
Climate Change and Agriculture Governance in Pakistan

Asif Khan

Post Doctorate (IIASA, Austria)

Ph.D (Cambridge, UK)

Working as Individual Consultant

Ex-Director Research at WIT LUMS

Lead Author (IPCC AR-6), Switzerland

Member Upper Indus Network, Nepal

Member Indus Basin Knowledge Forum, USA

Member Cambridge Philosophical Society, UK

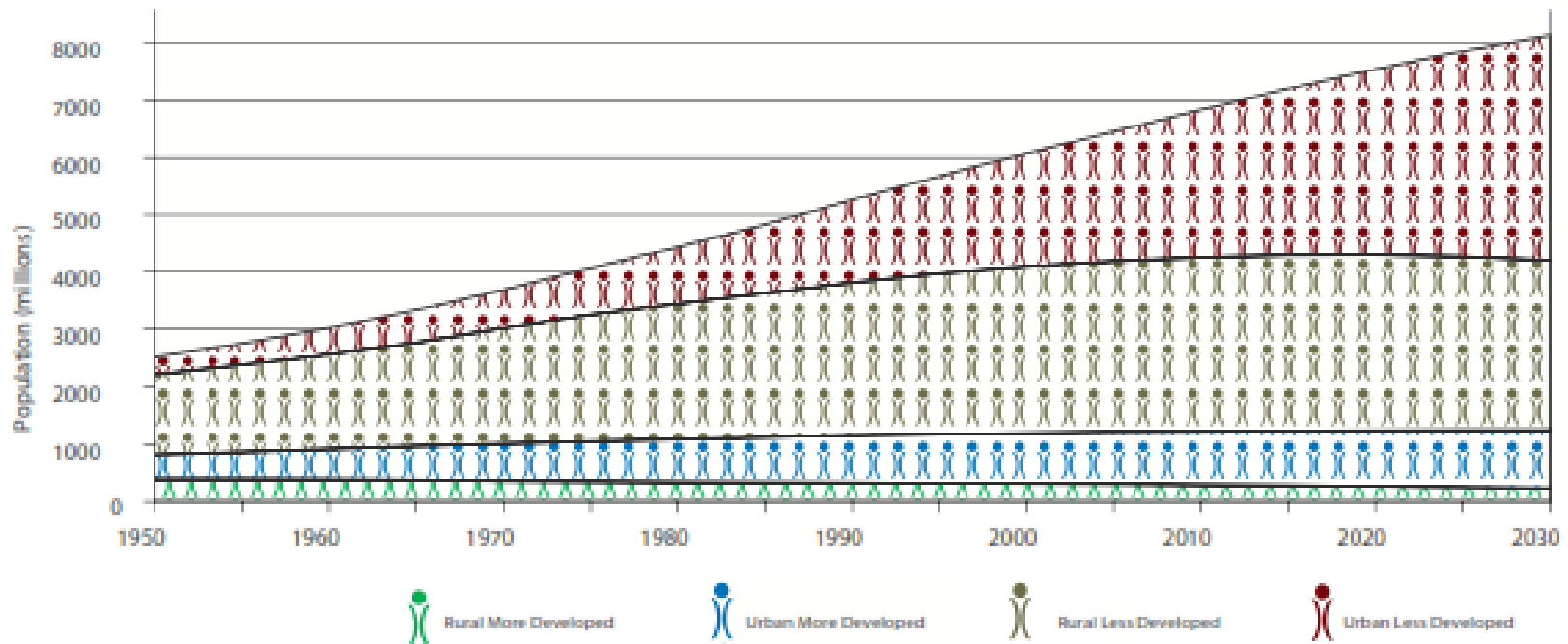
Member British Hydrological Society, UK

Outline

- Global challenges
- Potential and problems related to the Indus Basin
- Climate change assessment and challenges in agriculture sector
- Potential adaptation and mitigation measures
- Key stakeholders and available policies/acts
- Way Forward
- Questions and Answers

Global challenges

- Population growth
- Global warming and climate change

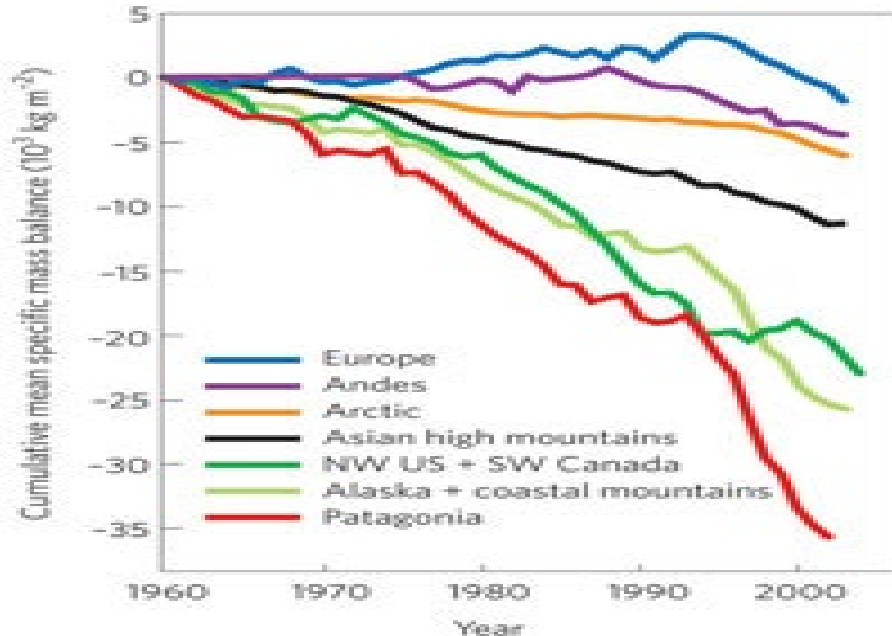


Source: UN: facts and trends (2006)

Increased population will need more: i) water supply, ii) food production, iii) energy production/supply, iv) flood and drought mitigation, v) urbanization, and v) industrial development

Global challenges

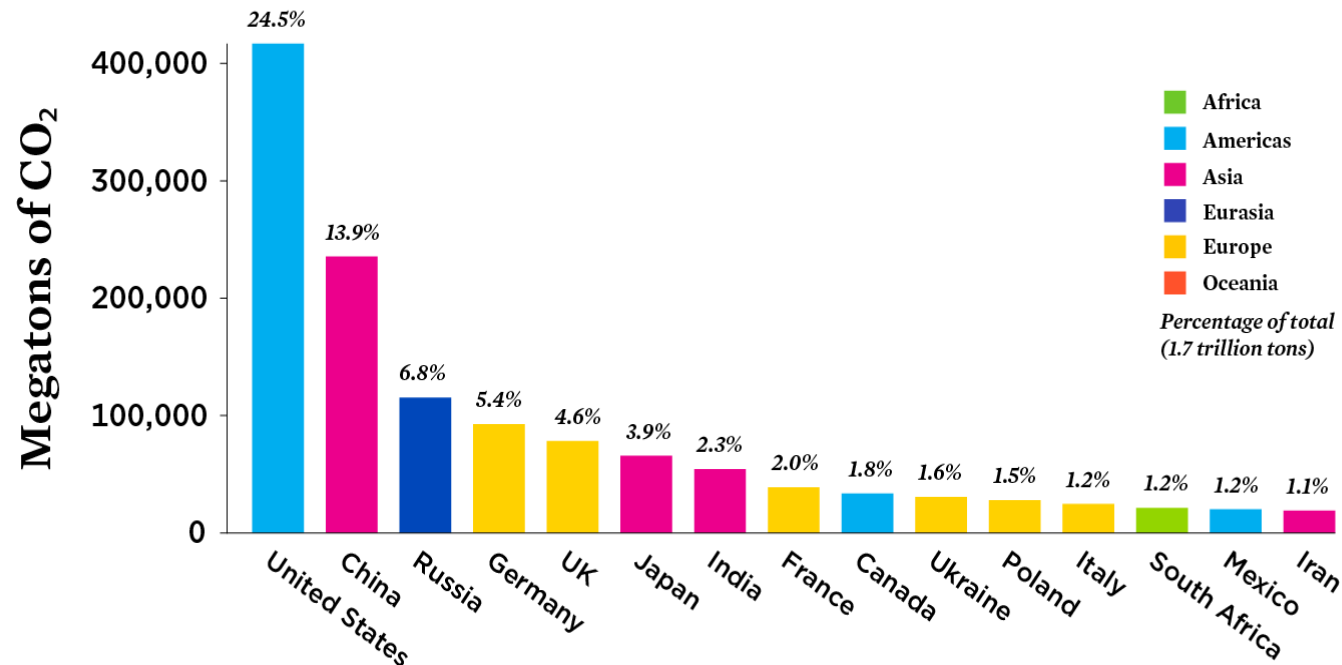
- Population growth
- Global warming and climate change
- Global mean surface temperature increased by 0.74 ± 0.18 °C during 1906-2005, while
- projected expected increase is 1.4 to 5.8 °C during 1990 to 2100 (IPCC 2007, 2013)



Source: [\(Inman 2010\)](#)

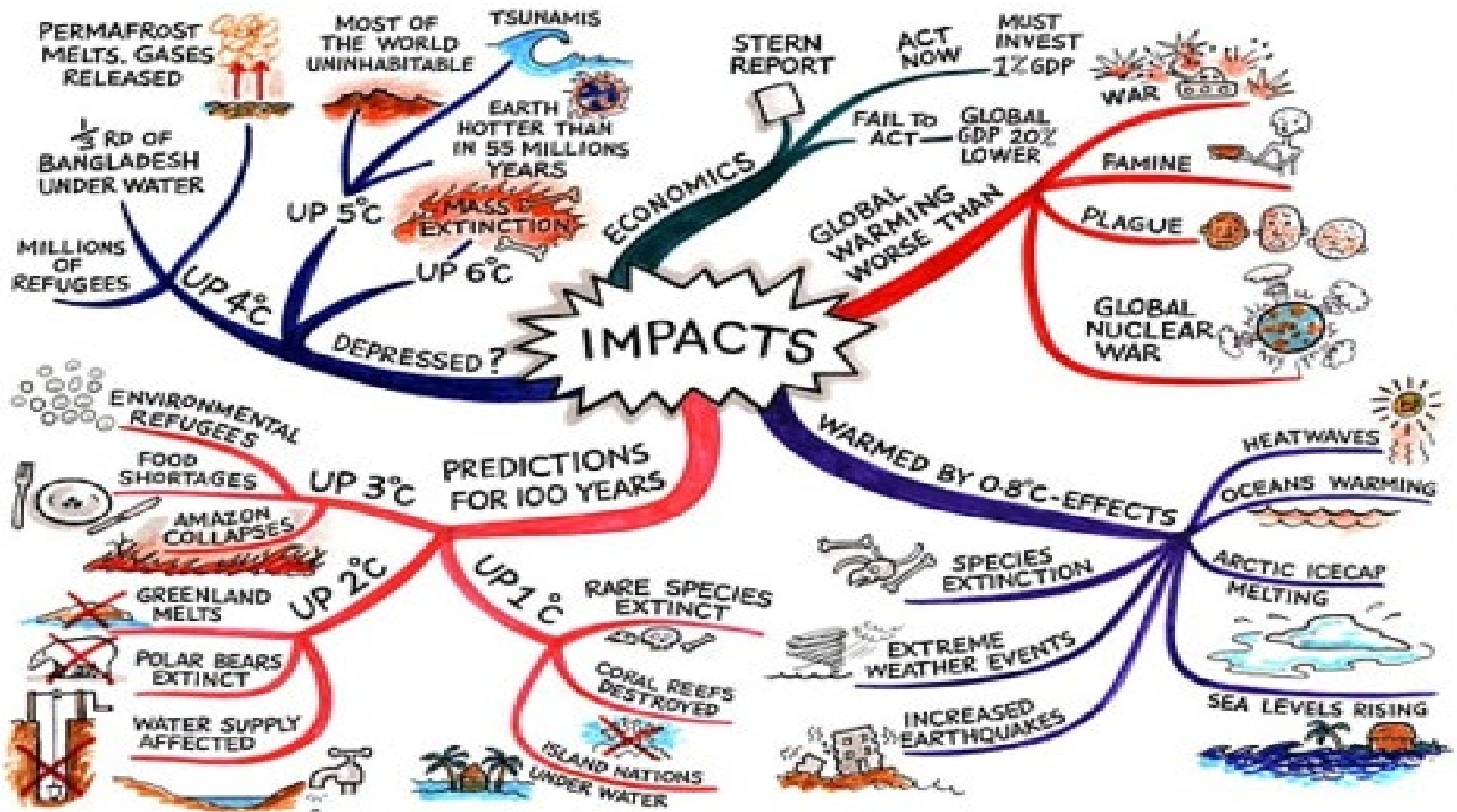
- Global warming is causing glacier retreat,
- Severity in floods and droughts,
- Increasing water scarcity,
- Increasing slope instability and landslides,
- Increasing Glacier Lake Outburst Floods (GLOFs)
- Reservoir sedimentation,
- Forest fires,
- Increasing water losses/evapotranspiration
- Adverse impact on Agriculture and Eco-system

Top CO₂ Emitting Countries, 1750-2020 (from fossil fuels and cement)



© 2021 Union of Concerned Scientists
Data: Global Carbon Project via Our World in Data

Source: (<https://www.ucsusa.org/resources/each-countrys-share-co2-emissions>)

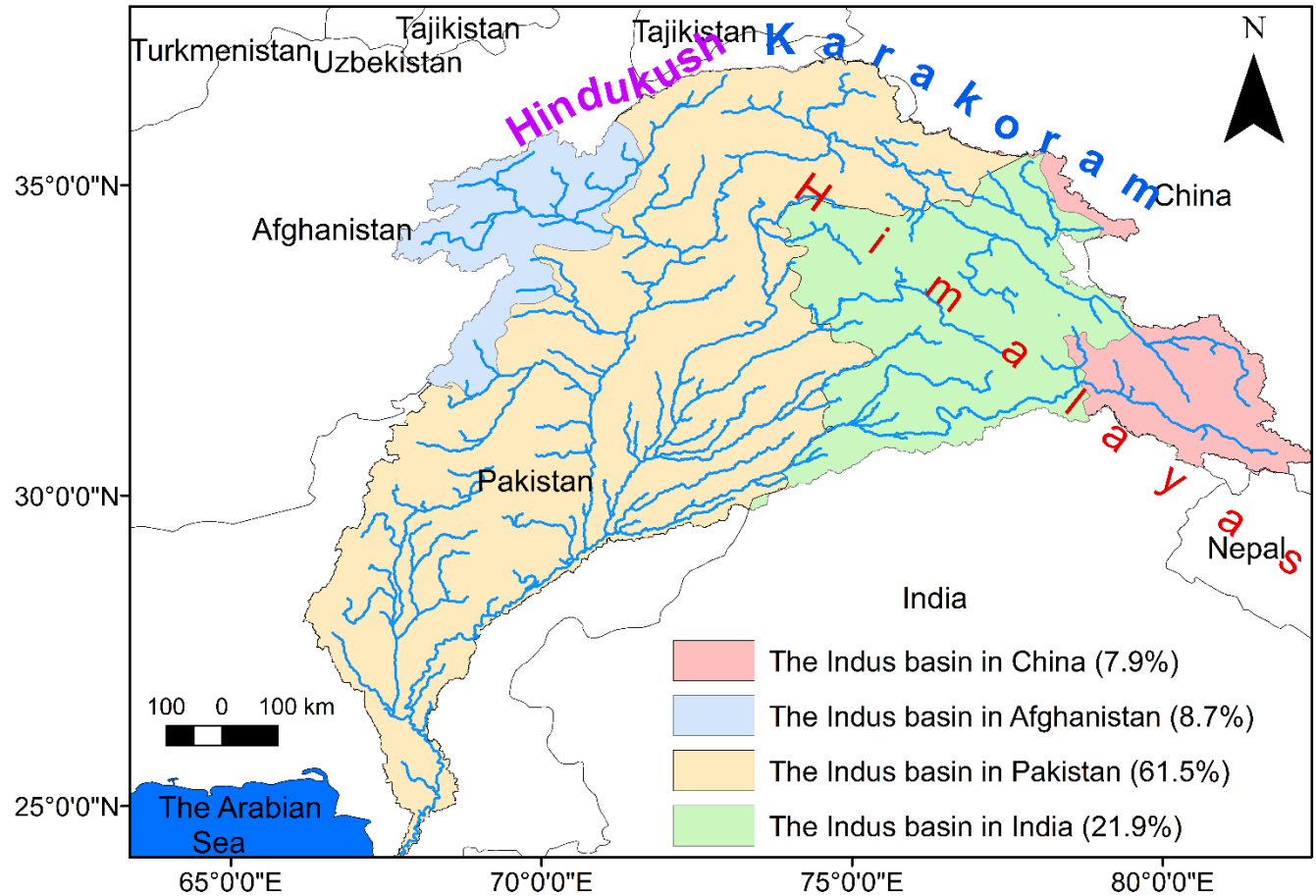


An aerial photograph of a wide, deep valley. A prominent river with a milky, turquoise color flows through the center of the valley, winding slightly to the right. The river is flanked by wide, sandy and gravelly banks. The surrounding mountains are rugged and barren, with shades of brown, tan, and grey. In the distance, some peaks are covered in snow. The sky is a clear, vibrant blue with scattered white clouds. The overall scene is one of a high-altitude, arid environment.

The Indus Basin

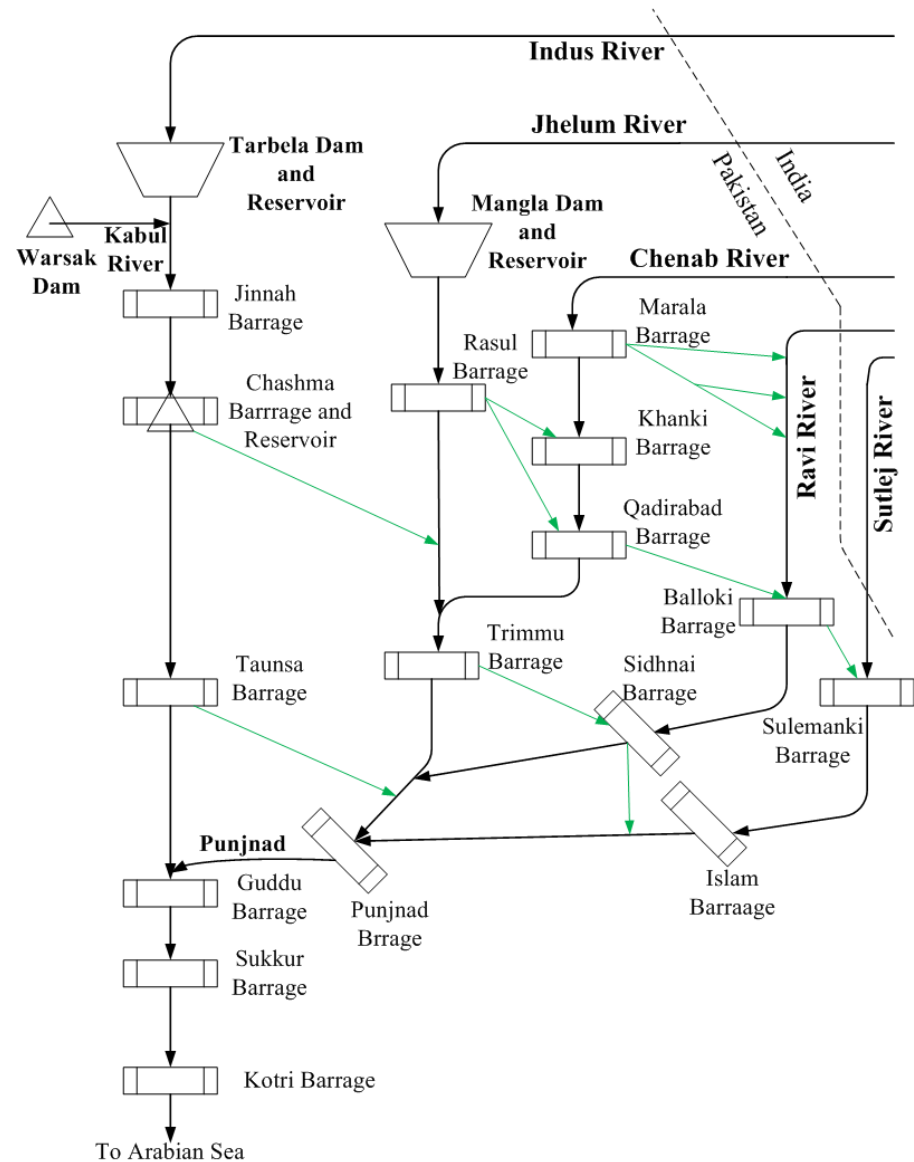
The Indus Basin

The Indus Basin originates from the Hindukush-Karakoram-Himalaya and Tibetan Plateau (HKH-TP) region, and runs from the north to south.

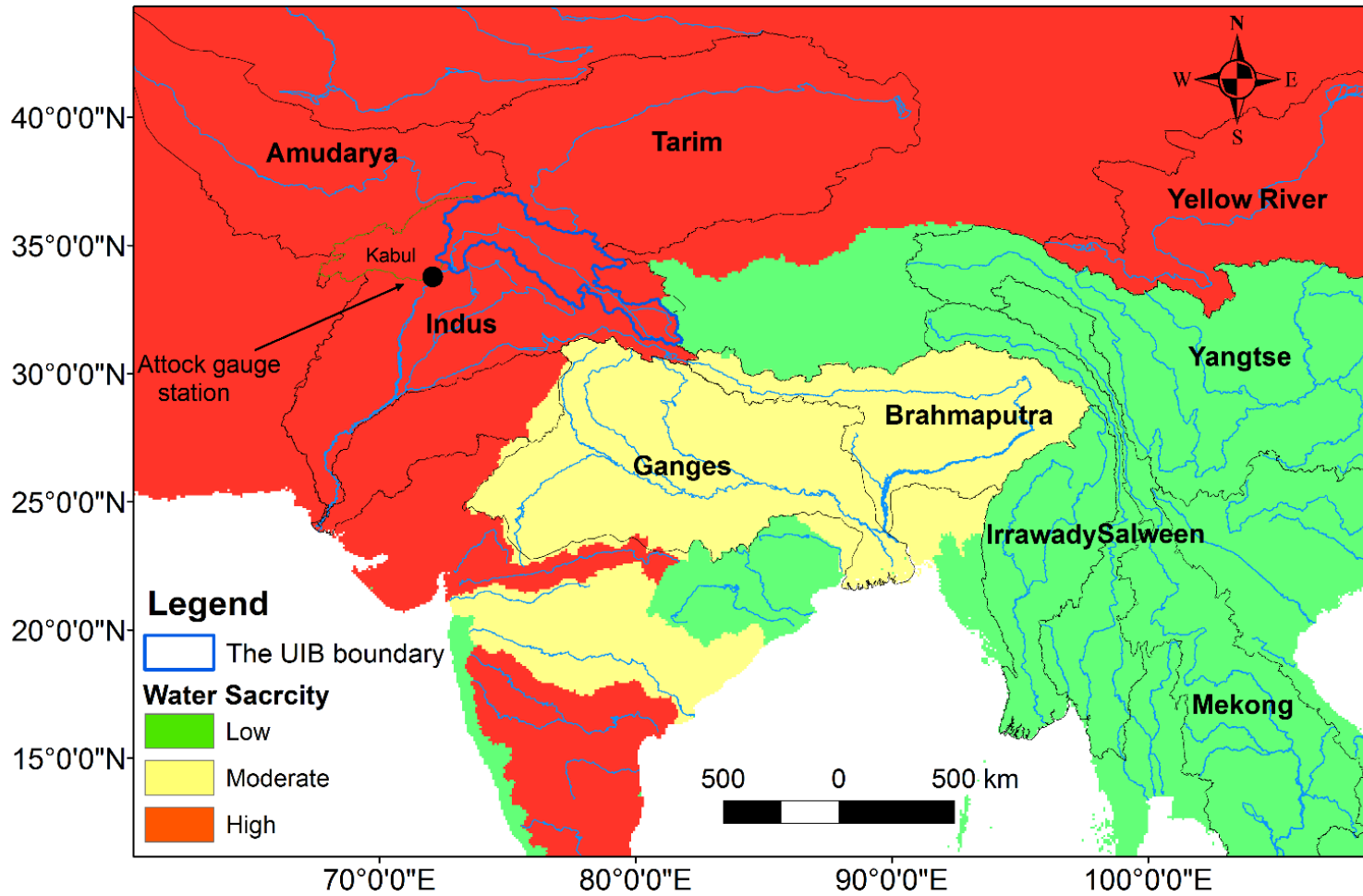


The Indus Basin

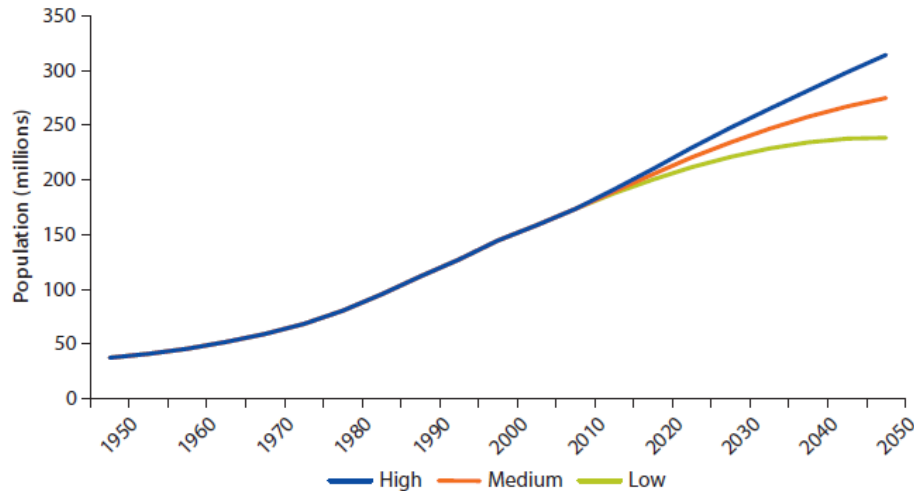
- The Indus Basin Irrigation System (IBIS) is one of the largest in the world
- Fulfills ~ 90% of the irrigation needs
- Cater for > 33% of energy needs (mostly in Pakistan)
- More than 56-70% of Pakistan and India's population is dependent on agriculture
- Agriculture contribute ~24% in annual GDP of Pakistan
- 90% Agriculture is dependent on irrigation



Water: water scarcity



Water: Population growth and food demand



Source: Yu et al. (2013)

Water Requirements and Availability

	(MAF)		
Year	2000	2013	2025
Population (Million)	148	207	267
Water Requirement			
Irrigation	143.1	206.4	
Non-irrigation	5.9	8.7	
Total Requirements	149.0	215.1	277.4*
Water Availability**			
Total Surface and Groundwater	108.7	107.3	126.6
Shortfall	40.3	107.8	150.8

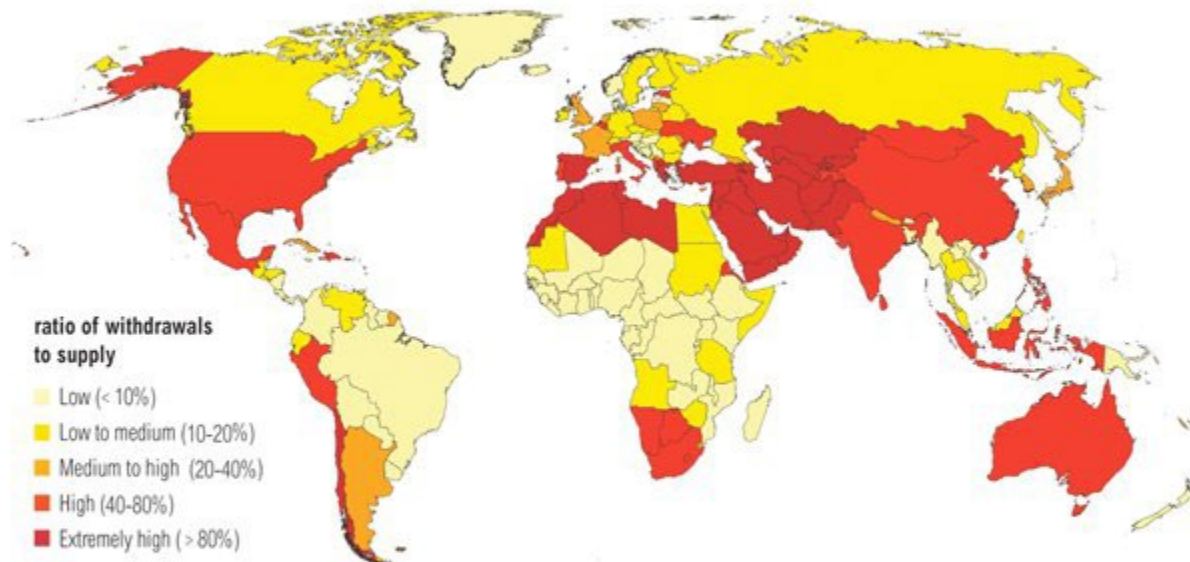
* Extrapolated.

**At Watercourse head.

Source: Afzal (1996)

Water: water stress in 2040

Water Stress by Country: 2040

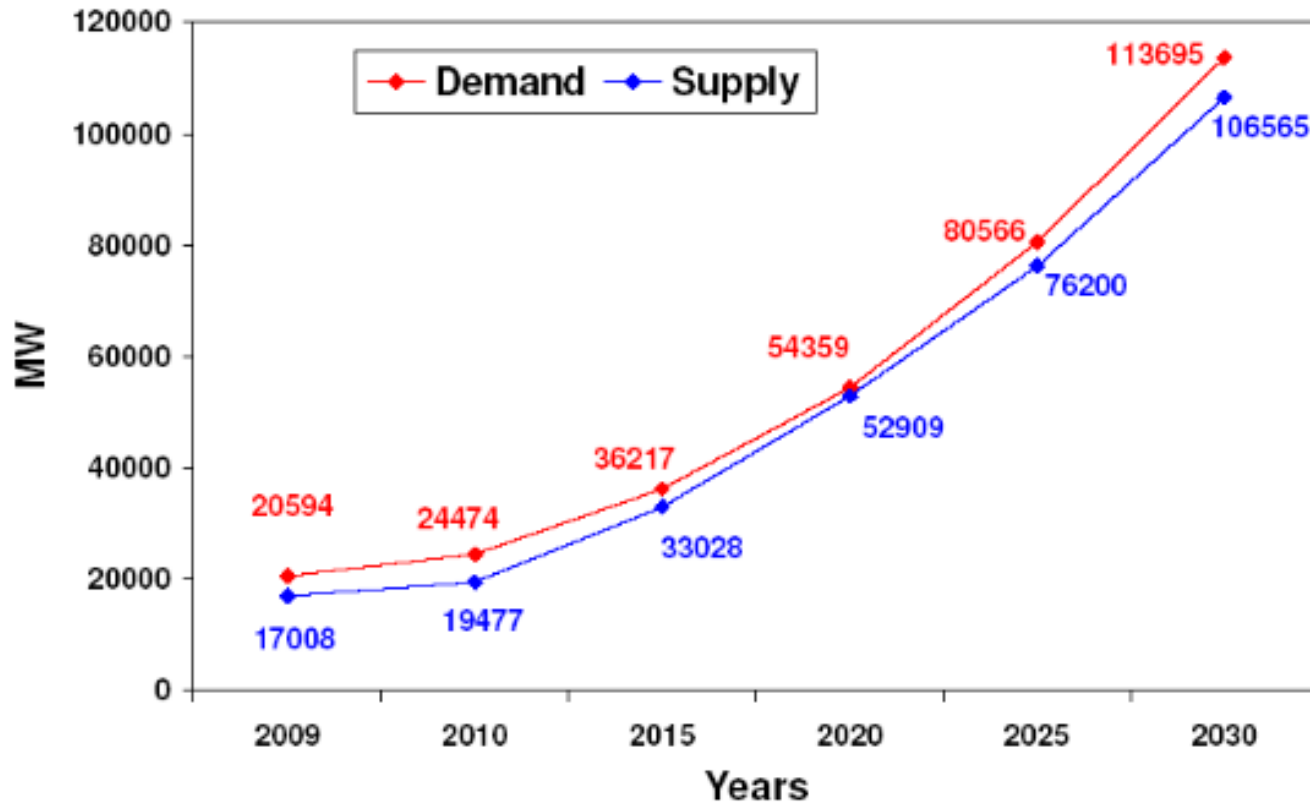


NOTE: Projections are based on a business-as-usual scenario using SSP2 and RCP8.5.

For more: ow.ly/RiWop

 WORLD RESOURCES INSTITUTE

Energy Demand: Current and Future



*Projected demand includes captive power also. Average growth rate is expected to be about 8%

Source: Hussain et al. (2011)

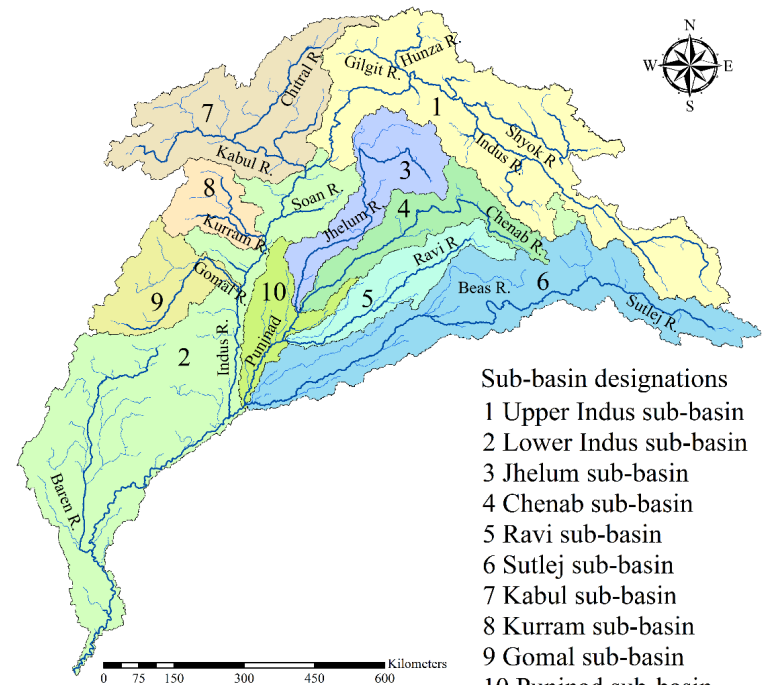
Current shortfall in Pakistan is > 4000 MW (Javaid et al., 2011)

Issues/Problems

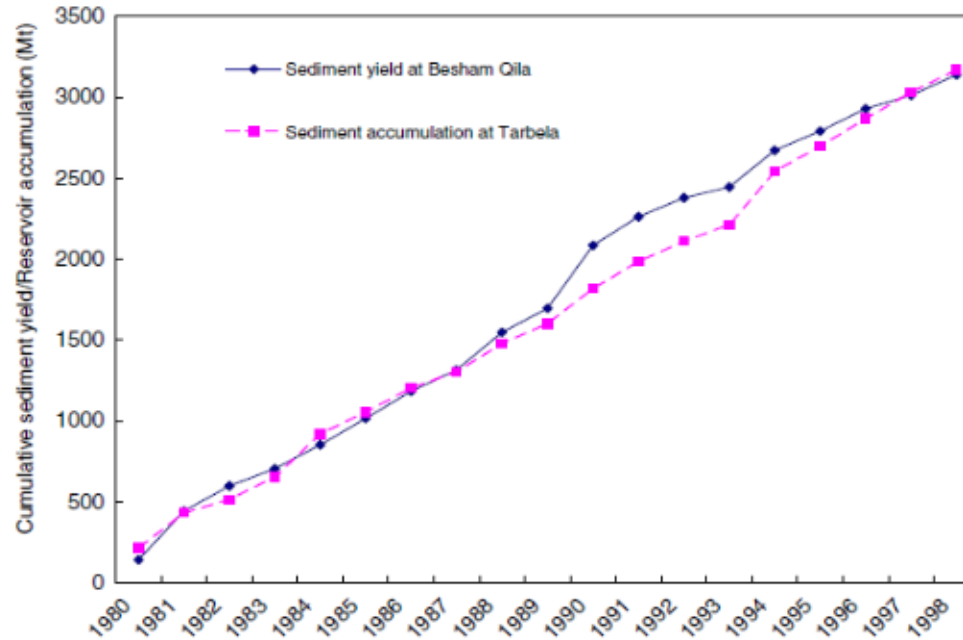
- Asian temperature rise is greater than world's average temperature rise (IPCC 2007, 2013)
- According to CMIP 5, under the RCP 4.5, the expected temperature rise is about 2°C (relative to 1961-1990) in the whole HKH during 2021-2050,
- The HKH-TP region has a glacier area of about 33,000 km² (ICIMOD, 2009) and contains about 12,000 km³ of freshwater (IPCC, 2007b)
- Glaciers in the western Himalayas, Hindukush, and eastern Karakoram are losing mass at a high rate (Kaab et al., 2012, 2015, Gardelle et al., 2012, 2013)
- Glaciers in the western Karakoram are advancing and bear slightly negative mass balance during the last decade (Kaab et al., 2012, 2015; Gardelle et al., 2012, 2013)
- Monsoon precipitation became more intense and frequent in the last four decades, and is responsible for floods in the region (Wang et al., 2011)

Issues/Problems

- Snow- and glacier-melt contributes more than 80% in stream flows in various sub-basins of the Indus Basin
- Any change in temperature or snow-fall or snow-/glacier-melt will cause significant ramification on downstream water resources
- Land sliding and floods may affect existing and ongoing projects, such as Pak-China economic corridor
- Historic civilization in the northern Indus basin is under threat due to floods, and proposed reservoirs
- There are more than 1800 glacial lakes, of which >50 are potentially dangerous (Campbell, 2005)



Issues/Problems: Sedimentation

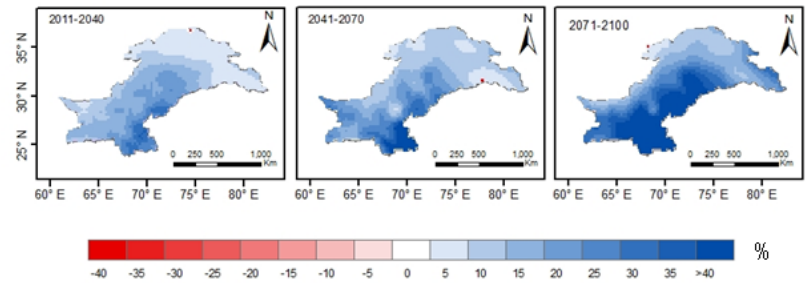
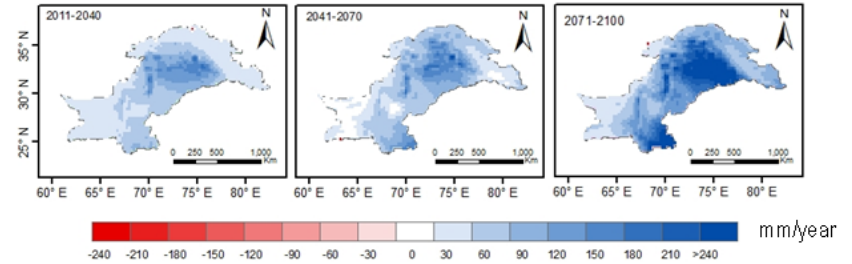
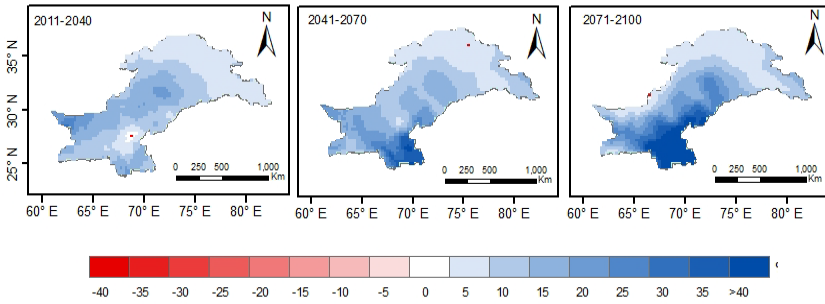
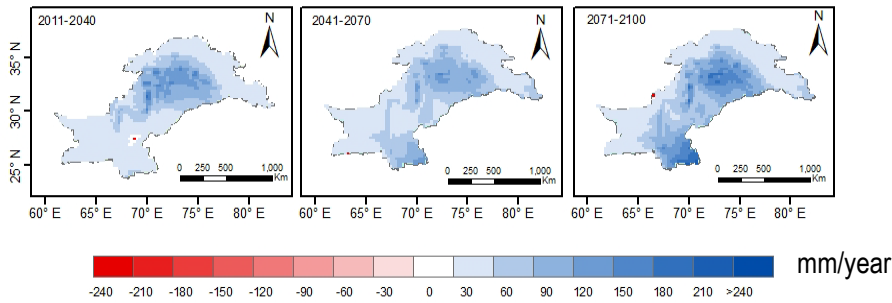


Sedimentation at Tarbela Dam (Ali and Deboer, 2007)

- ❑ Tarbela Dam lost ~31% of storage capacity during 1978-2015,
- ❑ Mangla Dam lost ~ 18% (1967-2009),
- ❑ Chashma barrage lost 51% during 1971-2009

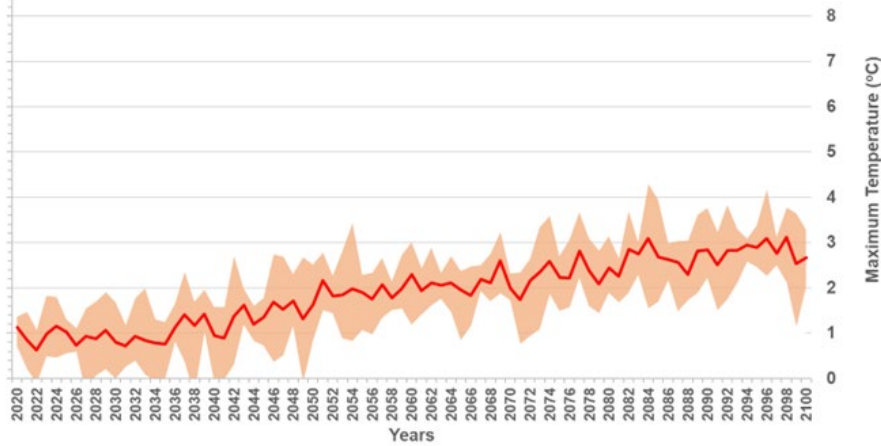
Sedimentation will rise with increase in snow and glacier melt

Precipitation projections during 2011-2100

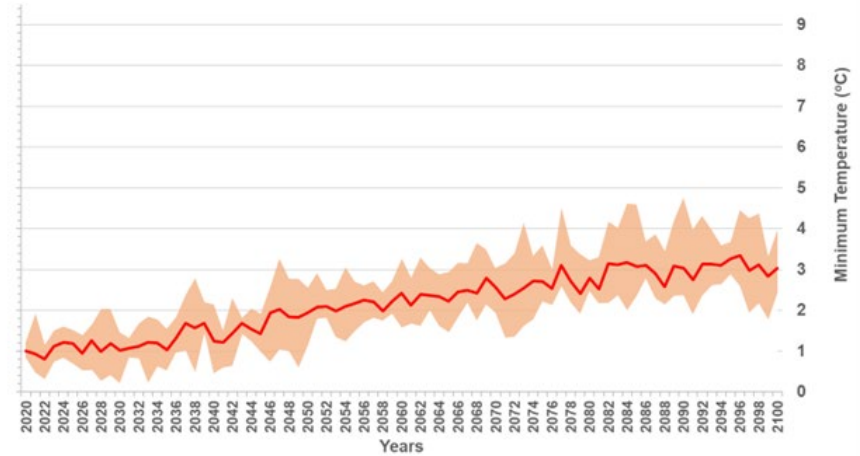


Temperature projections during 2011-2100

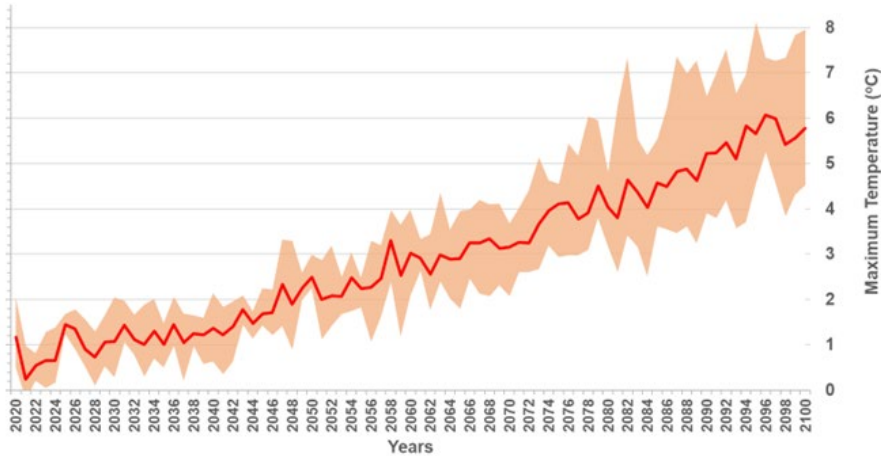
a) Maximum Temperature variations based on SSP245 scenario



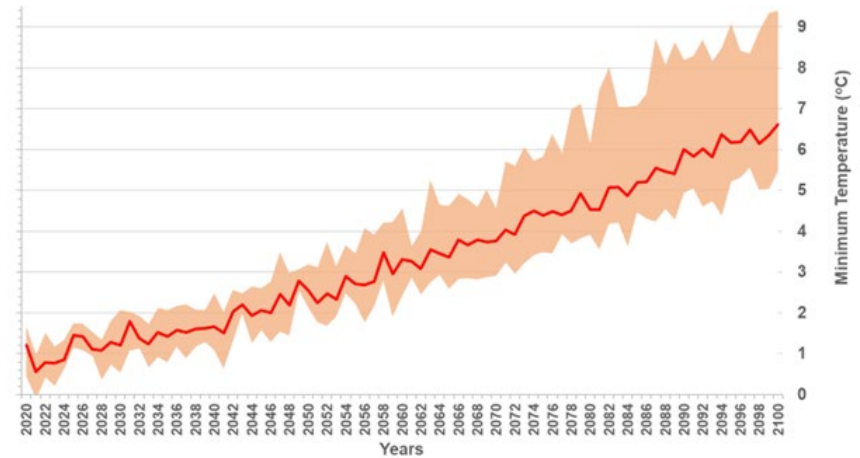
a) Minimum Temperature variations based on SSP245 scenario



b) Maximum Temperature variations based on SSP585 scenario



b) Minimum Temperature variations based on SSP585 scenario



Potential Impacts

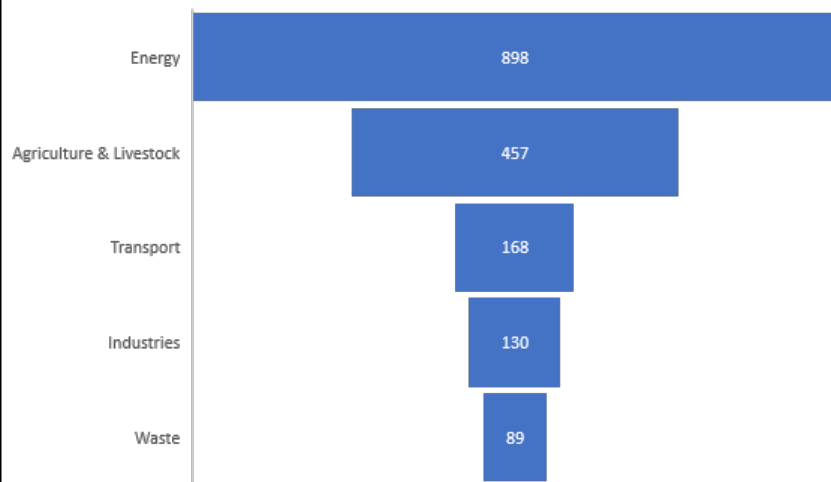
- Increase in floods
- Increase sediment transport and reduction of reservoir storages
- Changes in water availability
- Increase in temperature and heat-waves
- Increase in high winds
- Increase in droughts (in some areas)
- Change in seasonal lengths

Potential Impacts on Agriculture

- Increase in crop-water requirements
- Change in crop-yield
- Change in availability of agricultural land
- Change in ripening of crops
- Adverse impacts of temperature rise and heat-waves
- Change in seasons-opportunity in some areas

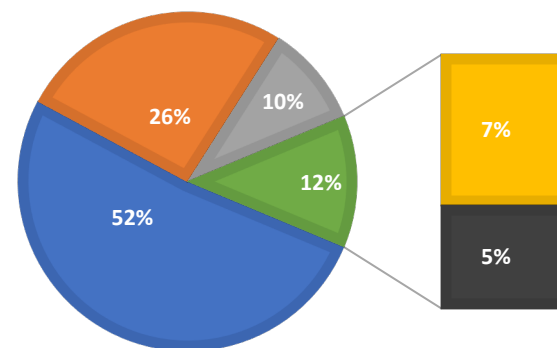
NDCs-2021

PROJECTED NATIONAL LEVEL EMISSIONS-2030 (MILLION TON)



PROJECTED NATIONAL LEVEL EMISSION-2030

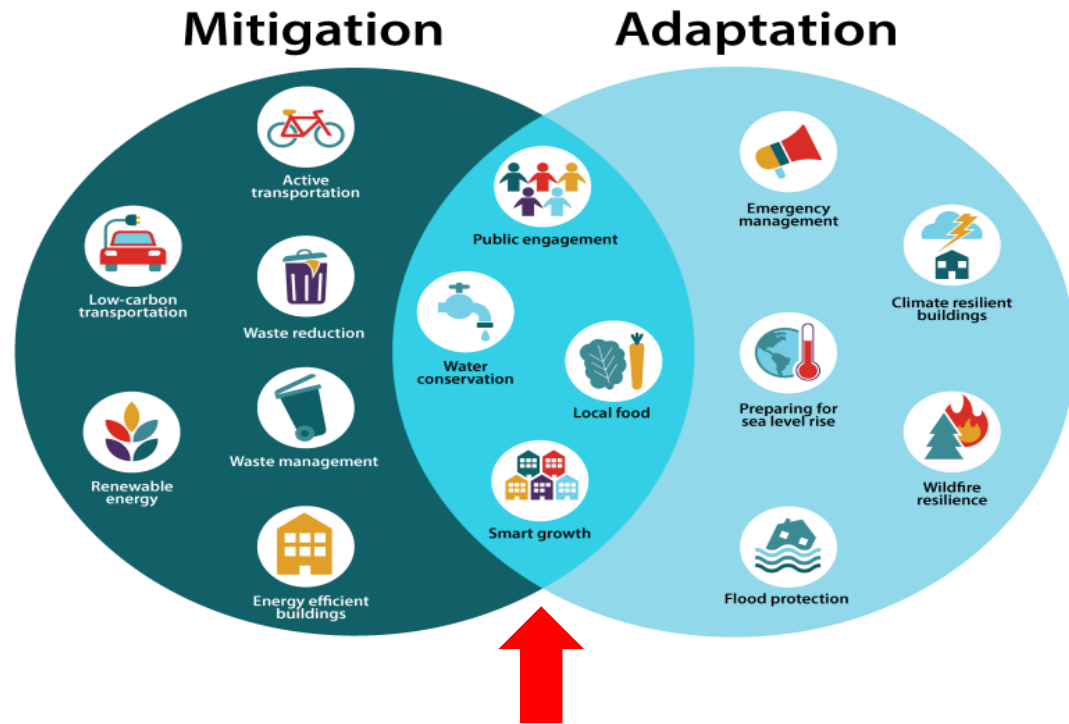
- Energy
- Agriculture & Livestock
- Transport
- Industries
- Waste



National Level Activities

- 60% Energy from renewable sources
- ban on open burning of rice stubble, solid waste etc. and crop residue proper disposal
- 30% new vehicles will Electric Vehicles
- adoption of clean production technologies, implementation of eco-standard, incentivize carbon trading between industries.
- Strengthening municipal service delivery Includes a composite index of five pillars i.e., water, sanitation, hygiene, solid waste management and plantation

Need of
the time



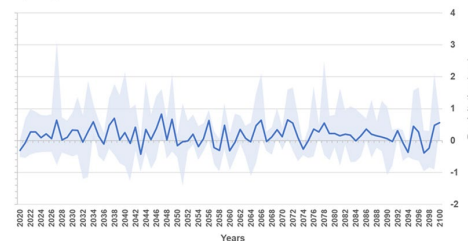
We need to be here to
become sustainable!

Climate Change Impact and Adaptation Measures

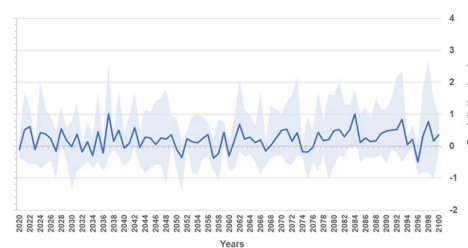
Climate Change Impacts and Adaptation Measures in the Agriculture Sector

- Preparation of district-level climate change assessment for Agriculture sector
- Identification of key impacts, such as potential floods, droughts, heat-waves, increase in cropwater requirements, changes in seasons shifts
- Preparation of potential actions to reduce adverse effects of climate change, such as use of HEIS, changes in cropping patterns, use of heat-resistant crops, construction of climate resilient storages, and surface water ponds
- Spreading awareness in farmers and stakeholders to understand the future needs and opt the proposed actions

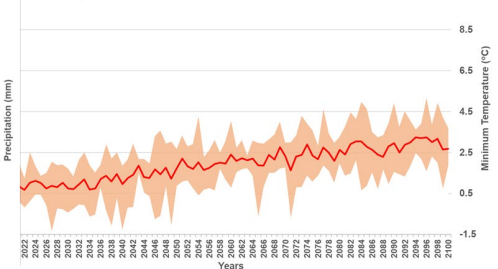
a) Precipitation variations based on SSP245 scenario



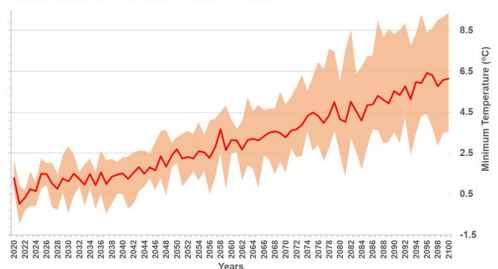
b) Precipitation variations based on SSP585 scenario



Minimum Temperature variations based on SSP245 scenario



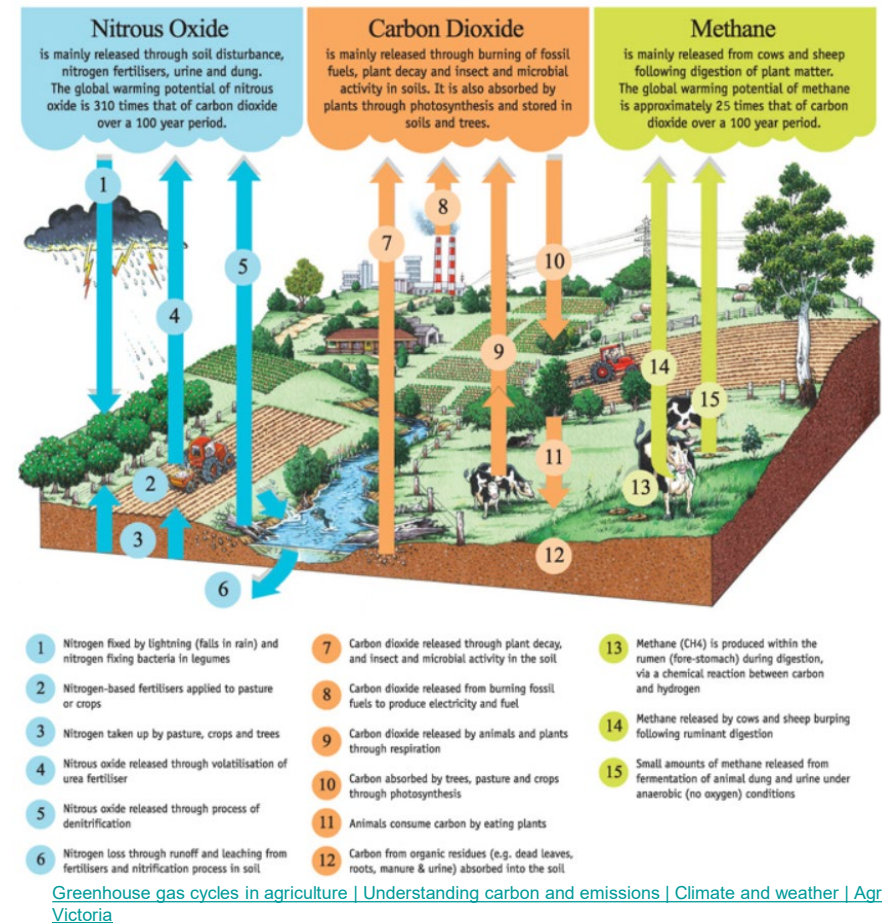
b) Minimum Temperature variations based on SSP585 scenario



GHG inventory for Agriculture and Mitigation Measures

GHG emissions sources and Mitigation Measures in the Agriculture Sector

- Preparation of provincial and district-level GHG emissions inventory for Agriculture sector
- Identification of key sources of GHG emissions at district-level
- Preparation of potential actions to reduce GHG emissions, such as use good quality feed for livestock, enhance surface water use for irrigation purposes, use of technologies to prepare seeds for climate resilient crops
- Spreading awareness in farmers and stakeholders to understand the future needs and opt the proposed actions



The Key Stakeholders

Ministry of National Food Security and Research

- Agriculture Policy Institute (API)
- Federal Seed Certification and Registration Department (FSC&RD)
- Department of Plant Protection (DPP)
- Animal Quarantine Department (AQD)
- Plant Breeder Rights Registry (PBRR)
- Livestock and Dairy Development Board (LDDDB)
- Pakistan Agricultural Research Council (PARC)
- Pakistan Central Cotton Committee (PCCC)
- Pakistan Agricultural Storage & Services Corporation (PASSCO)
- National Veterinary Lab (NVL)
- Federal Water Management Cell (FWMC)
- Pakistan Oilseed Department Board (PODB)
- Fisheries Development Board (FDB)
- National Fertilizer Development Centre (NFDC)
- **TECHNICAL WINGS**
- Livestock Wing
- Food Security Commissioners I,II
- Cotton Commissioners
- Economic Wing

Academia and Private Sector stakeholders

Available key policies and acts

- National Climate Change Act-2017
- Updated National Climate Change Policy-2021
- National Adaptation Plan-2023
- National Water Policy 2018
- Provincial Water Policies and Acts
- Provincial level climate change policies and action plans
- Nationally Determined Concentrations (NDCs) 2021
- National Food Security Policy 2014

Lack of Nexus Studies in the Upper Indus Basin



Way
Forward





**Any
Questions**



**Thank
You**