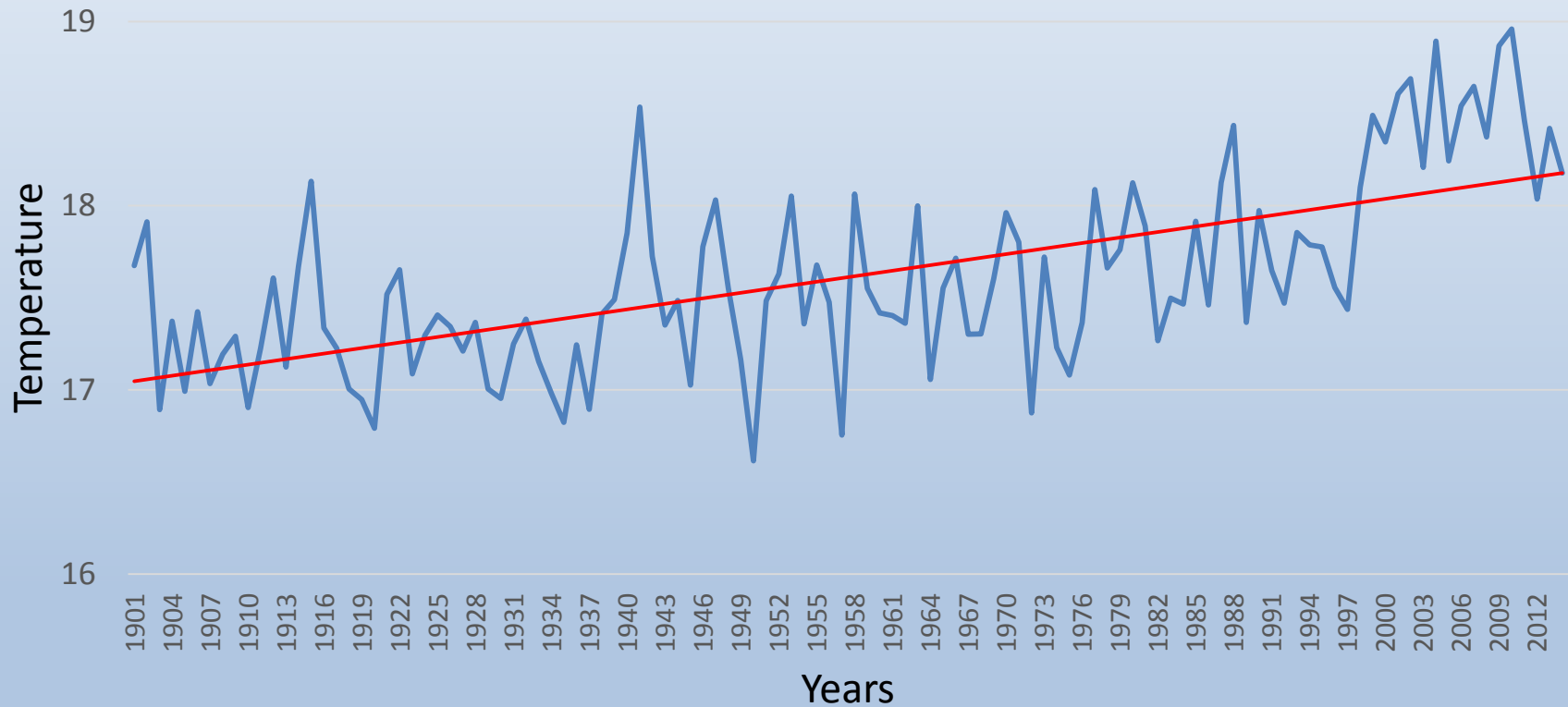
Climate Change In Pakistan



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:

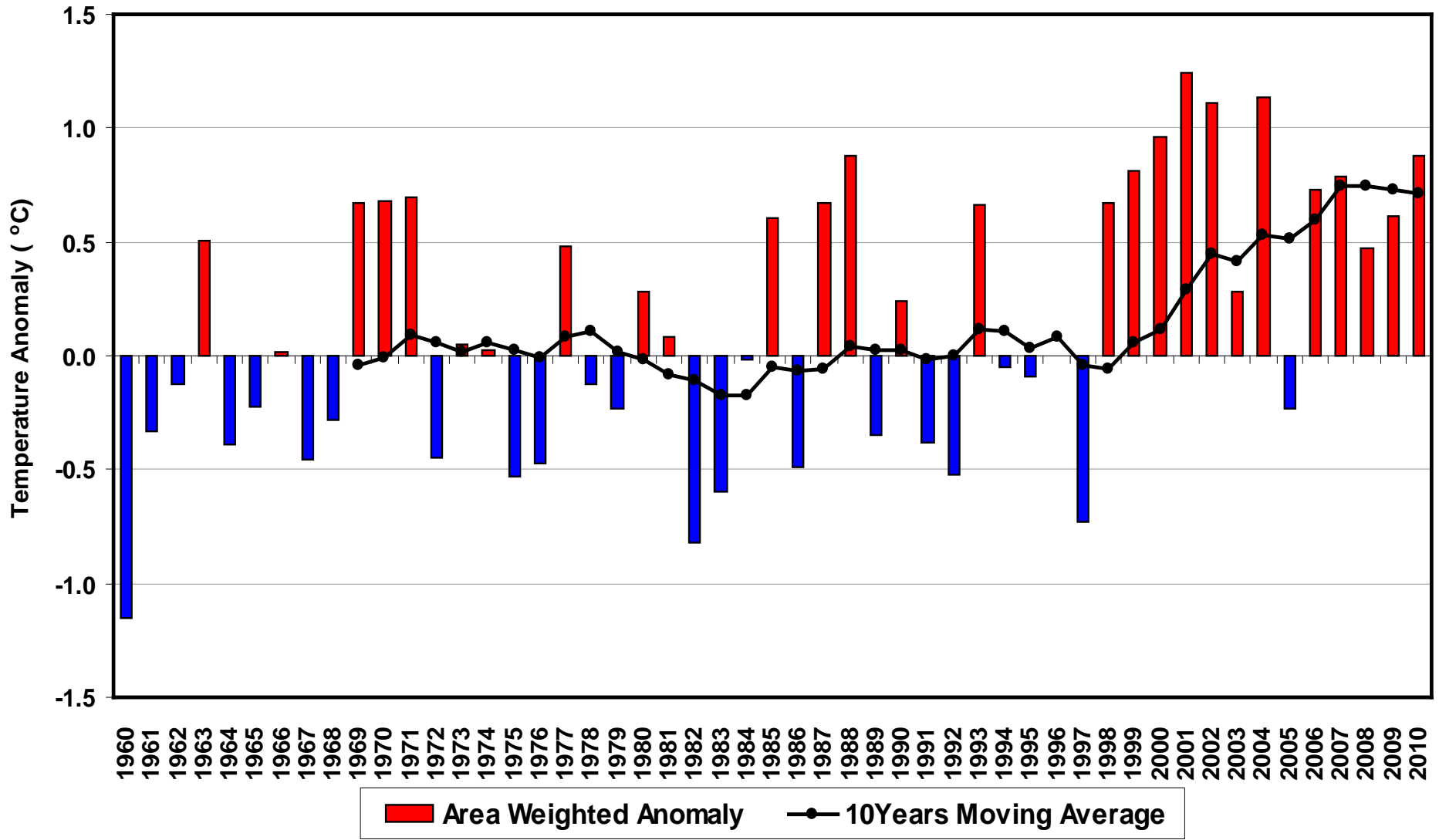
1901-2000 0.06 °C per decade

1960-2007 0.24 °C per decade

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

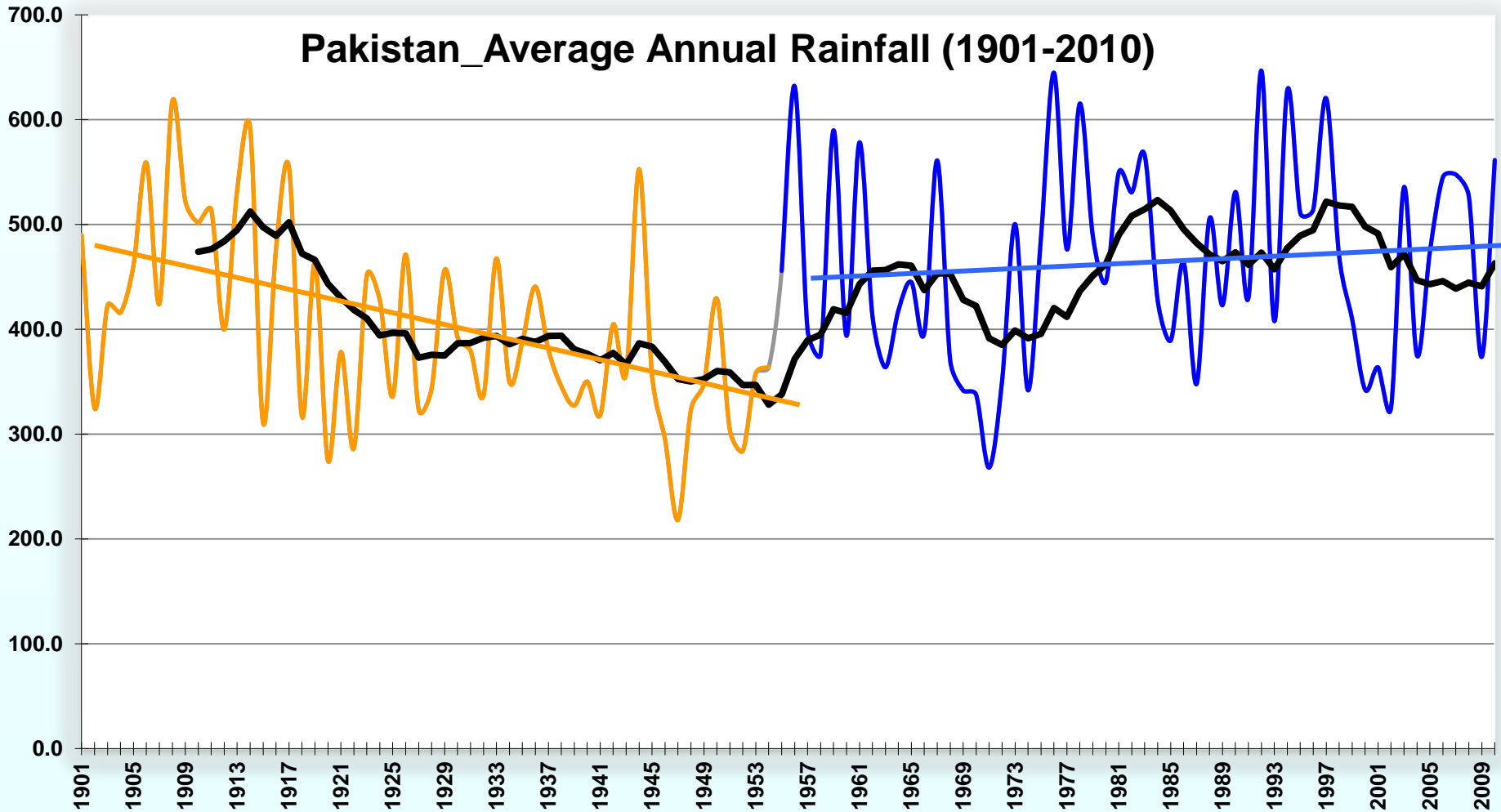


Area Weighted Mean Temperature Anomaly of Pakistan (1960-2010)





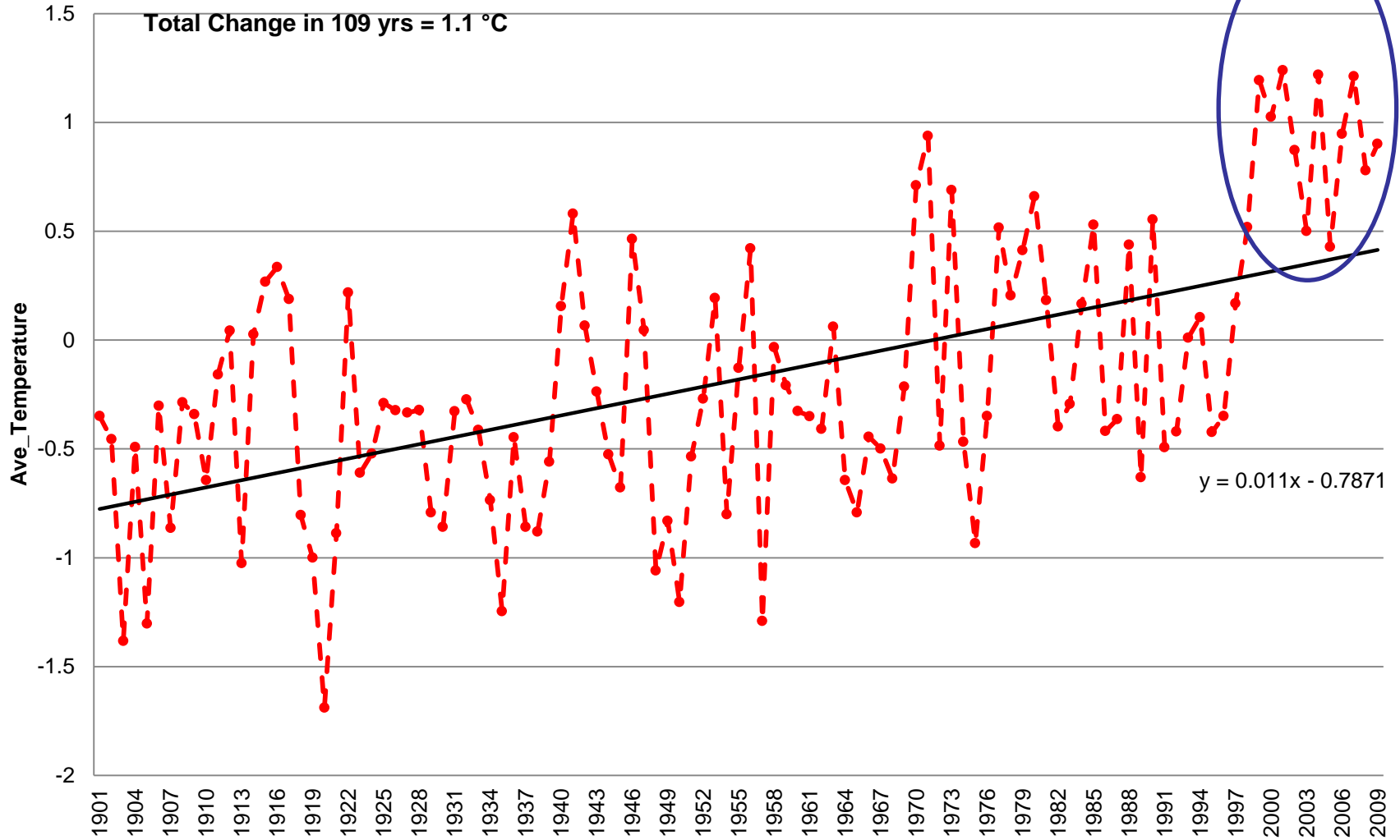
Pakistan_Average Annual Rainfall (1901-2010)



— All_Pakistan_Rainfall_Annual — 1901-1954 — 1955-2010 — 10 区間移動平均 (All_Pakistan_Rainfall_Annual)

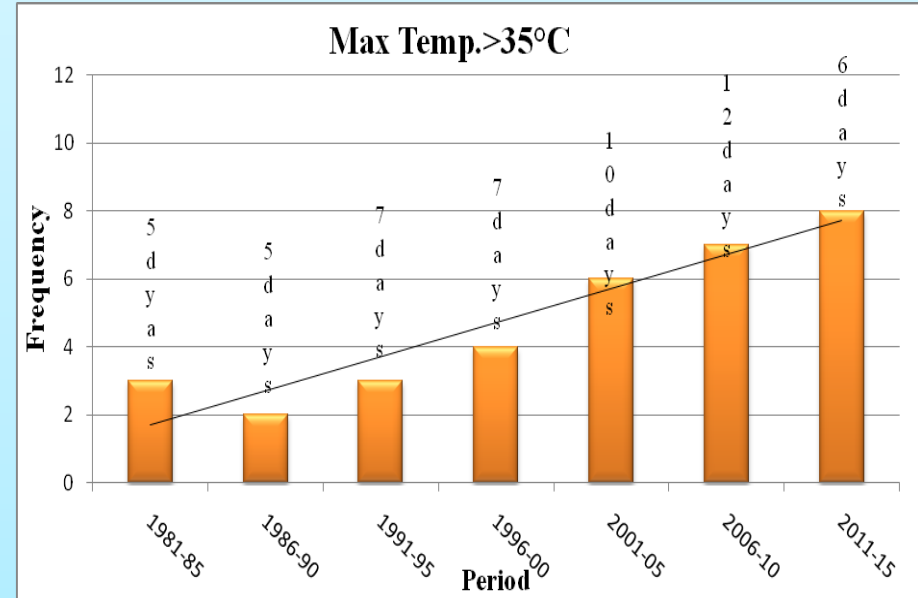
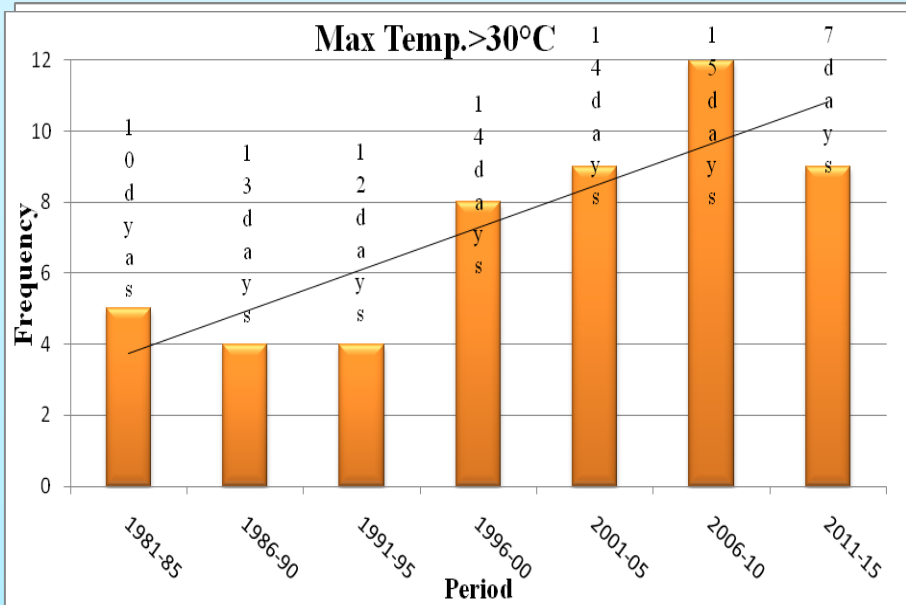


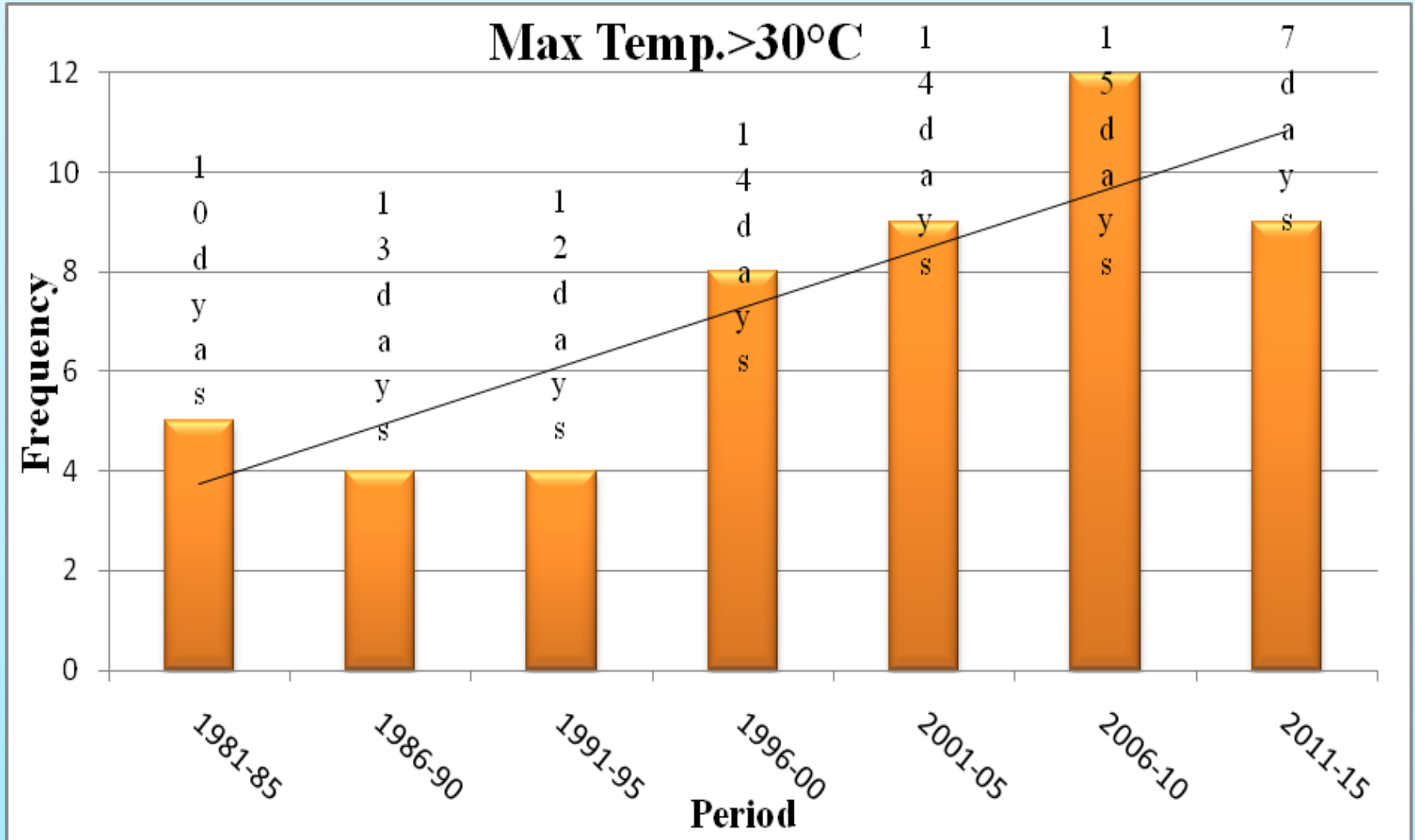
Average Temperature of Northern Areas of Pakistan (1901-2009) based on Climate Research Unit (CRU data)





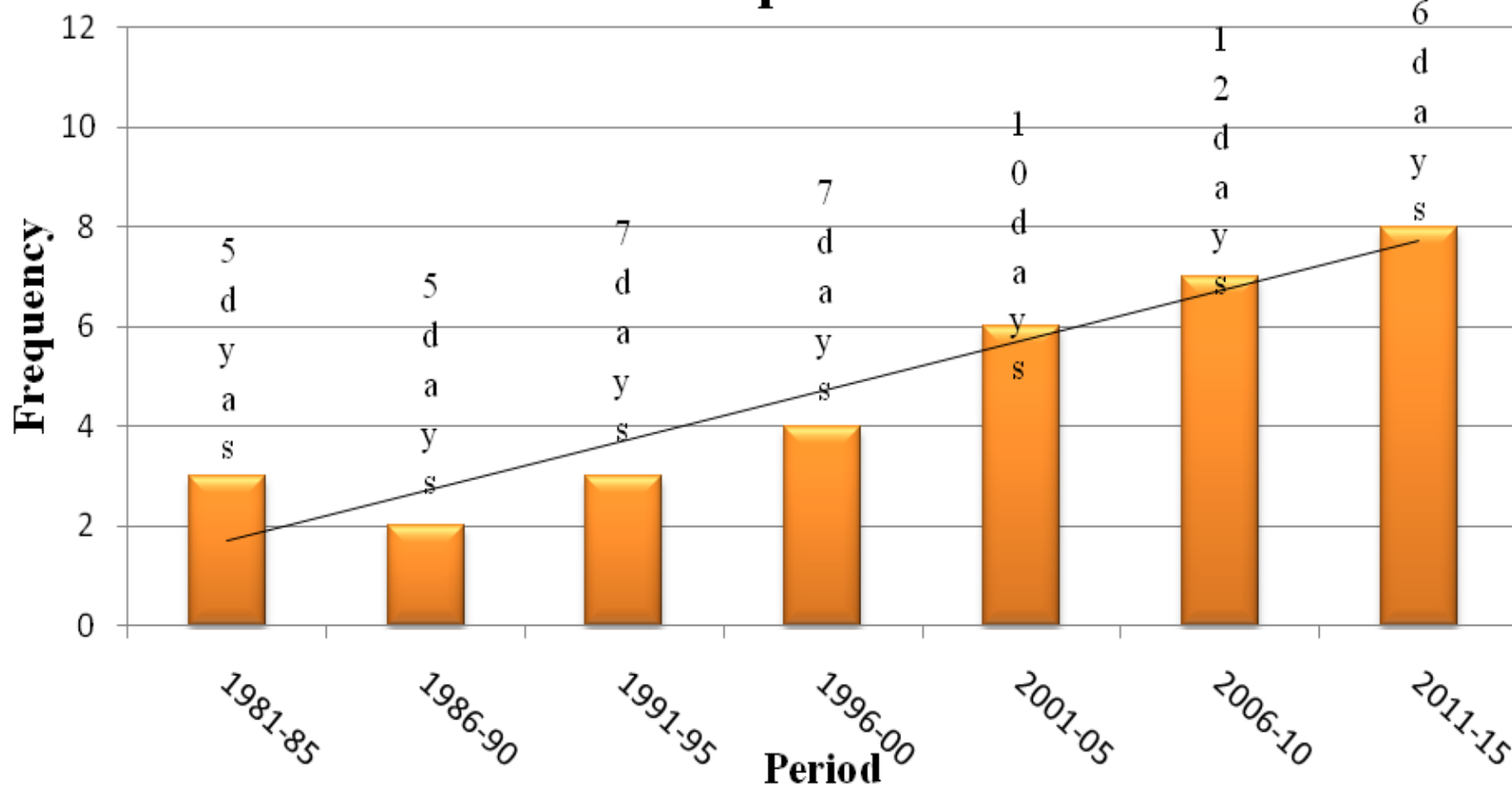
Heatwave Frequency in Upper KP and GB





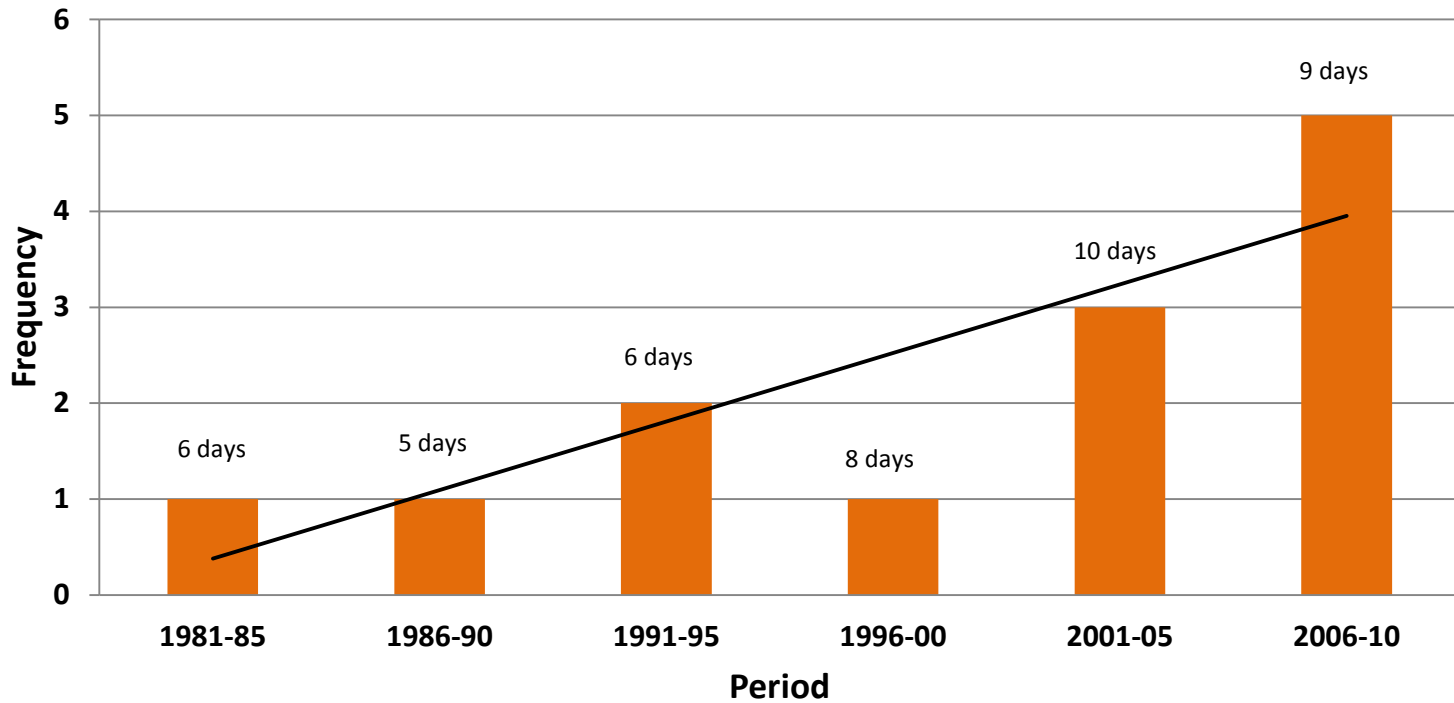


Max Temp. >35°C



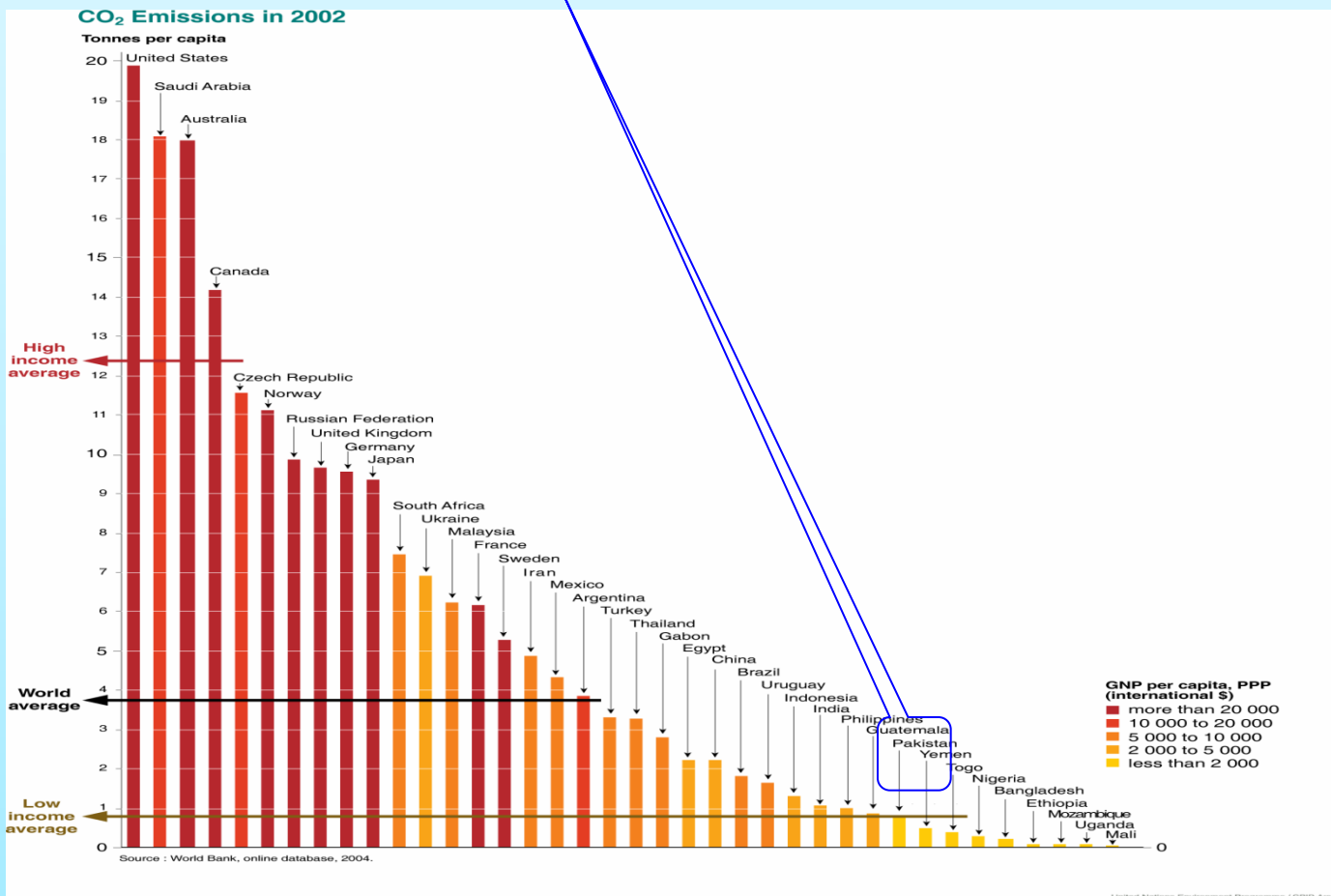


Max Temp. >40 °C



Emissions – where Pakistan Stands on the climate front?

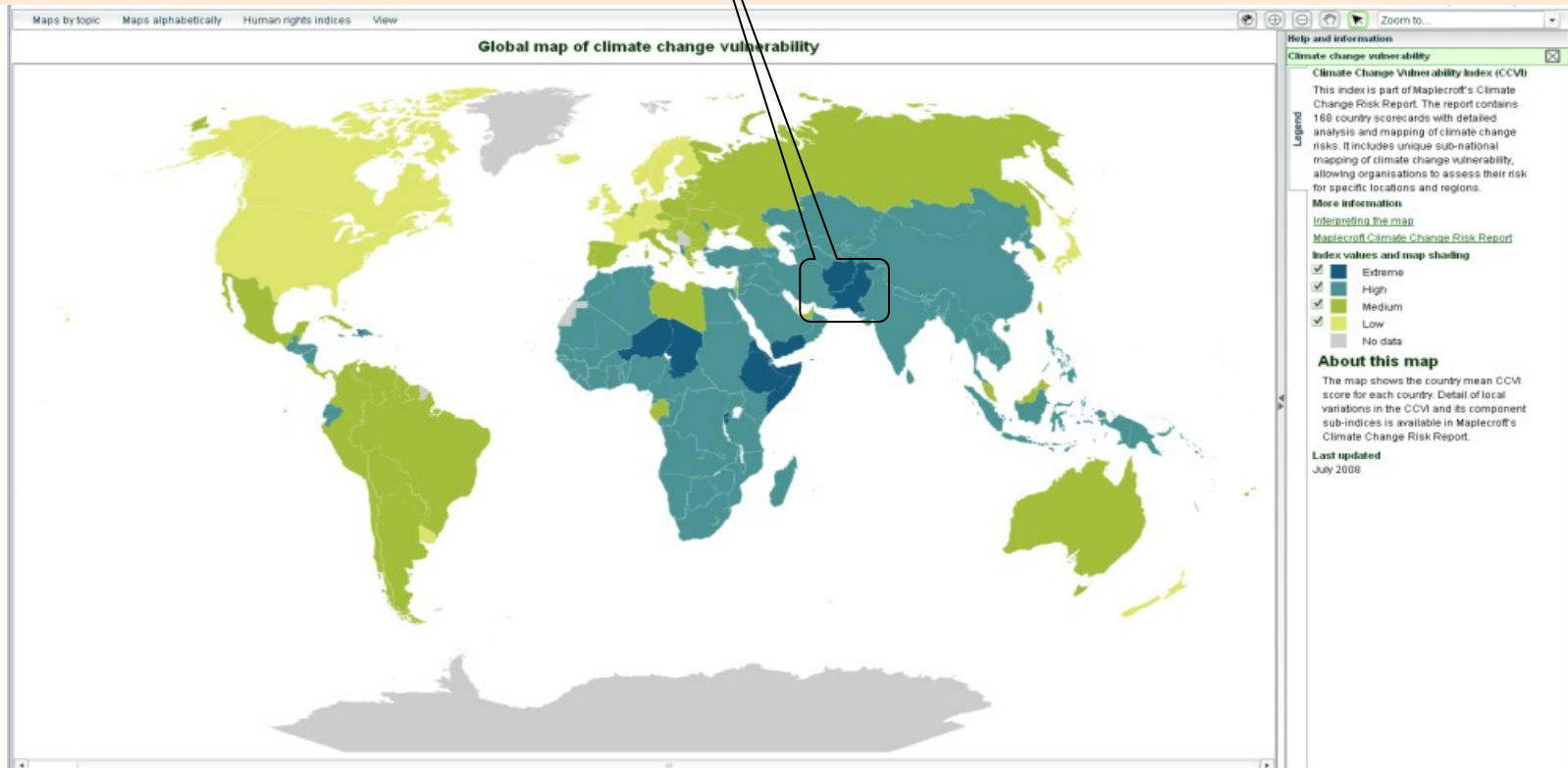
One of the lowest per capita emitters



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

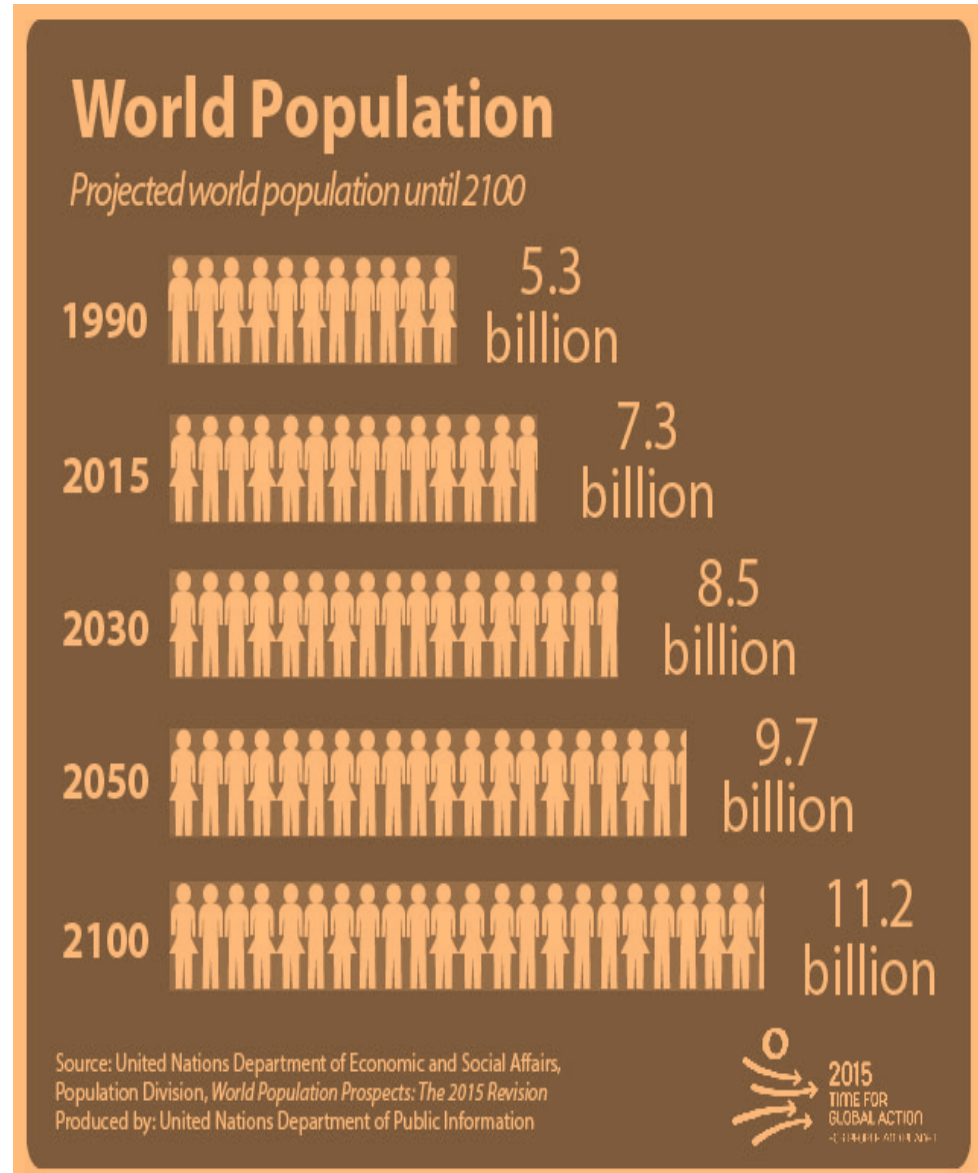
Siltation in Mega Dam

Increasing water deficit

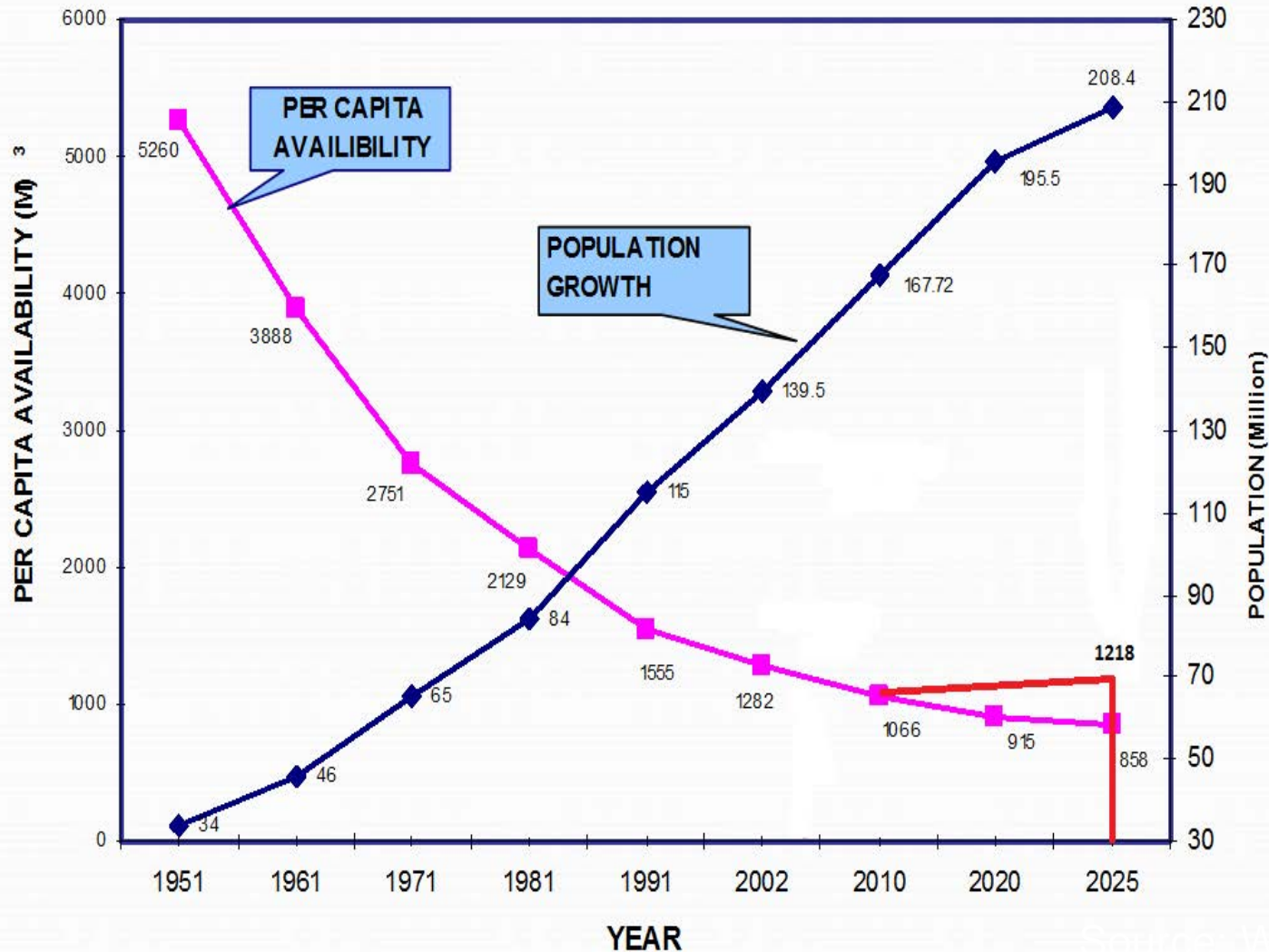
Water sharing issue



- 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)

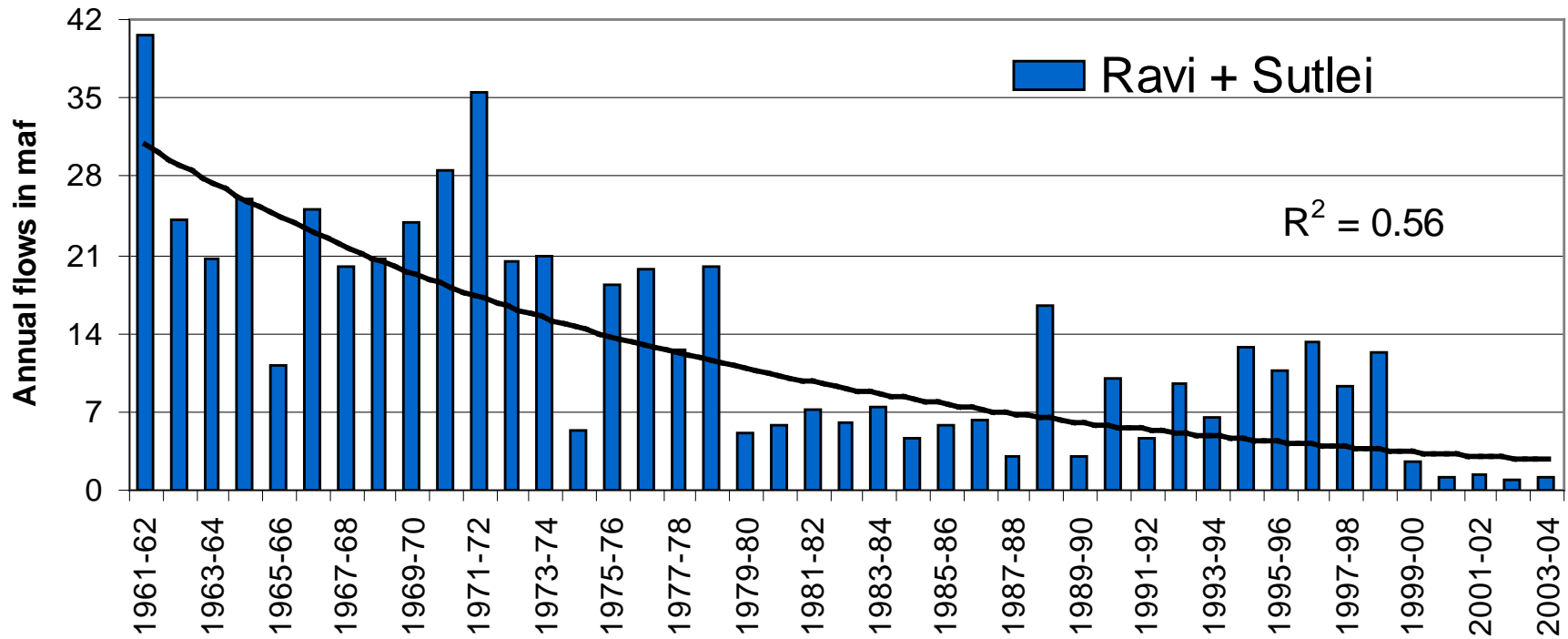


Condition of Per Capita Availability with expected increased Rainfall by 2025



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

Eastern Rivers Ravi and Sutlej component at Balloki and Sulamanki



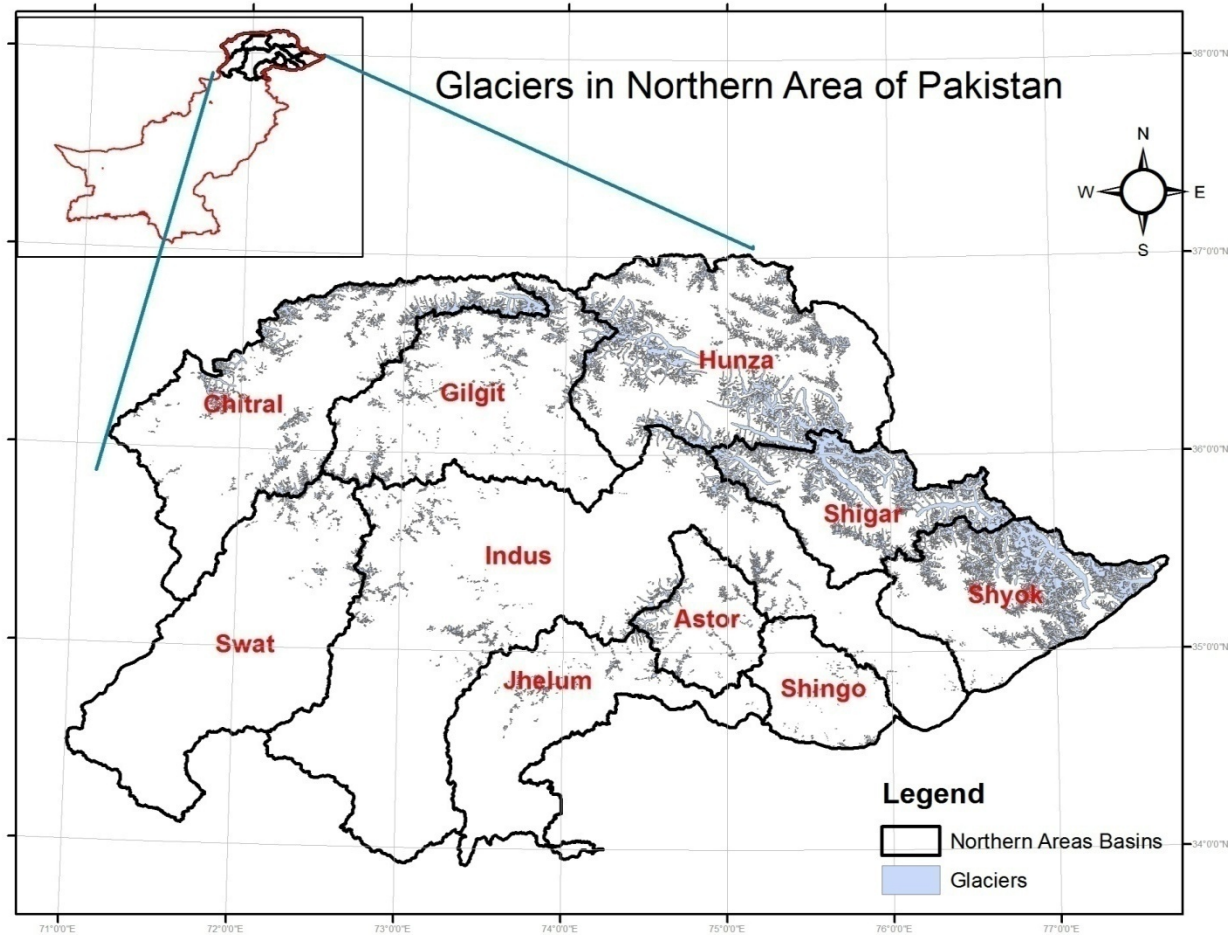
Water Security

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

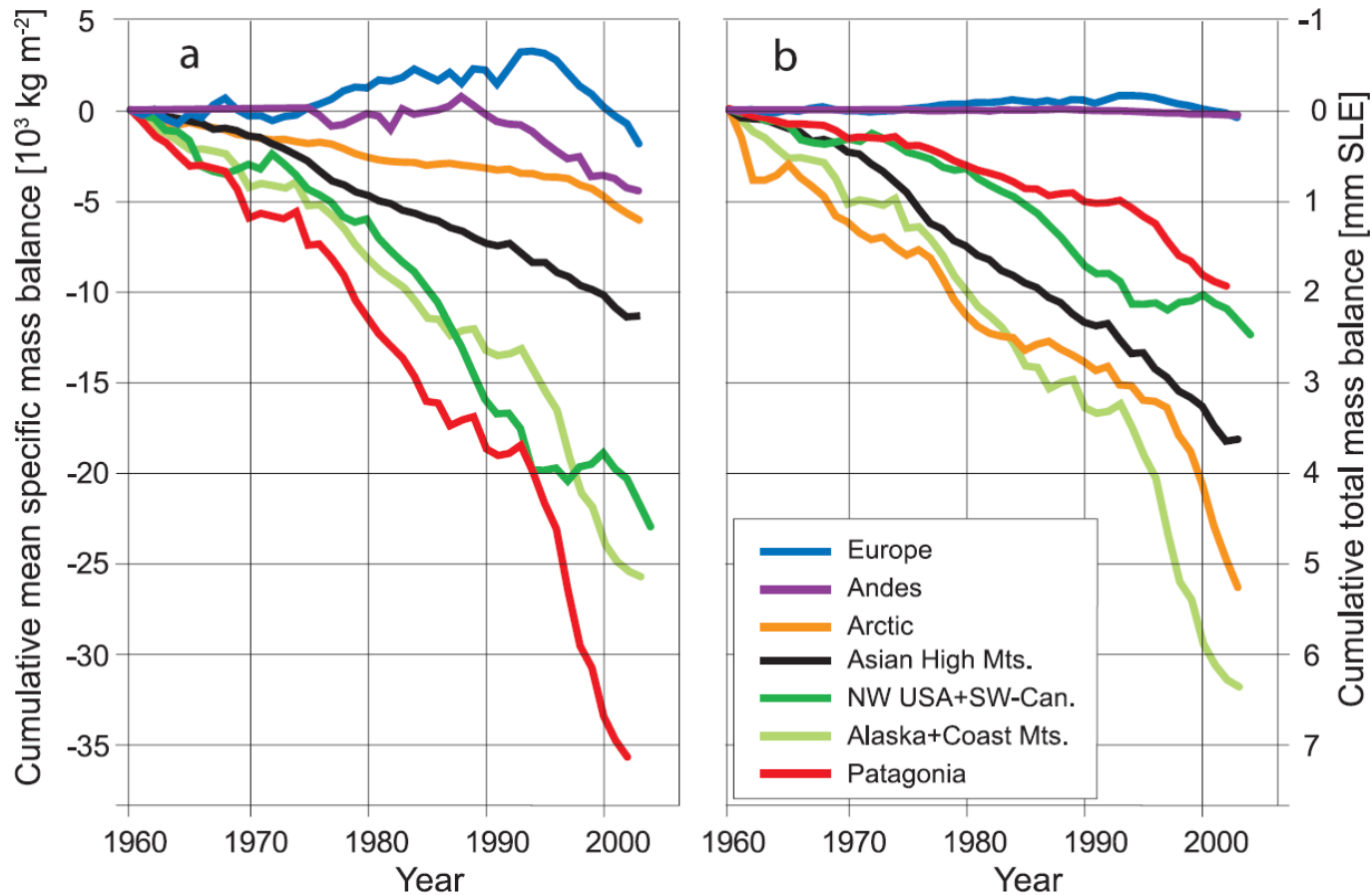


Pakistan's Cryospheric Assets

Number of Glaciers	Area of Glaciers (km ²)	Volume of Ice (km ³)	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

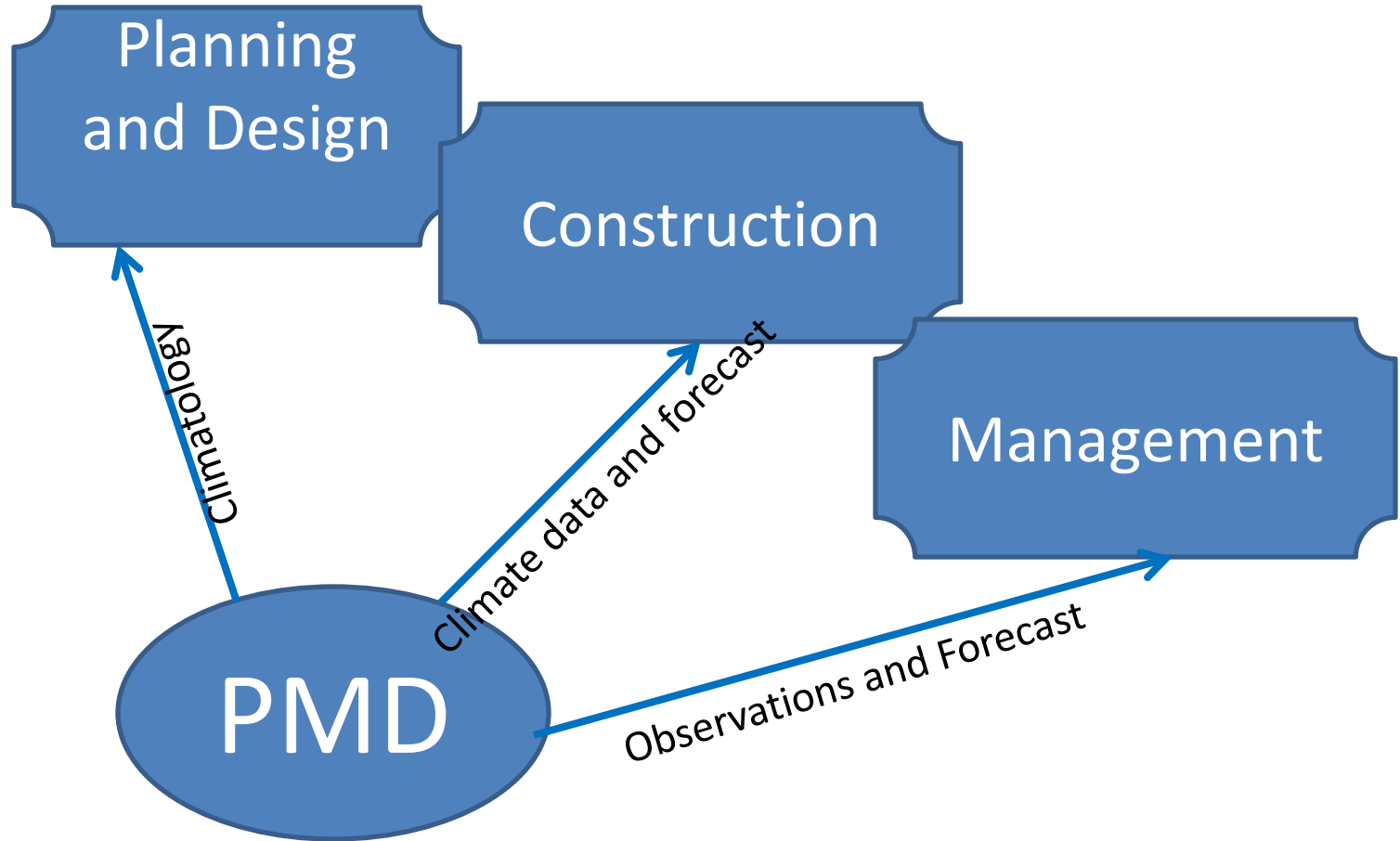
Pakistan is historically prone to Extreme Weather Events/Disasters, such as;

■ 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**



- **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.



Rs. Million

SN	Description	Remarks
Radars	<ul style="list-style-type: none"> •12 New •5 Replacement 	Provinces
Met Data (Observation Network)	<ul style="list-style-type: none"> • 40 New, 430 AWS •10 Agro-met •8 Wind Profilers (Aviation) 	Federal Govt
Flood Warning Centers Regional Centers	<ul style="list-style-type: none"> • 5 Centers (Provincial) 	Federal Govt
GLOF Flash Flood WC	<ul style="list-style-type: none"> • 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!