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# Effects of Retreating Glaciers on Seasonal Water Availability

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# Introduction

Water shortages as a result of shrinking glaciers

- Reduction of water in glacial-fed streams
- Decline of dry-season surface streamflow affecting humans

Two specific areas of focus,

- The Himalayas and The Andes

Climate change driven issue

Worldwide glacier volume is declining at an accelerating pace

- Agricultural production
- Drinking
- Power generation
- Sanitation
- Industrial processing



[https://commons.wikimedia.org/wiki/File:Glacial\\_melt\\_water\\_carving\\_the\\_ice\\_river\\_source\\_Himalayas\\_India.jpg](https://commons.wikimedia.org/wiki/File:Glacial_melt_water_carving_the_ice_river_source_Himalayas_India.jpg)

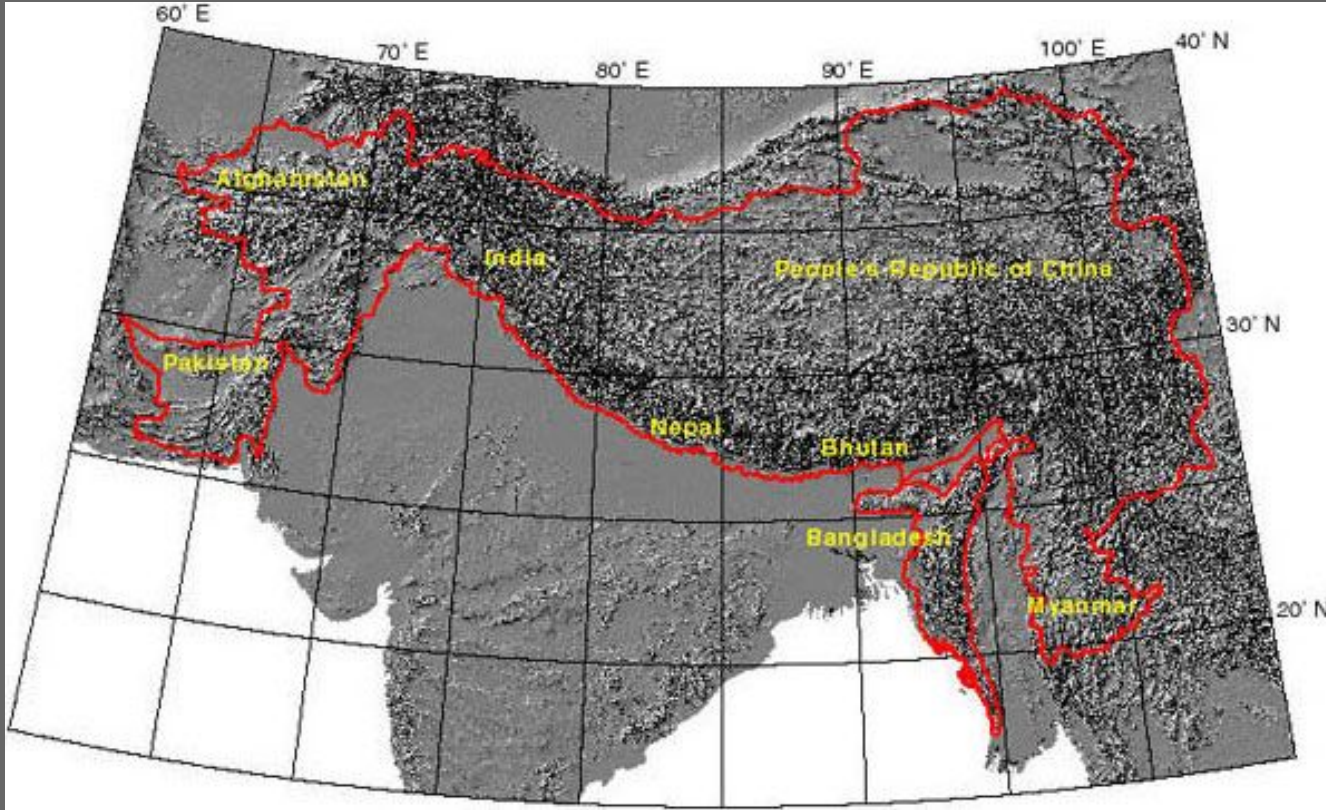
# Glaciers as water reservoirs

Glaciers accumulate water in the winter and store it

From spring, through summer, stored ice slowly melts and travels downstream

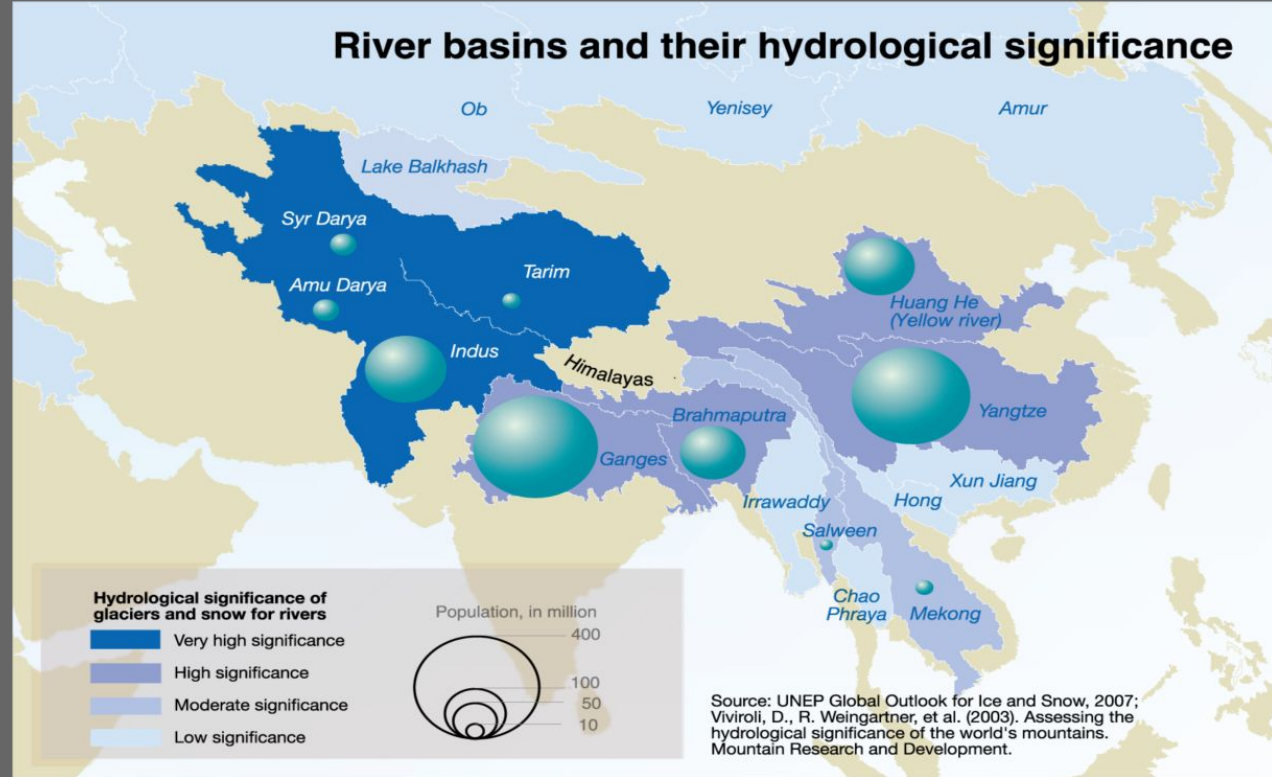
- Provides a steady and dependable source of water for the summer
- Cushions streamflow when precipitation is low

# Himalayas



- Around 15,000 glaciers
- Massive area of ice and snow

- High populations around Himalayas
- Glaciers generate a huge amount of water



# The Indus River

Flows through four countries  
(Afghanistan, Pakistan, India and  
China)

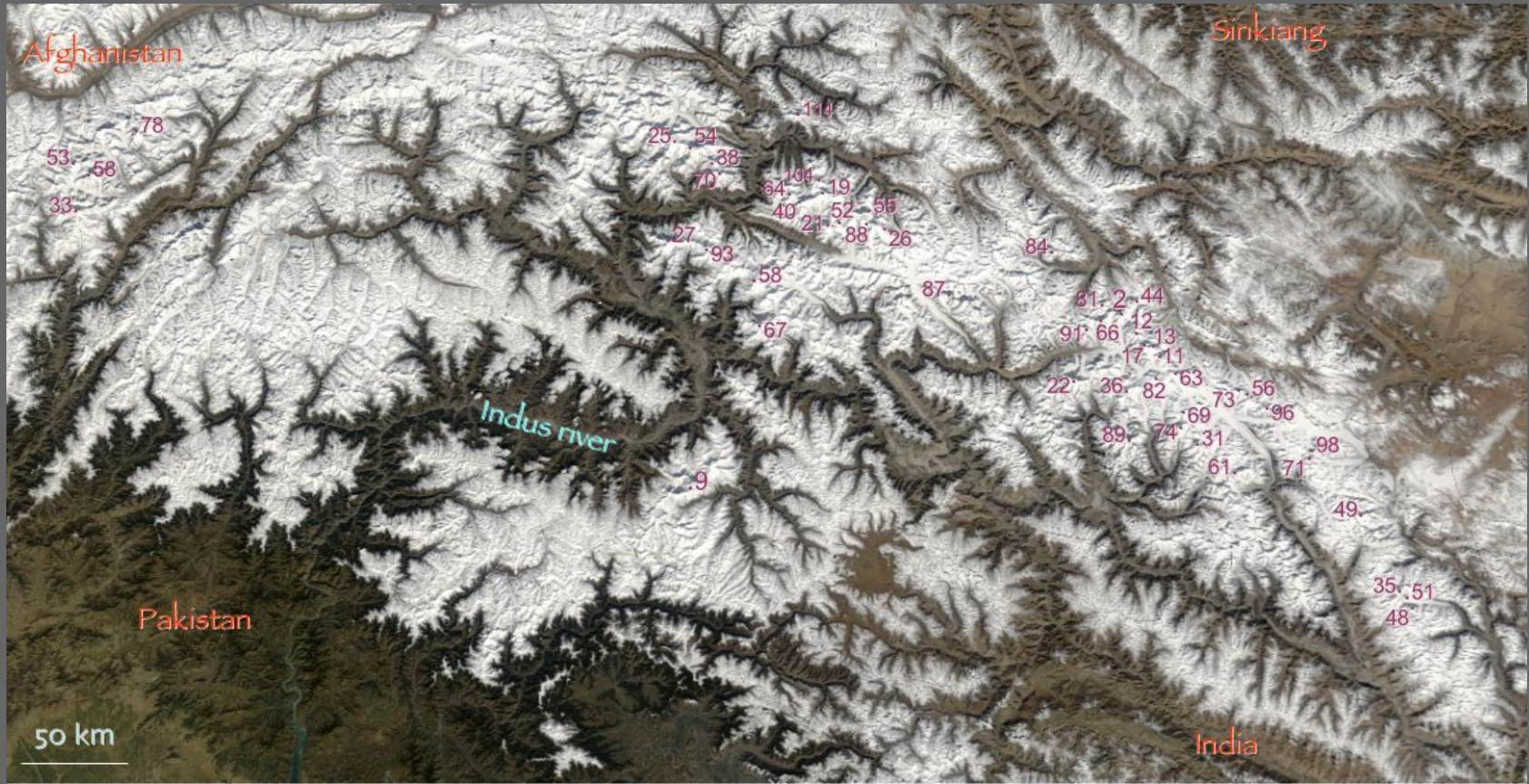
26% annual flow from glacier melt,  
summer contribution is much, much  
higher

Approximately 30% more arid than the  
nearby Ganges river basin



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[https://commons.wikimedia.org/wiki/File:Hindu\\_Kush\\_and\\_Karakoram\\_peaks\\_annotated\\_\(NASA\\_satellite\\_Terra\\_MODIS\).png](https://commons.wikimedia.org/wiki/File:Hindu_Kush_and_Karakoram_peaks_annotated_(NASA_satellite_Terra_MODIS).png)

Irrigates 80% of Pakistan's agricultural land

160 million people living in Pakistan alone

Less water per person than the minimum recommended by the United Nations

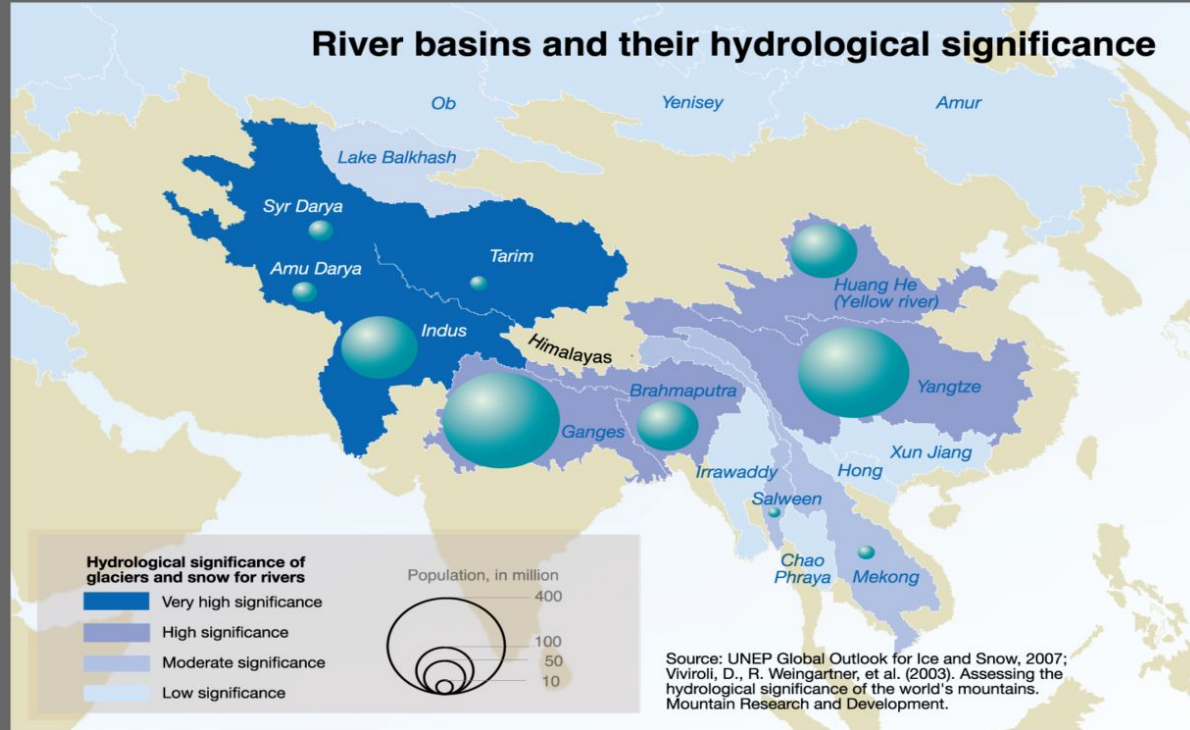
37% of Pakistan's total electric-generation capacity from hydroelectric



<https://commons.wikimedia.org/wiki/File:Indus.A2002274.0610.1km.jpg>

Central Asia is much drier than Eastern Asia

More sparsely populated, but still populated by tens of millions of people excluding the Indus



# Andes



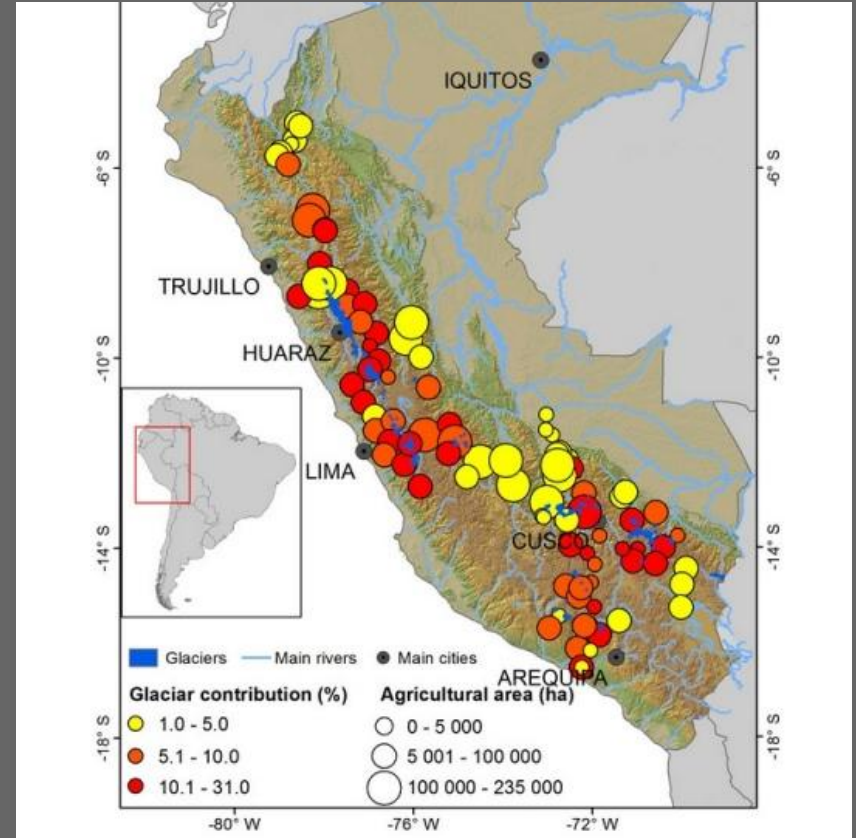
[https://en.wikipedia.org/wiki/Andes#/media/File:Andes\\_bolivianos.jpg](https://en.wikipedia.org/wiki/Andes#/media/File:Andes_bolivianos.jpg)

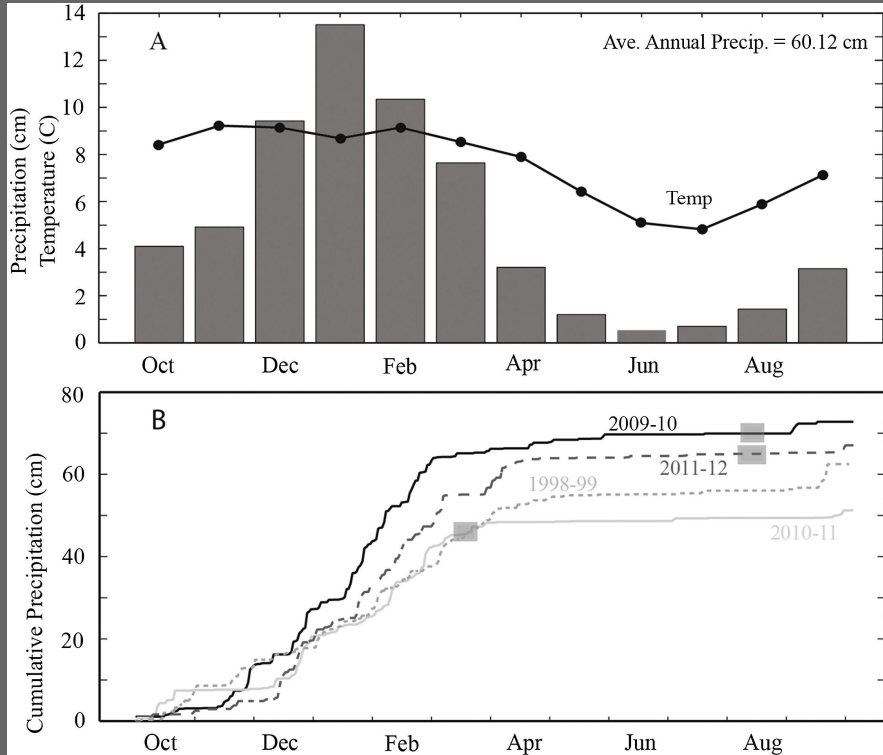


[https://commons.wikimedia.org/wiki/File:Tropical\\_Andes.PNG](https://commons.wikimedia.org/wiki/File:Tropical_Andes.PNG)

Major cities of Bolivia and Peru nearby, 2 million people drawing water from glacier-fed watershed

Dry season glacial meltwater contributes about 39–71% of surface water





National Meteorological and Hydrological Service (SENAHMI) in Bolivia

Extremely arid region, virtually no rainfall in the summer months

Leads to reliance on meltwater

# Future Implications

- Glaciers will be nearing extinction in the coming decades
- Temporarily increased glacier melt water
- Systems around the world will be affected, some are more vulnerable
- Arid areas may experience life threatening water and food shortage
- Climate refugees



[https://en.wikipedia.org/wiki/Andes#/media/File:La\\_Paz\\_Skyline.jpg](https://en.wikipedia.org/wiki/Andes#/media/File:La_Paz_Skyline.jpg)

# Conclusion

- Glaciers provide an important water resource service
- More glacio-hydrologic research needed
- Assessing changes in the quantity of freshwater for certain vulnerable places of the world
- Adapting policy and water management strategies



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