

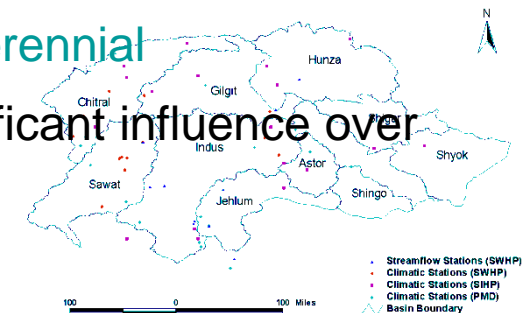


**Report on**  
**Climate Change Adaptation and Water Nexus**  
*Pakistan*

**The 9<sup>th</sup> International Coordination Group (ICG) Meeting  
GEOSS Asian Water Cycle Initiative (AWCI)**

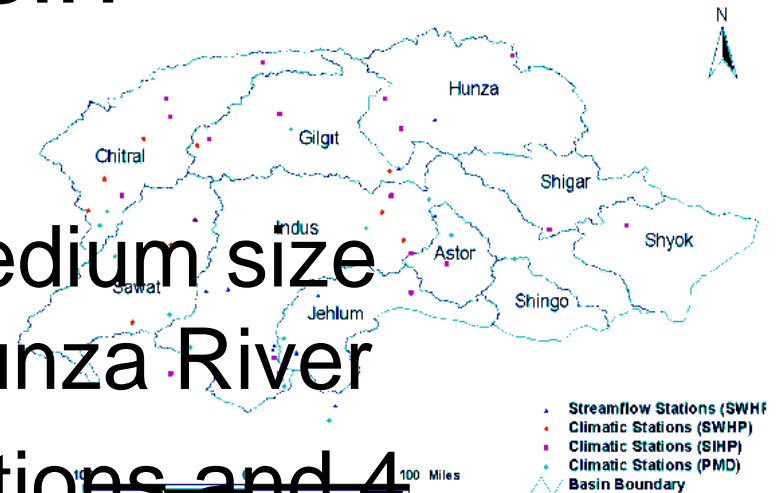
# Natural Resource Base

- Pakistan is **predominantly arid** and semi-arid (85%) where rainfall is less than 300 mm.
- Out of 79.6 m ha, only **20 m ha** area **available for farming**
- 16 m ha **irrigated** and 4 m ha under **rainfed** farming
- Pakistan has diverse landscapes including:
  - **snow-covered peaks**, eternal glaciers, and the inter-mountain valleys in the north,
  - undulating highly vulnerable agri. areas of rainfed Pothwar
  - vast rich **irrigated plains** in the Indus basin,
  - **stark deserts** and rugged rocky expanse of plateaus in the south-west of Balochistan.
  - **snow and glacier melt** keeps the Indus Basin rivers **perennial**
  - climate changes in HKH region can thus have a significant influence over the water resources of the country



# Data Network Upgradation in Hunza Basin

- Shimshal valley hosts 18 medium size glaciers and it drains into Hunza River
- Two automatic Weather Stations and ~~4~~ automatic precipitation gauges have been installed
- Field measurements on surface velocity, Melt rate under clear/debris cover and discharge are intensified



# Climatic Risk Management

## ✚ Research and Development Projects

- ✚ **Reducing Risks and Vulnerability from Glacier Lake Outburst Floods in Northern Pakistan by UNDP (May 2011 – April 2015)**
  - ✚ **Project budget is \$7.6 millions (contributions from UNDP and GoP)**
  - ✚ **Objective is to reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs)**
  - ✚ **Establishment of early warning system in two valleys**
- ✚ **APN CAPaBLE “Impact of Climate Change on Glacier Melting and Water Cycle Variability in Asian River Basins”**
- ✚ **Safe Prototyping by JAXA “Monitoring Water Cycle Variations and Assessing the Climate Change Impacts on them in Pakistan**
- ✚ **DFID Project” Calibration of snowfall and rainfall above/below snowline in UIB for Models”**

# Climatic Risk Management

## ✦ Research and Development Projects

### ✦ Building Capacity on Climate Change Adaptation in Coastal Areas of Pakistan (CCAP) by WWF-P (*ongoing*)

✦ WWF-P launched the project in collaboration with WWF-UK and Lead Pakistan.

✦ Funded by the European Commission, the project started in January, 2012

### ✦ Drought Emergency Relief Assistance (DERA) (*ongoing*)

✦ The project implementation commenced in 2002 with loan of ADB, World bank and GoP

✦ The total investment outlay of the programme is US \$ 160 million.

### ✦ UNESCO Project “ Strengthening Flood Forecasting Capabilities of Pakistan in the Indus”

# Climatic Risk Management

## + Research and Development Projects

- + **Inventory of Glaciers, Glacial Lakes and GLOFs in HKH Region by PARC/ICIMOD (*completed*)**
  - + **ICIMOD in collaboration with PARC implemented the project, funded by APN for a period of three years (2003-2005).**
  - + **Under this project a detail inventory of glaciers and glacial lakes were developed and total ice reserves of the Upper Indus basin of the country were estimated.**
- + **Water Resources in South Asia: Assessment of Climate Change-Associated Vulnerabilities and Coping Mechanisms by APN (*completed*)**
- + **National Economic & Environmental Development Study (NEEDS) by ENVORK, LEAD, SDPI (*completed*)**

# Climatic Risk Management

## Policy and Advocacy Initiatives

- ✦ **National Climate Change Policy-2012**
- ✦ **Task Force on Climate Change – 2008-2010**
- ✦ **Task Force on Food Security – 2008-2009**
- ✦ **National Disaster Risk Management Framework-2007**
- ✦ **National Disaster Management Ordinance 2006**

# Climatic Risk Management

## ✦ Institutional Arrangements

- ✦ Ministry of National Disaster Management
- ✦ National, Provincial & District Disaster Management Authorities (NDMA, PDMAs, DDMAAs) (*Risk assessment and Relief measures*)
- ✦ National Institute of Disaster Management, Islamabad (*Training*)
- ✦ Global Change Impact Studies Centre (*Research*)
- ✦ Pakistan Metrological Department (*Weather Forecast & Research*)
- ✦ Pakistan Agricultural Research Council (*Research*)
- ✦ Pakistan Council of Research in Water Resources (*Research*)
- ✦ Nuclear Institute of Biotechnology and Genetic Engg. (*Research*)
- ✦ Nuclear Institute of Agriculture and Biology, Faisalabad (*Research*)
- ✦ Nuclear Institute of Agriculture, Tando Jam (*Research*)
- ✦ Pakistan Institute of Development Economics (*Socio-economic Research*)
- ✦ SUPARCO (*Flood Risk Assessment*)



# Natural Resources Degradation

- Deforestation is **reducing the life** of Tarbela and Mangla reservoirs (90% food & fiber production)
- **Water mining** without **recharge** resulted into sharp decline in water re-charge in Balochistan
- **Over-exploitation of rangelands** adversely affecting the livelihood of pastoral communities
- **Arid coastal strips and mangrove** areas are under increased environmental stress from reduced fresh water flows
- **Prolonged droughts** rendering fragile ecosystems like sandy deserts, Rod Kohi and coastal areas unproductive

# Key Climatic Challenges

## Water Security

- ✦ **Reduced river inflows due to recession of Hindu Kush-Karakoram-Himalayan (HKH) glaciers**
- ✦ **Increased variability in seasonal and annual river inflows**
- ✦ **Loss of storage capacity due to erosion resulting from changes in land use and land cover**
- ✦ **Water shortage due to increased irrigation requirements, deteriorating water quality, rapid population increase and increasing urbanization**

# Key Climatic Challenges

## Food Security

- ✚ **Reduced productivity of crops and livestock due to severe water-stressed and heat-stressed conditions in arid and semi-arid regions**
- ✚ **Crop failures or increased production losses caused by extreme events (floods, droughts and cyclones)**
- ✚ **Reduced agricultural productivity due to natural resources degradation (land, water, rangeland, forests)**
- ✚ **Greater risk of insects, pests and pathogens in warmer and more humid environment**
- ✚ **Agriculture would also be affected by uncertainty of climatic parameters and water availability**

# Key Climatic Challenges

## **✦ More Threats to Indus Delta & Lowland Coastal Region**

- ✦ Increased sea level rise resulting in erosion of beaches, flooding & inundation of wetlands & lowlands, increased sea water intrusion into the Indus deltaic and lowland coastal region**
- ✦ Increased sea water intrusion will deteriorate surface and groundwater quality & threaten coastal agriculture and marine ecosystem (mangroves, coral reefs & breeding grounds of fish)**
- ✦ Increased cyclonic activity due to high sea surface temperature**
- ✦ Increased ground subsidence in the Indus deltaic and lowland coastal region due to reduced sediment flux and excessive ground water extraction**

## **✦ Very high vulnerability due to:**

- ✦ Geographical location (high temperature zone)**
- ✦ Greater dependence on climate sensitive sectors (agriculture and natural resources)**
- ✦ Low adaptation capacity**
- ✦ Knowledge and technology gaps**
- ✦ Resource constraints**

# Upper Indus Basins



**Glaciers:** 5,218  
**Covered Area:** 15,040 Sq. km  
**Total ice reserves:** 2,738.5km<sup>3</sup>

*Shyok, Shigar and Hunza Basins contain 83% of total ice reserves*

## Glacial lakes:

**Total Glacial Lakes:** 2,420  
**Covered Area:** 126 Sq. km

**Potentially dangerous lakes:** 52

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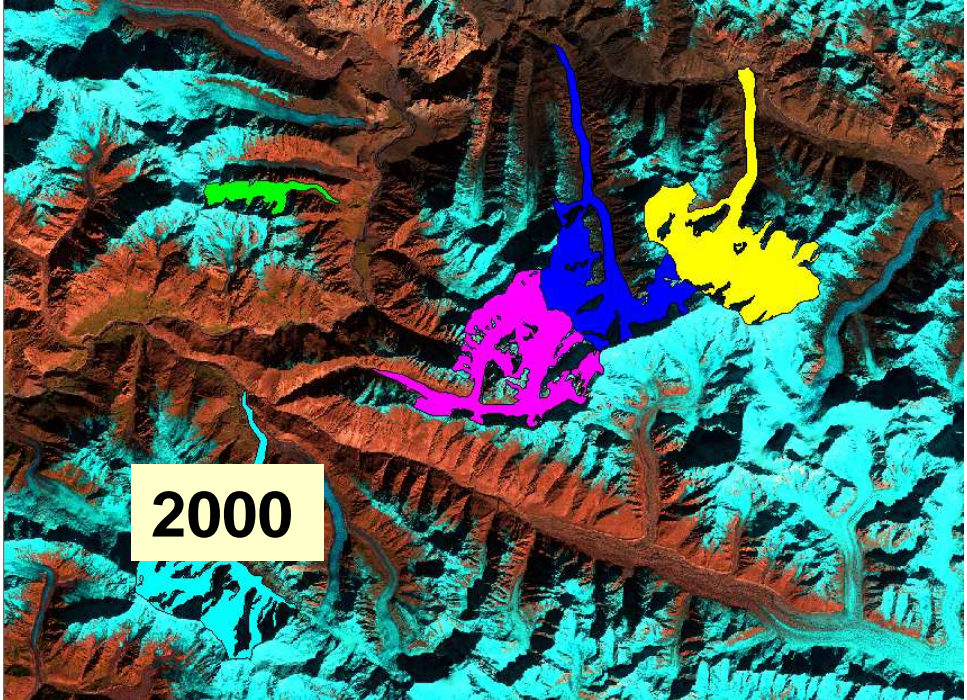
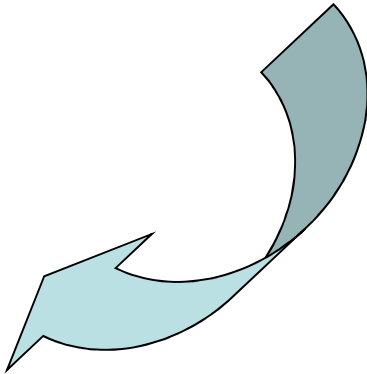
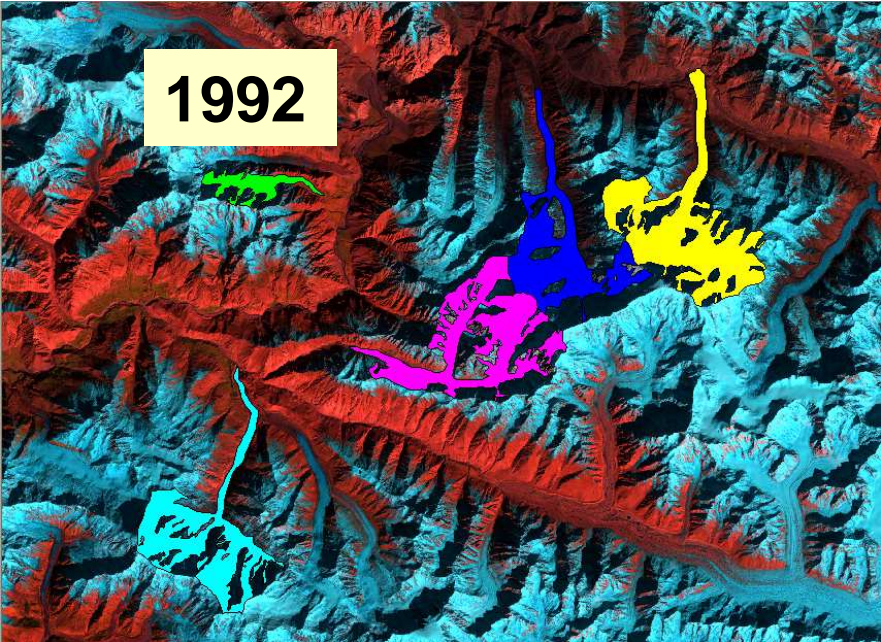
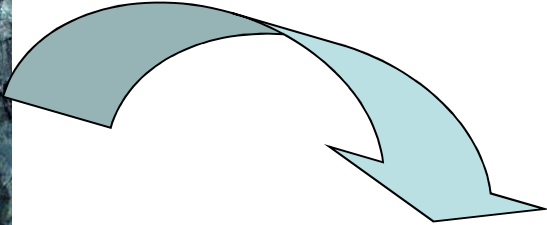
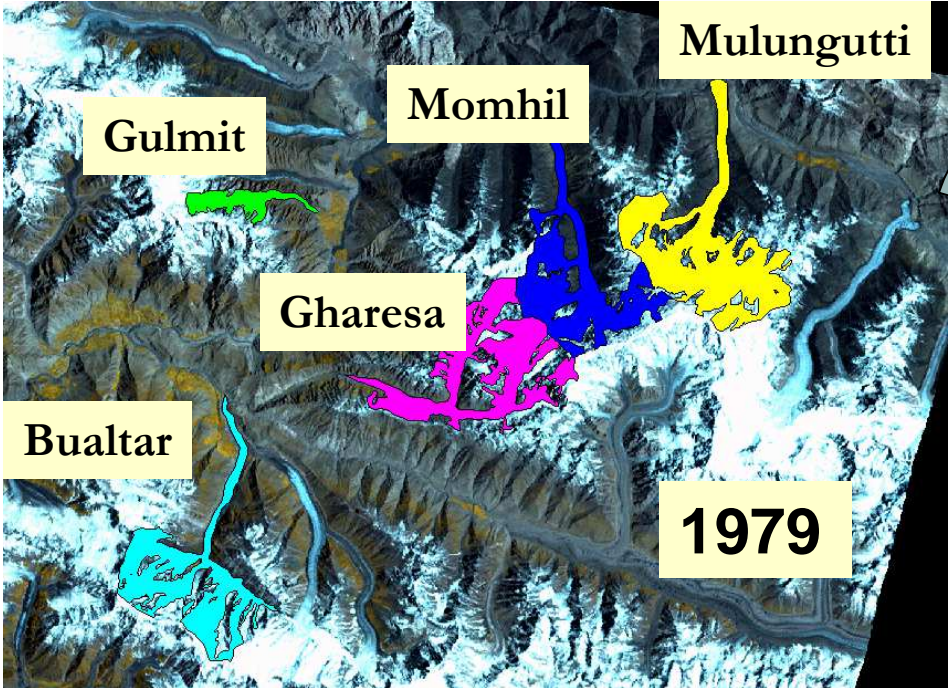
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Sq. km

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# **CLIMATE CHANGE IMPACTS ON GLACIER ENVIRONMENT**

## **KARAKORAM GLACIERS**

Five KARAKORAM GLACIERS



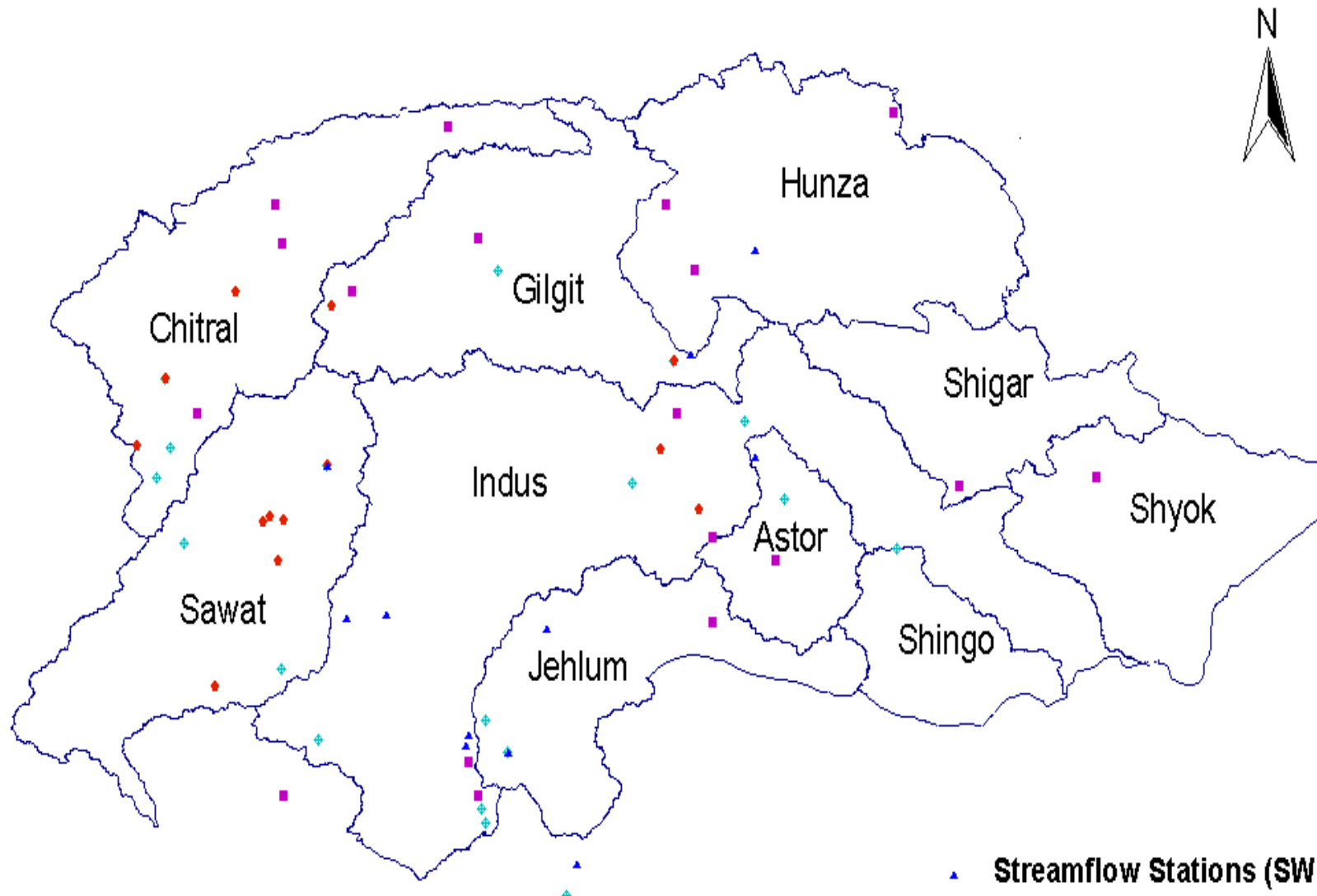


## Five Karakoram...Glaciers Area (sq.km)

<b>Glacier</b>	<b>1979</b>	<b>1992</b>	<b>2000</b>
<b>Mulungutti</b>	<b>97.96</b>	<b>97.25</b>	<b>96.35</b>
<b>Bualtar</b>	<b>63.69</b>	<b>63.63</b>	<b>63.46</b>
<b>Gulmit</b>	<b>14.21</b>	<b>14.05</b>	<b>14.07</b>
<b>Momhil</b>	<b>73.48</b>	<b>75.59</b>	<b>75.04</b>
<b>Gharesa</b>	<b>70.23</b>	<b>81.77</b>	<b>83.05</b>

# **Demonstration River Basin in PAKISTAN**

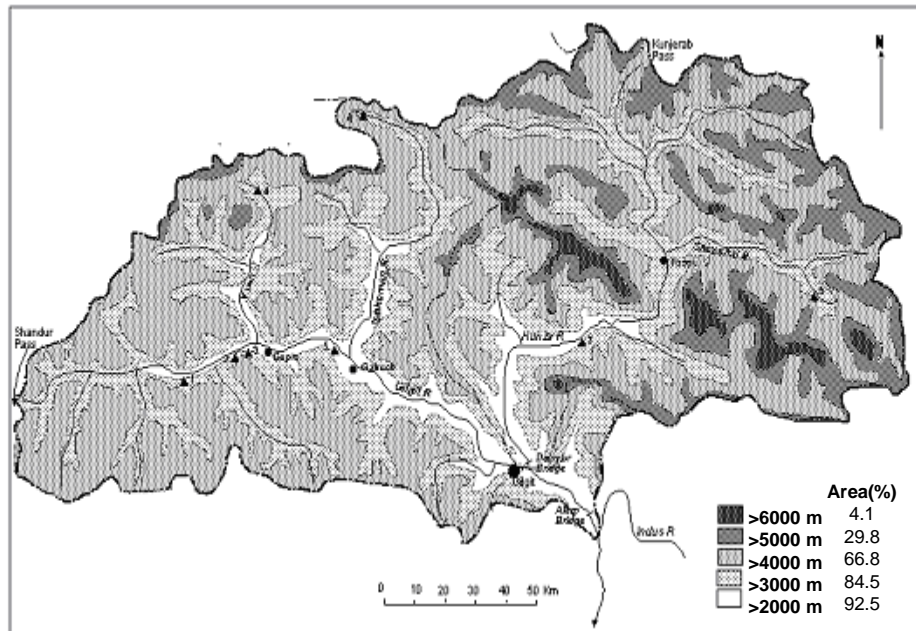
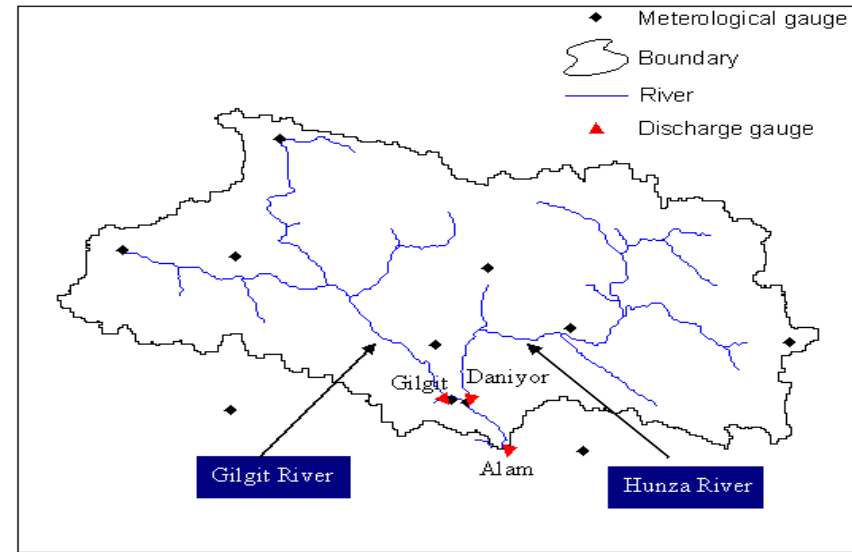
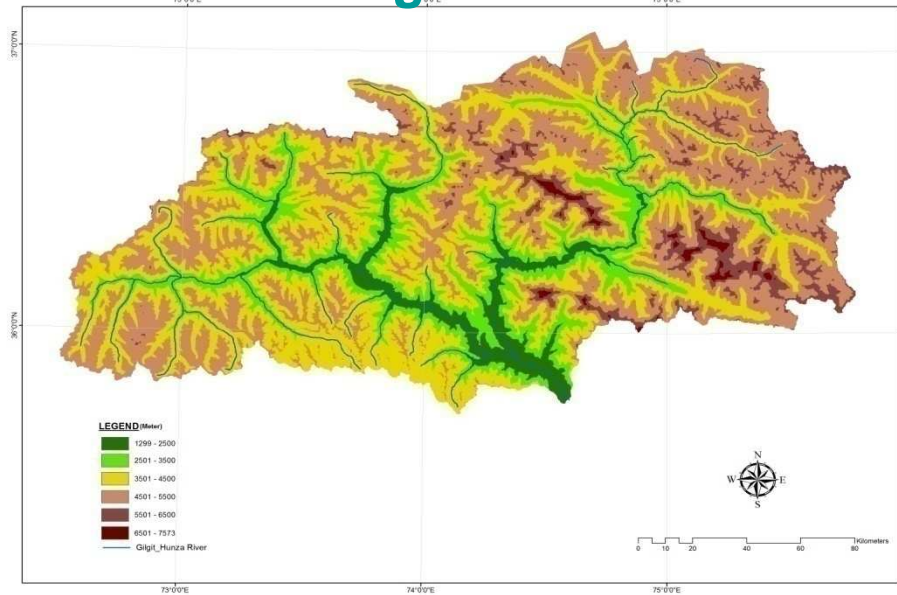
**Gilgit River Basin at Alam bridge  
(Gilgit & Hunza)**



- ▲ Streamflow Stations (SWHP)
- Climatic Stations (SWHP)
- Climatic Stations (SIHP)
- ◆ Climatic Stations (PMD)
- Basin Boundary

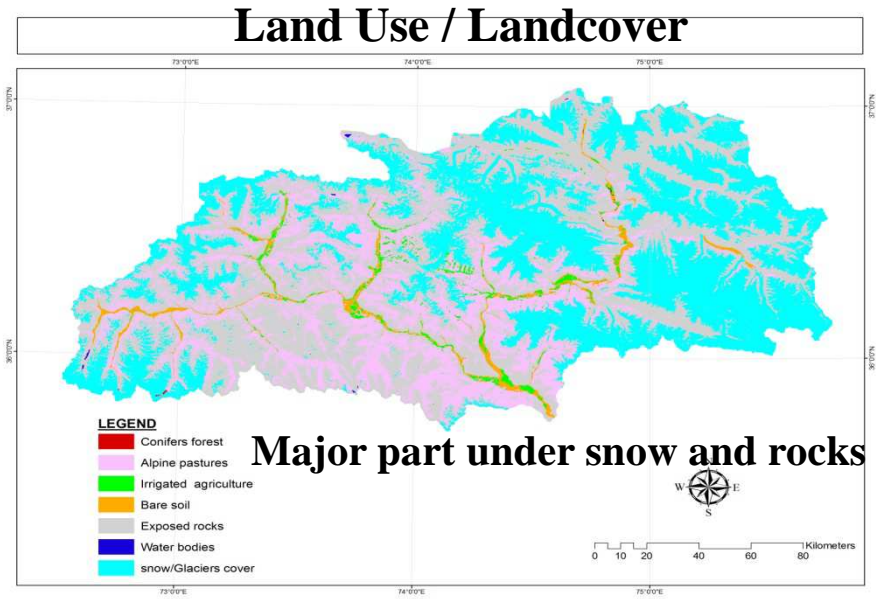
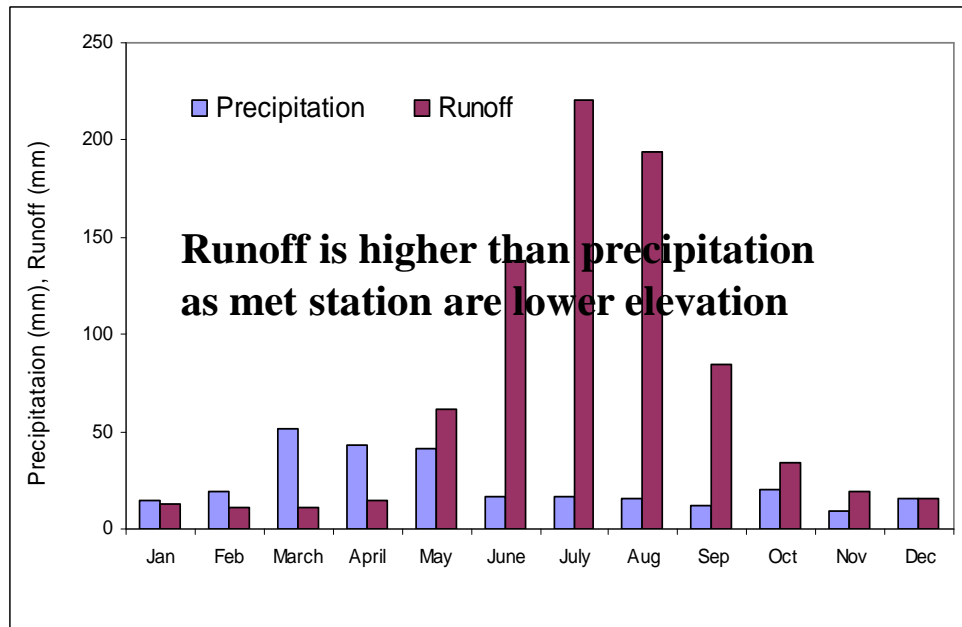
➤ Demonstration Basin = Gilgit & HUNza

## DEM of Gilgit River Basin



- Gilgit basin area 26200 km<sup>2</sup>
- Annual precipitation = 300 mm
- Annual runoff = 800 mm
- Two main tributaries, Gilgit and Hunza
- Hunza River at Daniyor 13157 km<sup>2</sup>
- Gilgit River at Gilgit 12095 km<sup>2</sup>

# Monthly runoff and precipitation comparison



## Inter-station and seasonal precipitation variability

