Demonstration River Basins in Pakistan

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Turkmenistan
UZ Tajikistan
KG
China
HINDU KUSH
Northern Areas
Kabul River
Kabul
200 mi
200 km
Khyber Pass
Islamabad
Jammu and Kashmir
Afghanistan
Chenba River
Lahore
Zhob
Quetta
Multan
Bahawalpur
Nok Kundi
Pakistan
Indus River
Baluchistan Plateau
Iran
India
Sukkur
Ormara
Gwadar
Hyderabad
Karachi
Mouths of the Indus
Arabian Sea
PAKISTAN
LOW / HILLS / MOUNTAINS
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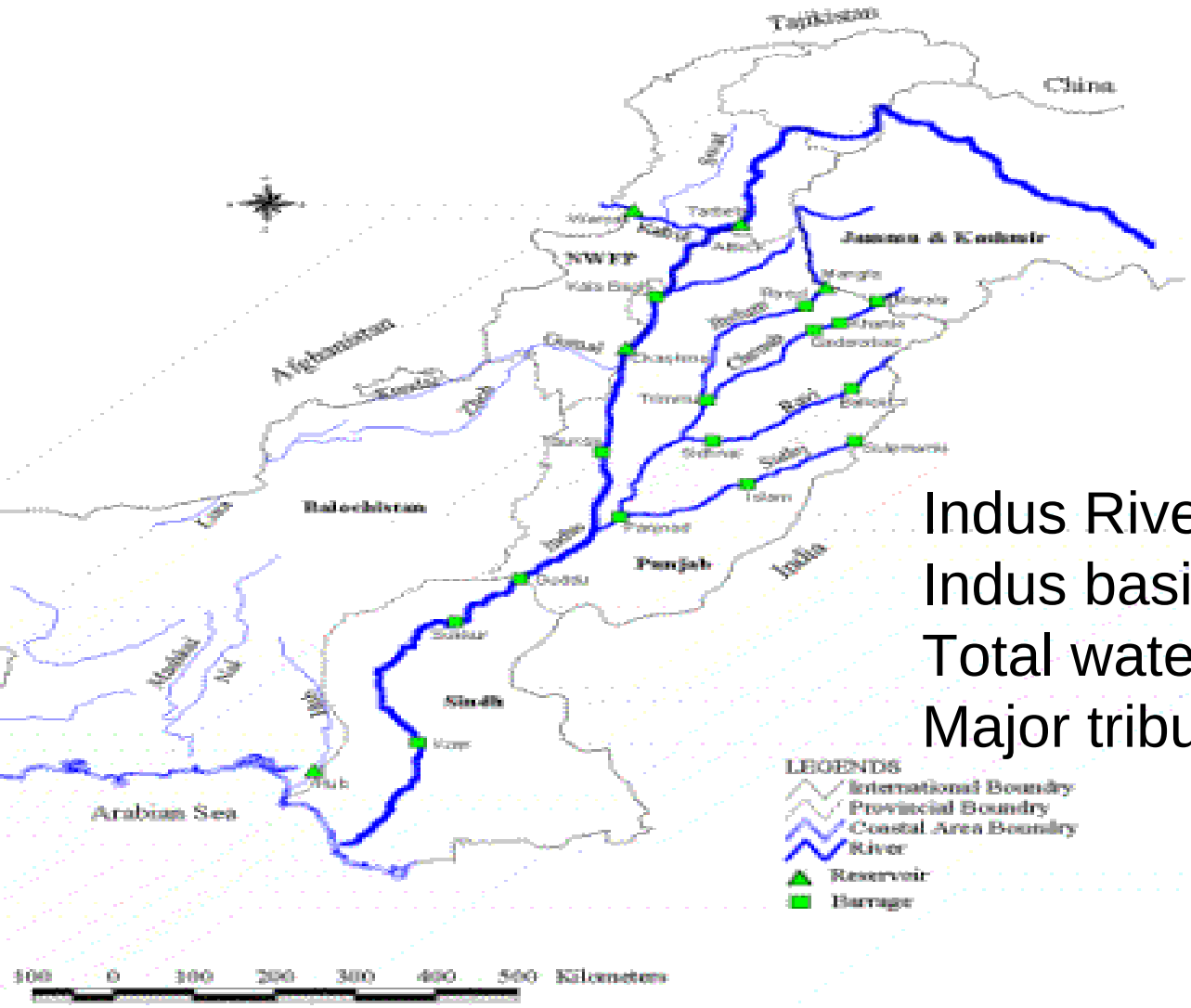
TURKEY
SYRIA
IRAQ
JORDAN
SAUDI ARABIA
IRAN
AFGHANISTAN
PAKISTAN
KAZAKHSTAN
UZBEKISTAN
OMAN
YEMEN
INDIA
SRI LANKA
MALDIVES
Indian Ocean
THAILAND
BRUNEI
MALAYSIA
SINGAPORE
INDONESIA
EAST TIMOR
SPRATLY ISLANDS
1. KUWAIT
2. BAHRAIN
3. QATAR
4. UNITED ARAB EMIRATES
5. TURKMENISTAN



Indus River Length:3200 km

Indus basin area: 566,000 km^2

Total watershed area:944,000 kr

Major tributaries = 14


Turkmenistan
UZ Tajikistan
KG
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HINDU KUSH
Northern Areas
Kabul River
Kabul
200 mi
200 km
Khyber Pass
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Chenba River
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Upper Indus
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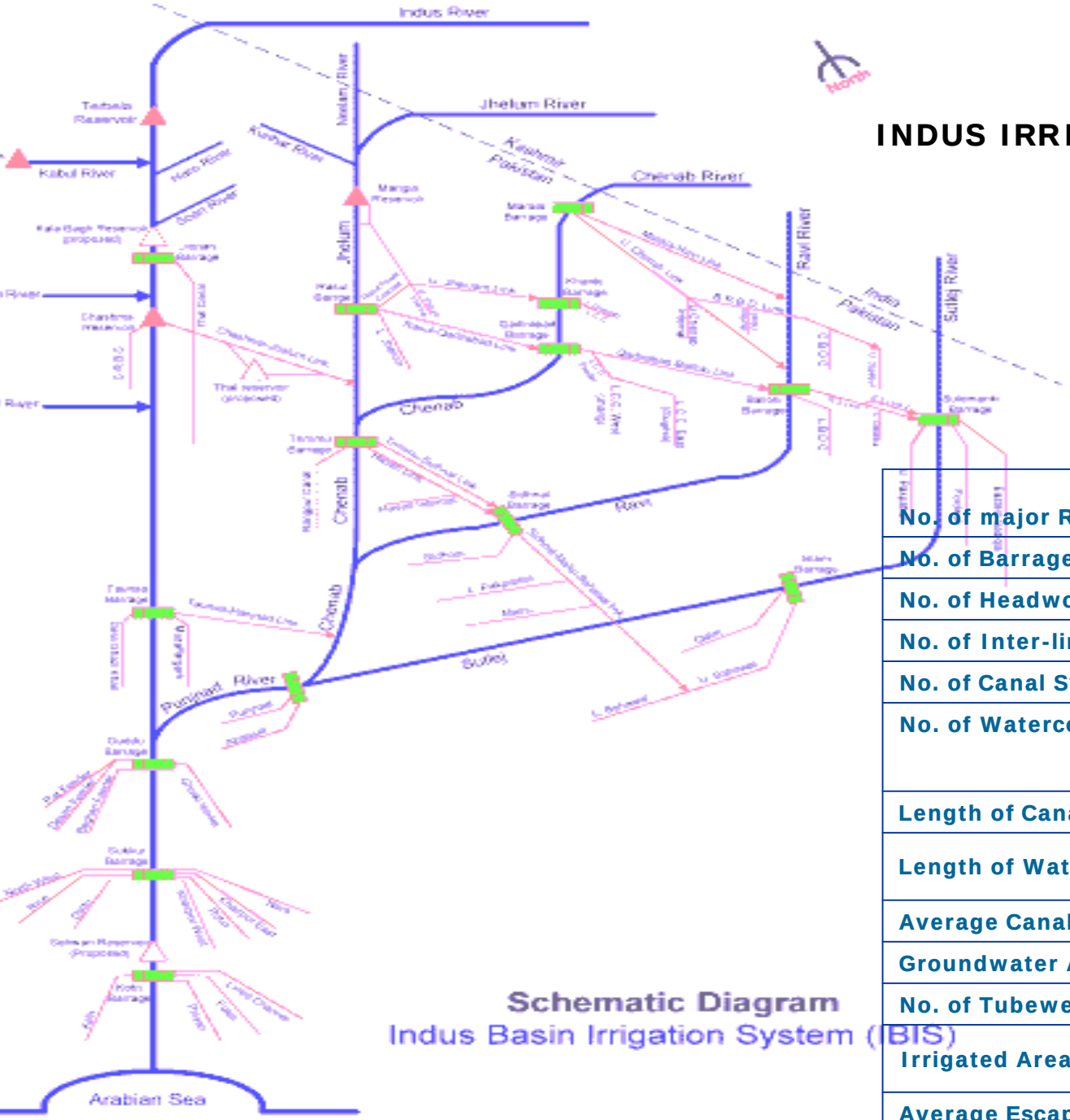
PAKISTAN
LOW / HILLS / MOUNTAINS

Indus Basin International Areas

Country/Region	Area (sq. km)	Area (%)
China	92,981	10
India	67,340	7
Kashmir	179,486	19
Afghanistan	75628	8
Pakistan	529,135	56
Total Area	944,569	100

- 80 to 90% of the UIB becomes snow-covered during most of winter season
- In UIB, seasonally snow covered areas are typically between 1500 m and 5000 m
- Snowline retreats to elevation about 4500 - 5000 m during July and August

UIB: Upper Indus Basin



Schematic Diagram
Indus Basin Irrigation System (IBIS)

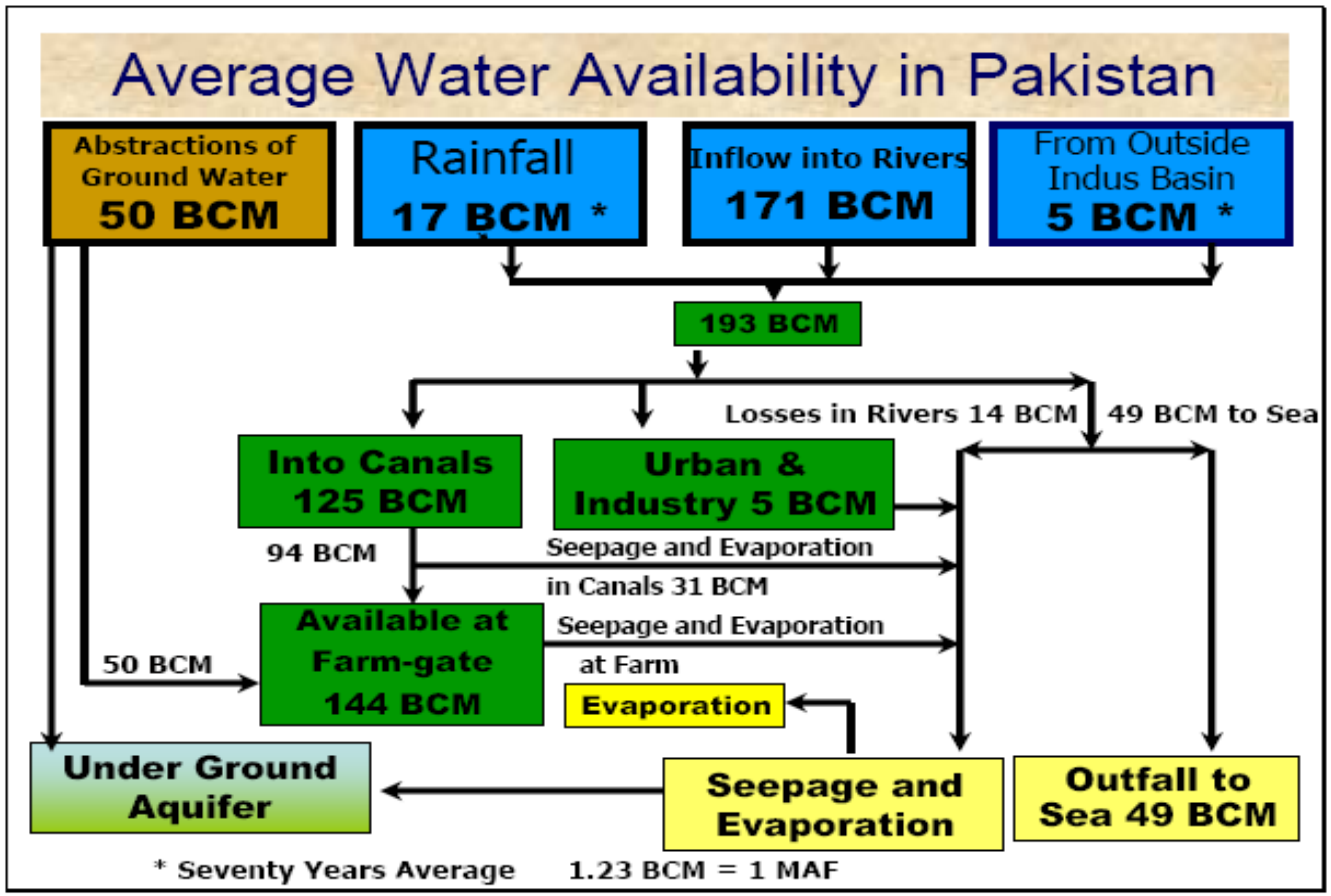
INDUS IRRIGATION SYSTEM IN PAKISTA

KEY FACTS

No. of major Reservoirs:	3
No. of Barrages:	16
No. of Headworks:	2
No. of Inter-link Canals:	12
No. of Canal Systems:	44
No. of Watercourses:	107,000
Length of Canals:	56,073 km
Length of Watercourses:	1.6 million km
Average Canal Water Diversions:	104.7 MAF
Groundwater Abstractions:	41.6 MAF
No. of Tubewells:	> 550,000
Irrigated Area:	36 million acres
Average Escapage to the Sea:	39.4 MAF

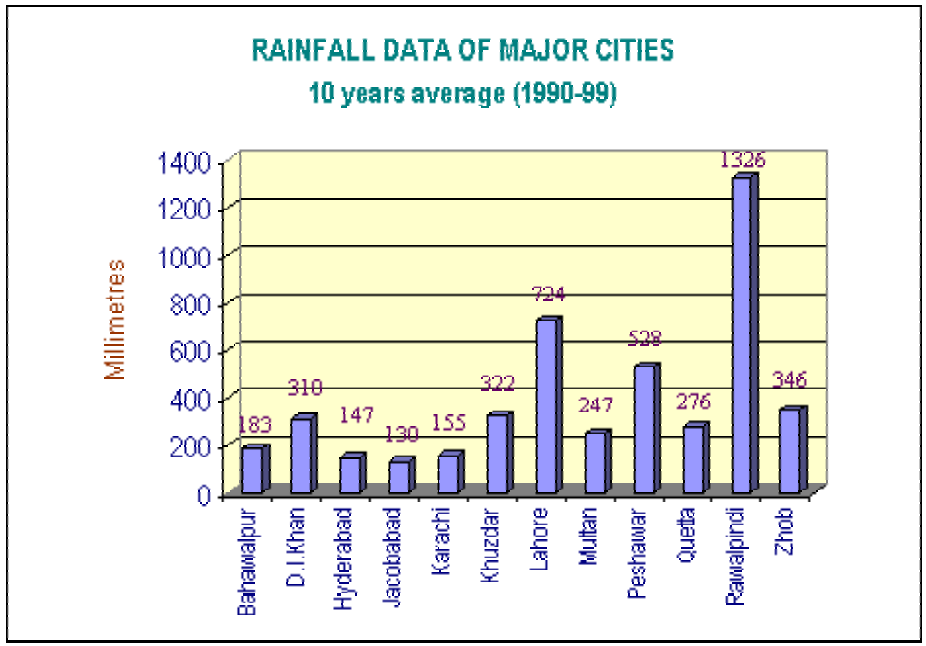
Source of fresh water is rainfall, snowmelt and glacier melt

- More than 70% of water resources are contributed by snowmelt and glacier melt



Source of fresh water is rainfall, snowmelt and glacier melt

- 70 % rainfall is from summer monsoons and rest is from westerly disturbances



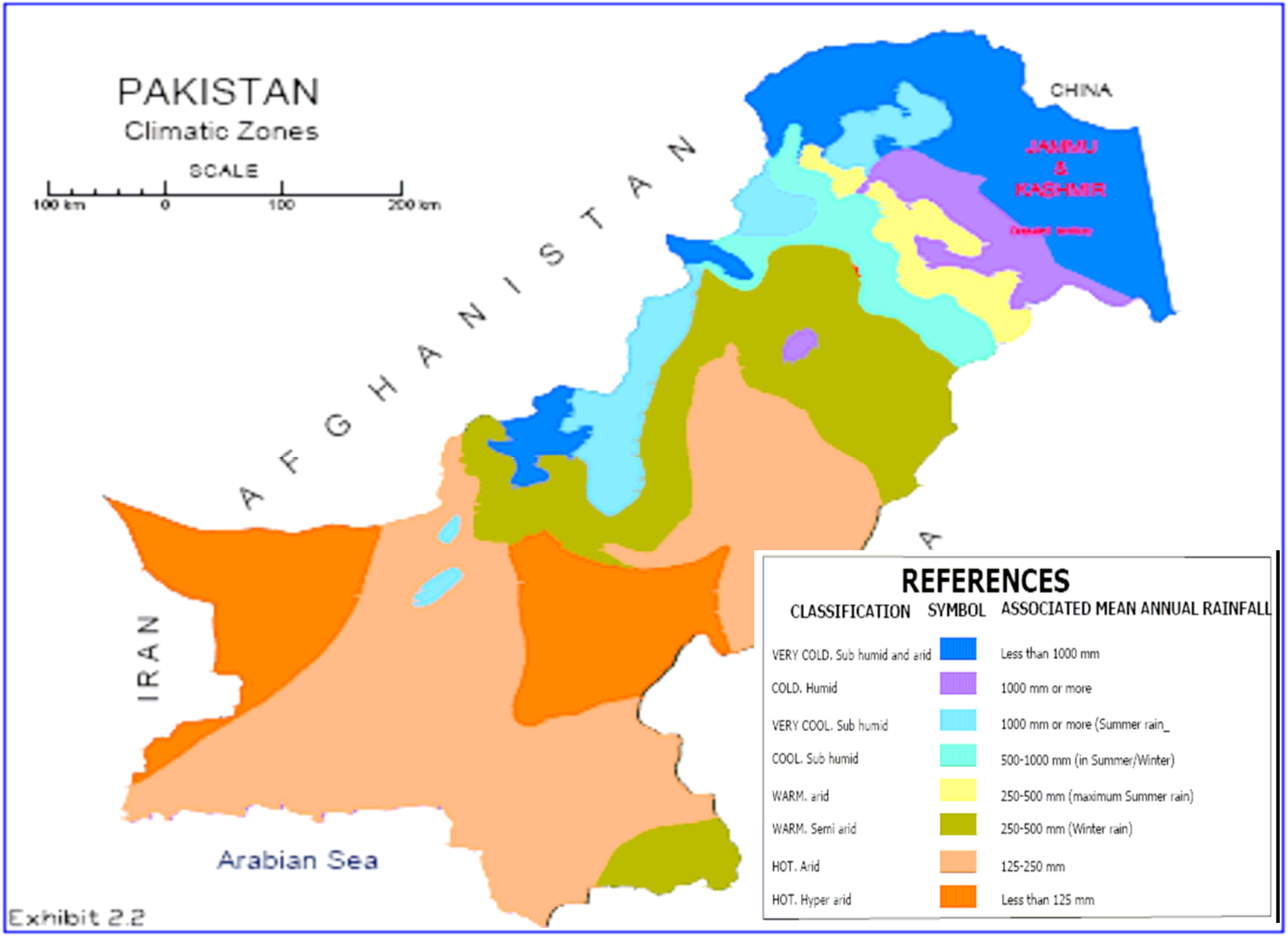
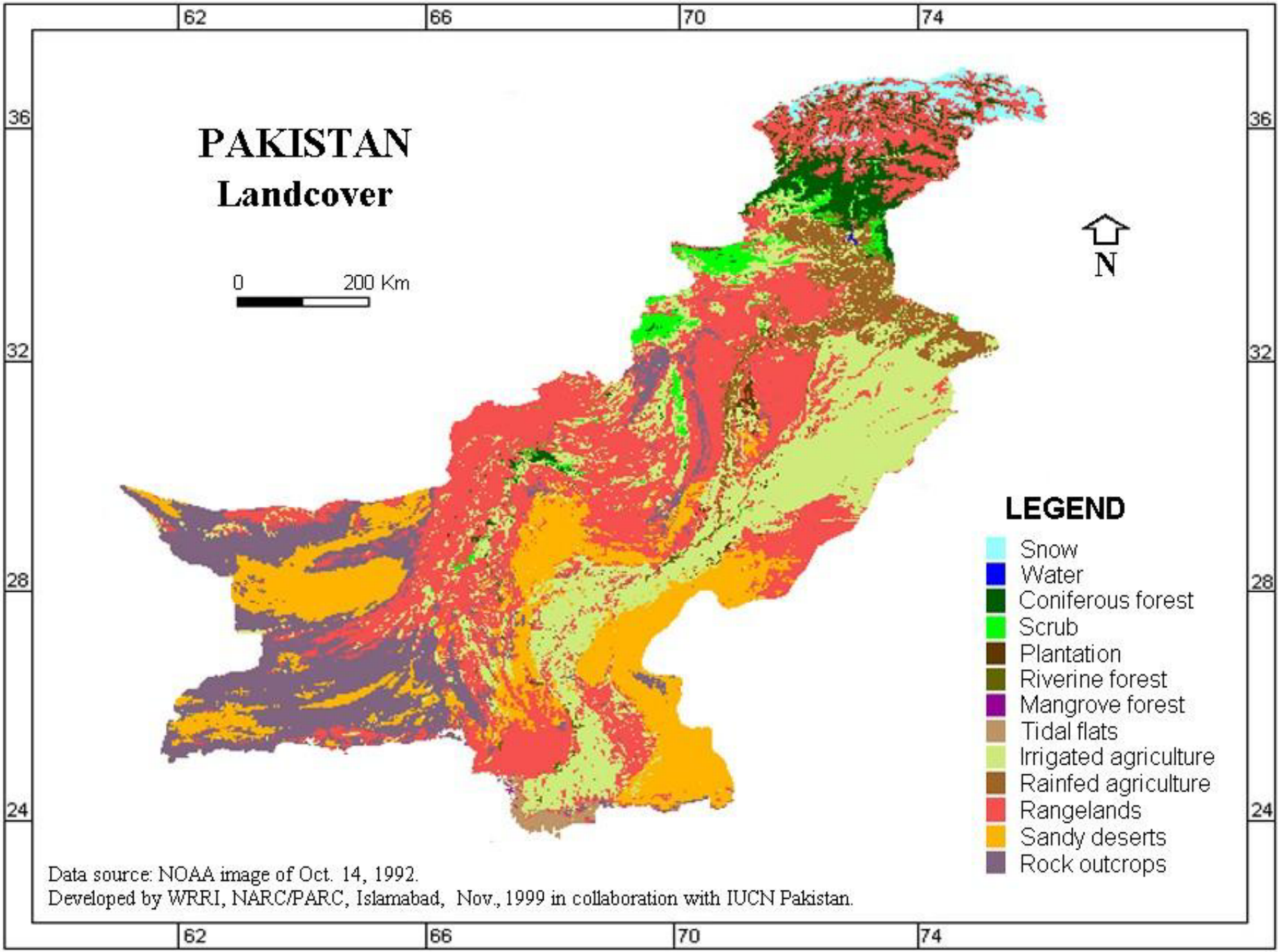


Exhibit 2.2

Source: Surveyof Pakistan


PAKISTAN
Landcover
0
200 Km
N
LEGEND
Snow
Water
Coniferous forest
Scrub
Plantation
Riverine forest
Mangrove forest
Tidal flats
Irrigated agriculture
Rainfed agriculture
Rangelands
Sandy deserts
Rock outcrops
62
66
70
74
36
32
28
24
Data source: NOAA image of Oct. 14, 1992.
Developed by WRRI, NARC/PARC, Islamabad, Nov., 1999 in collaboration with IUCN Pakistan.

Water resources issues

- **Water logging**
- **Salinity**
- **Water quality**
- **Floods**
- **Landslide**
- **Sediment flow**
- **Water scarcity**
- **Monitoring (especially in remote and difficult approach area**

Pakistan Meteorological Department (PMD)

Pakistan Meteorological Department (PMD) is a federal agency with a mandate to monitor and analyze meteorological data. It maintains a network of about 200 metrological stations across the country

Snow and Ice Hydrology Project (SIHP)

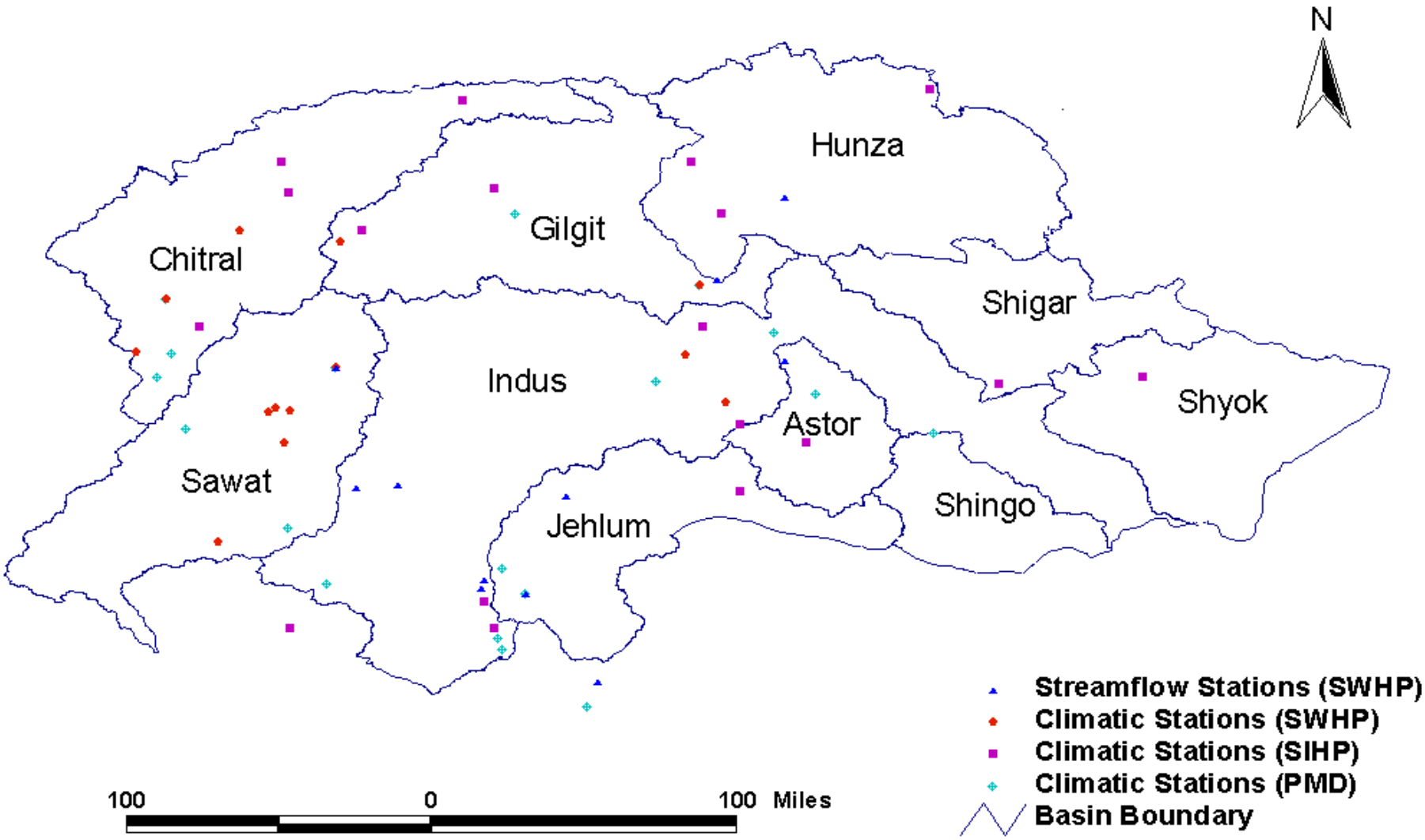
It maintains a network of 21 stations at high altitudes in upper Indus Basin

Surface water Hydrology Project (SWHP)

It maintains a network of 80 metrological stations throughout the country

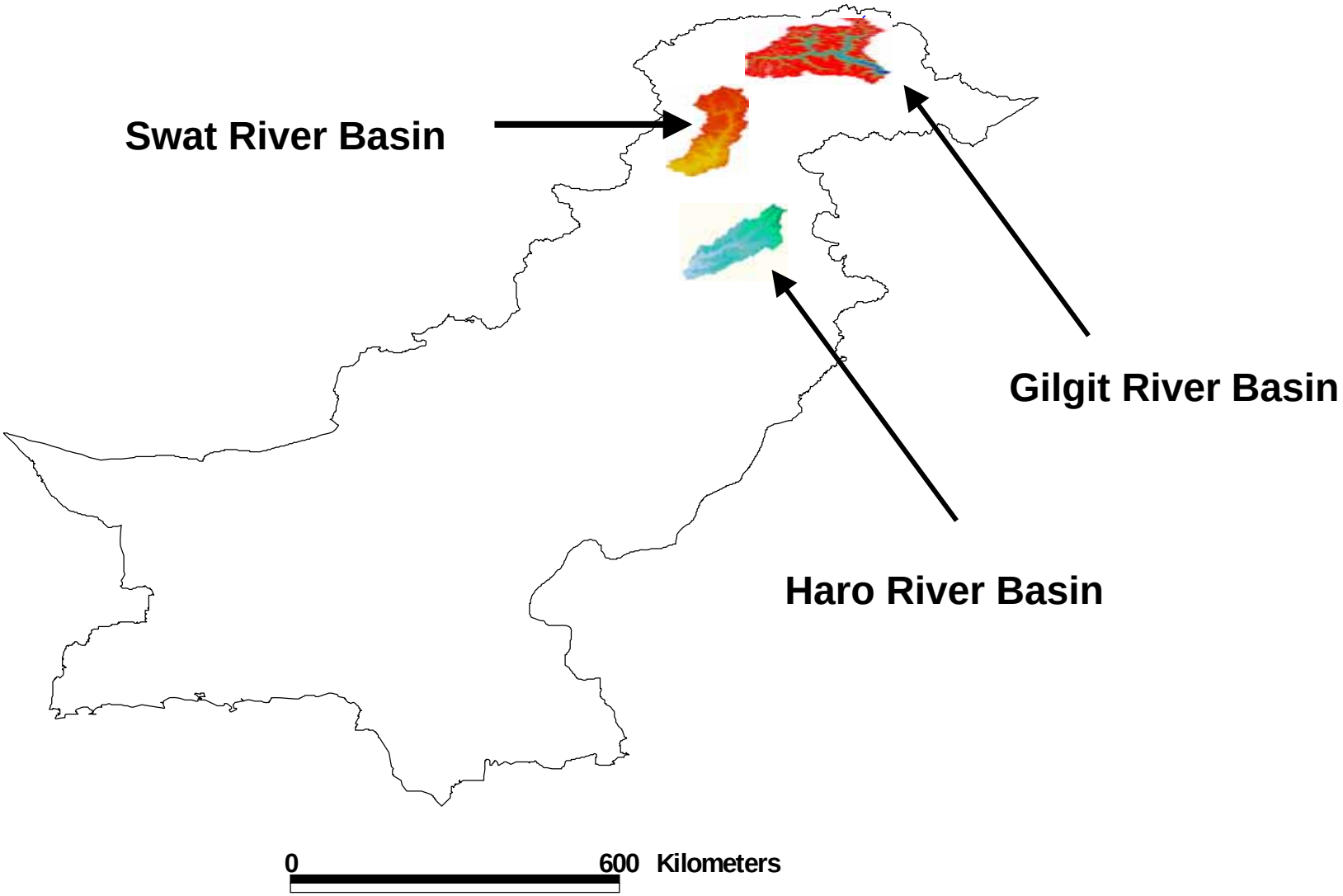
Ev-K2-CNR

They have established one Automatic weather station at high altitude in Karakoram and planning two more


N
Hunza
Gilgit
Chitral
Shigar
Indus
Shyok
Astor
Sawat
Shingo
Jehlum
100
0
100 Miles
Streamflow Stations (SWHP)
Climatic Stations (SWHP)
Climatic Stations (SIHP)
Climatic Stations (PMD)
Basin Boundary

Demonstration Basins

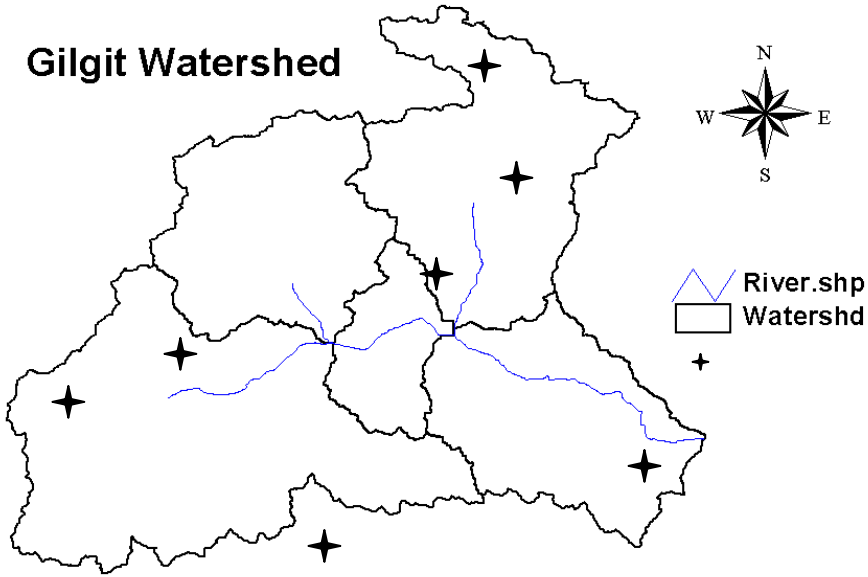
Demonstration River Basins



Objectives

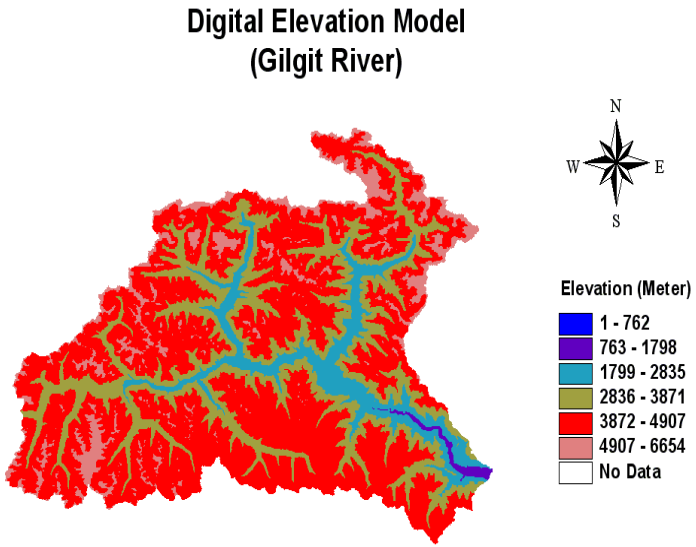
- Water resources assessment applying hydrological model using in-situ and satellite data
- Integrated water resources management
- Water resources forecast using RCM output
- Impact of climate change on fresh water resources
- Strengthen the observation network especially at high altitu

Gilgit Basin



Characteristics

- Area (sq km) 12800
- 27% Glaciered area
- 70-80 % covered by seasonal snowcover
- Annual precipitation (mm) 300
- Annual runoff (mm) 800
- Meteorological stations = 7
- Precipitation, temperature, evaporation, wind, shortwave radiation, streamflow, landuse, soil

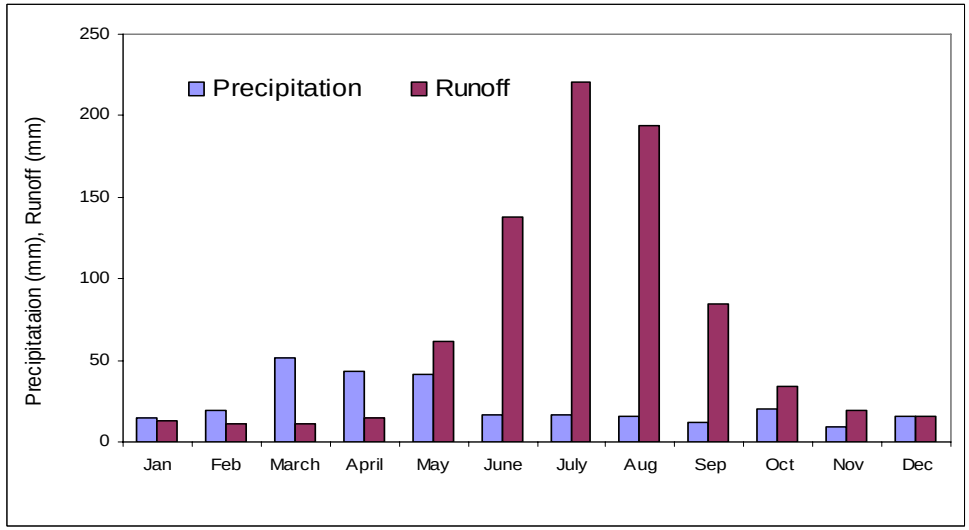


Issues

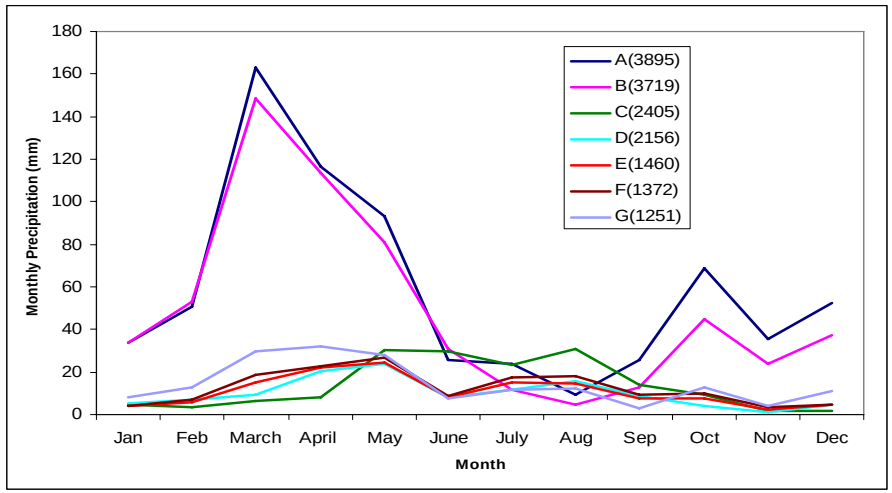
- GLOFS
- Water resources assessment and forecasting
- Landslide
- Sediment flow
- Water scarcity
- Monitoring (especially in remote and high altitude area

Gilgit Basin

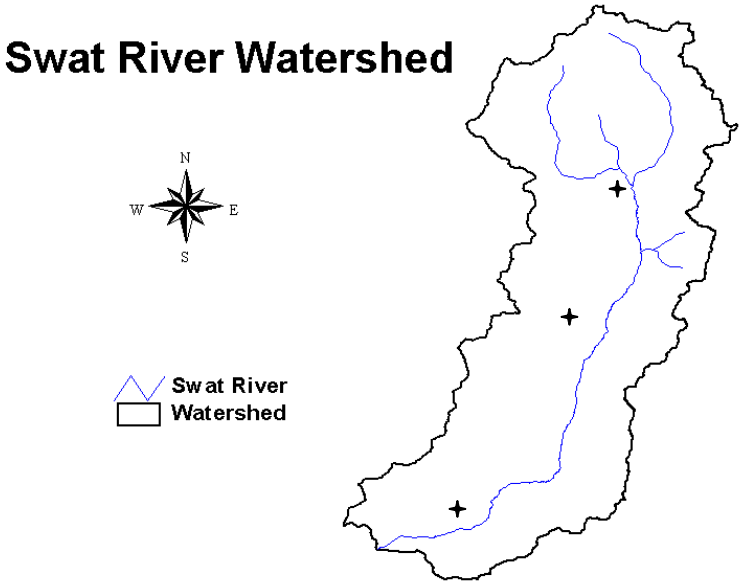
Monthly runoff and precipitation comparison



Inter-station and seasonal precipitation variability

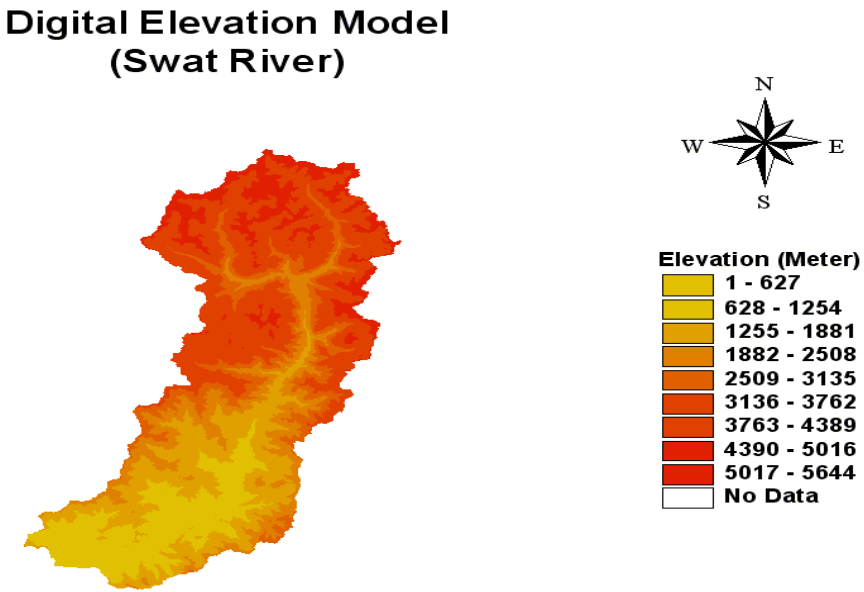


Swat River Basin



Characteristics

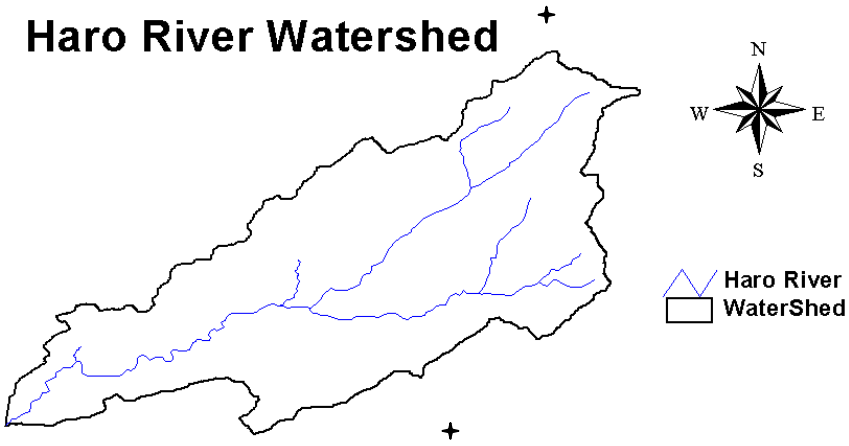
- Area (sq. km) 5894
- About 50-70% area covered by seasonal snowmelt
- Few Glaciers
- Maximum elevation (m) 5644
- Meteorological stations = 3
- Precipitation, temperature, evaporation, wind, streamflow, landsue, soil, vegetation, population

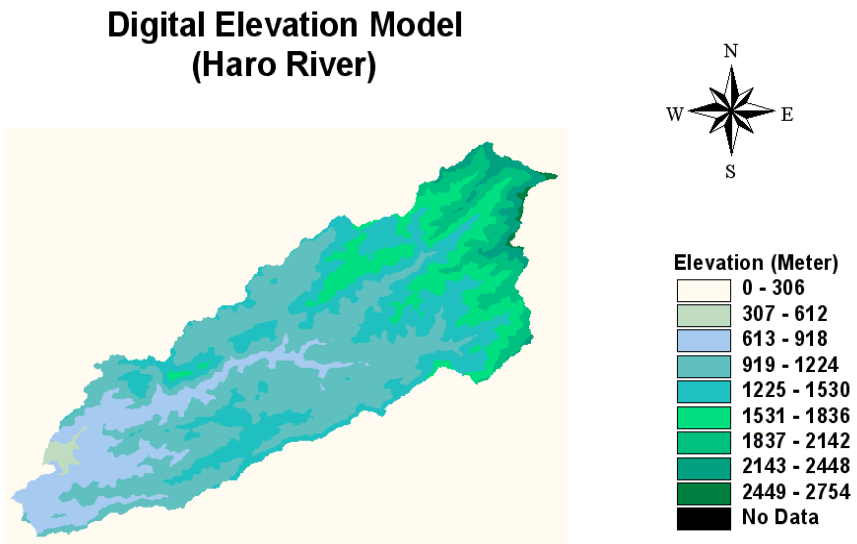


Issues

- Water resources assessment
- Land sliding
- Sediment flow
- Water quality
- Water Scarcity
- Monitoring at high latitude

Haro River Basin





Characteristics

- Area (sq km) 657
- Maximum elevation (m) 2755
- Meteorological stations = 2
- Precipitation, temperature, evaporation, wind, pressure, shortwave radiation, streamflow, DEM, Radar rainfall, Dam operation, landuse, soil

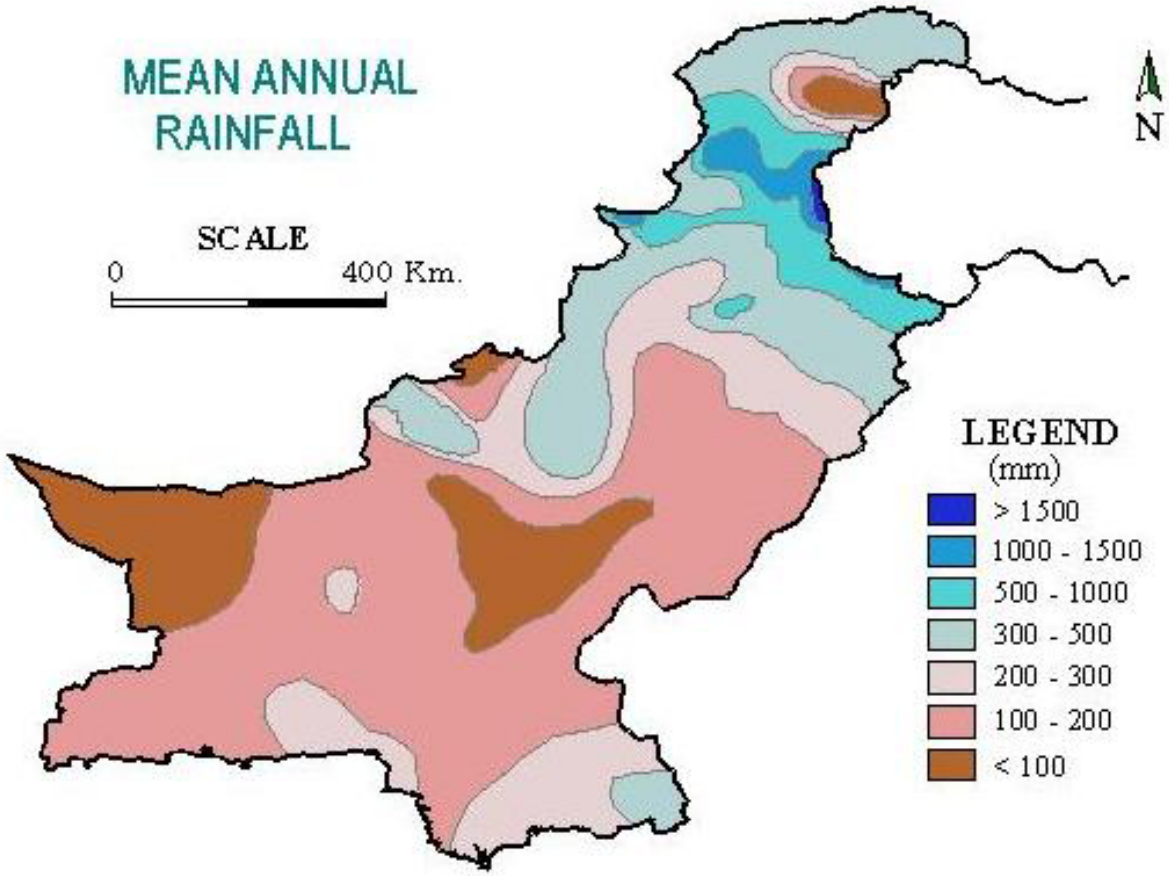
Issues

- Water resources assessment and forecasting
- Sediment flow
- Water scarcity
- Water quality
- Dam management for irrigation and domestic supply

Potential Collaborative Institutes/organization

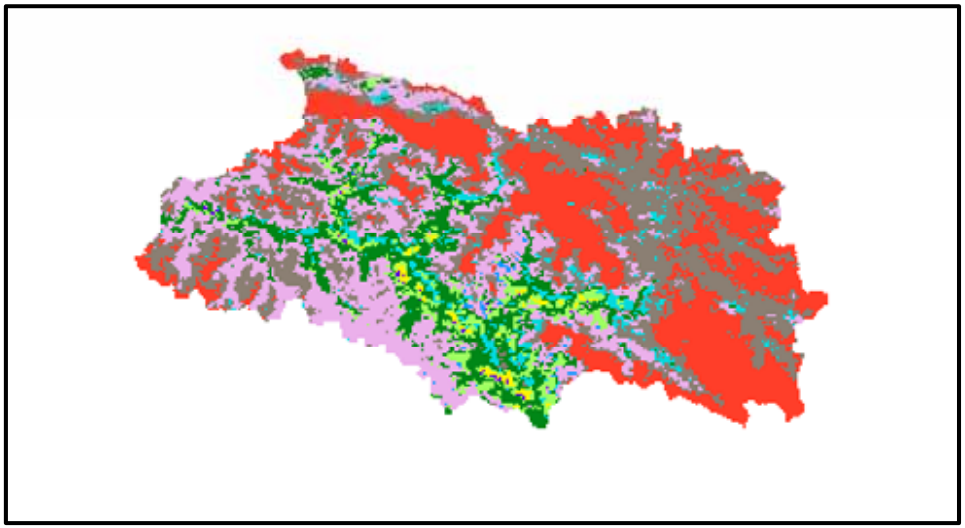
- Water & Power development Authority (WAPDA)
- Pakistan Metrological Department
- Snow and Ice Hydrology Project (SIHP)
- Water Resources Research Institute (WRRI), National Agricultural Research Center (NARC), Islamabad
- Pakistan Council of Research in Water Resources (PCRWR)
- Global Change Impact Study Center, Islamabad
- International Water Management Institute, Lahore


Thank you


MEAN ANNUAL
RAINFALL
SCALE
0
400 Km.
N
LEGEND
(mm)
> 1500
1000 - 1500
500 - 1000
300 - 500
200 - 300
100 - 200
< 100

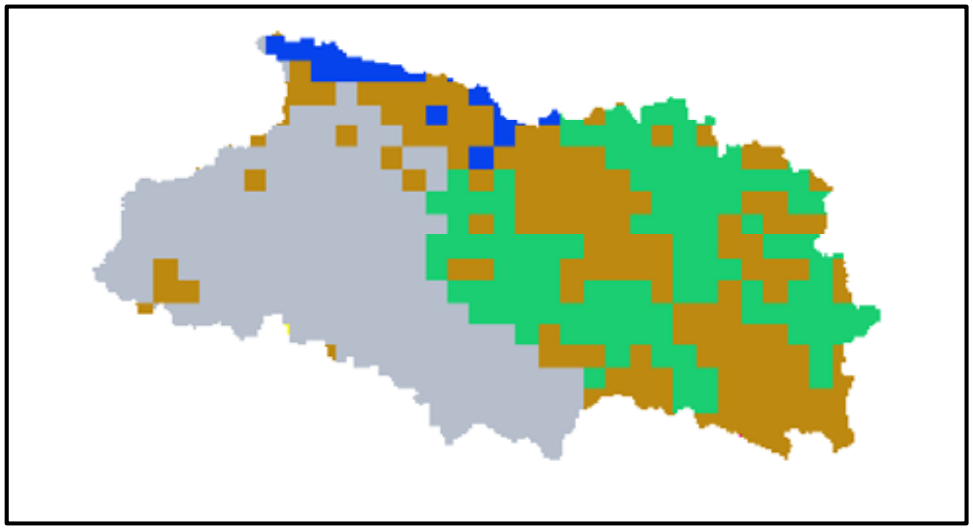
Gilgit Basin

Land Use Map of Gilgit River Basin



- Wooded Tundra
- Wooded wetland
- Barren / sparsely vegetated
- Mixed Shrub / grassland
- Irrigated cropland
- Non irrigated cropland
- Grassland
- Shurbland
- Snow / Ice

Soil Map of Gilgit River Basin



- *Type 1*
- *Type 2*
- *Type 3*
- *Type 4*
- *Type 5*
- *Type 6*