Water resource management challenges in the Himalayas: current trends and research needs

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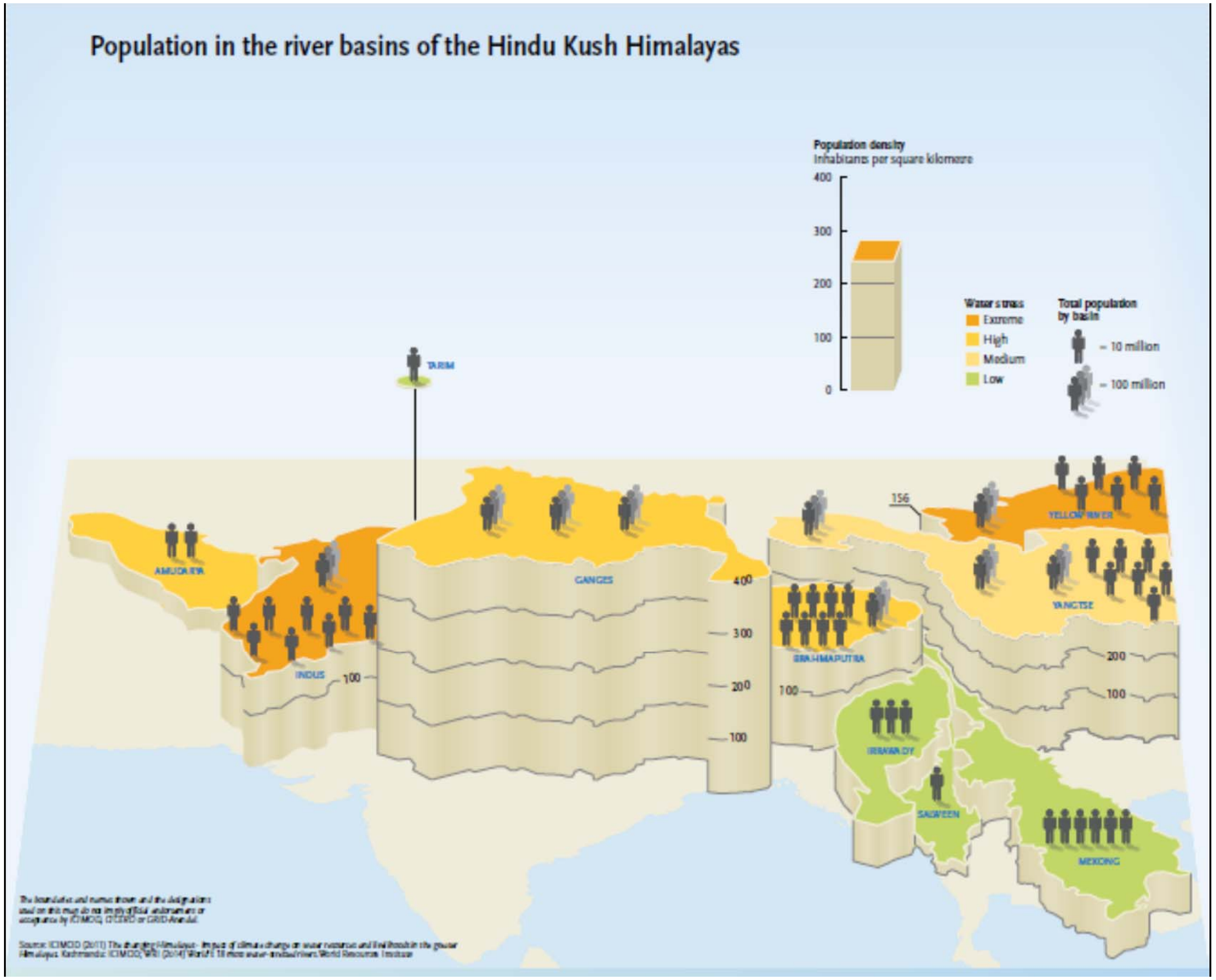
Hindu Kush Himalayas (HKH): an overview

- Afghanistan, Bangladesh, Bhutan, China, India, Nepal, Myanmar and Pakistan: **>4 million km²**
- 14 of the world's highest mountains: **'Roof of the World'**
- Most glaciated after Arctic and Antarctic: **'Third Pole'**
- 10 major rivers: **'Water Tower of Asia'**

Source: Shreshtha et al. The Himalayan Climate and Water Atlas: Impact of climate change on water resources in five of Asia's major river basins. ICIMOD, GRID-Arendal and CICERO 1–96 (2015)

Importance of water in the HKH

- Over **210 million people** within and **over 1.3 billion people** downstream rely on freshwater
  - ✓ Sustain livelihoods, food security needs
  - ✓ Support navigation, energy, terrestrial and aquatic ecosystems
- Largest loss of life and damage from water-related disasters



Source: Shreshtha et al. The Himalayan Climate and Water Atlas: Impact of climate change on water resources in five of Asia's major river basins. ICIMOD, GRID-Arendal and CICERO 1–96 (2015)

Importance of water: agricultural security

- **~ 90% of water withdrawals** – higher than world average (70%)
  - ✓ **Nepal**: 33% of Gross Domestic Product (GDP), employs 66%
  - ✓ **Pakistan**: 20% of GDP, employs ~ 50%
  - ✓ **China**: ~ 10% of the GDP

Importance of water: food security

- **Indus river**: production of > 80% of food grains in Pakistan
- **Ganges river**: freshwater for 50% of India and Bangladesh, and ~ entire population of Nepal
- **Brahmaputra river**: irrigation, hydropower and fisheries in Bangladesh, Bhutan and India

  ✓Over **2.5 million fishers in India, 0.4 million in Bangladesh,** and **33,000 in Nepal**: income and nutrition

Trends in water-related disasters

- **1990 – 2012: ~ 76 disasters each year**, **33% caused by floods**

  - ✓ **Pakistan in 2010**: **killed 2,000 people** and submerged 20% land, affecting 20 million people
  - ✓ Uttarakhand flood, **India in 2013**: **killed > 5,700 people**, 4,200 villages affected
  - ✓ **2014**, over **40% of the world's natural disasters** were reported here

Projected climate change trends (by 2050)

- **Temperatures** likely to **increase by 1–2°C**
- Winters – **greater warming** than summers
- **Monsoon** likely to **lengthen**, starting earlier and ending later
- **Precipitation** will **change by 5%**
- **Extreme rainfall** events are likely to **increase in intensity**
- **Glaciers** will continue to suffer **mass loss**

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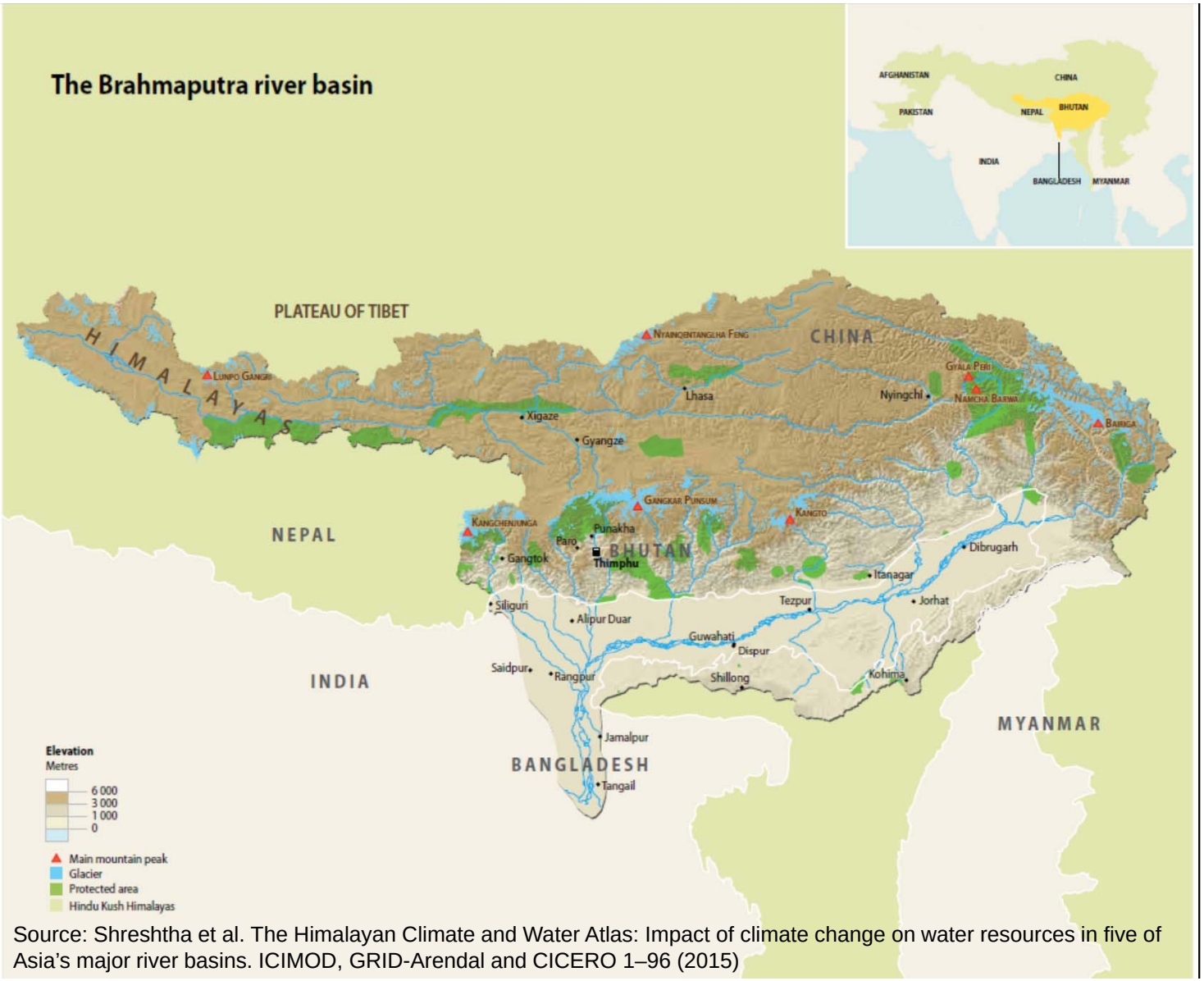
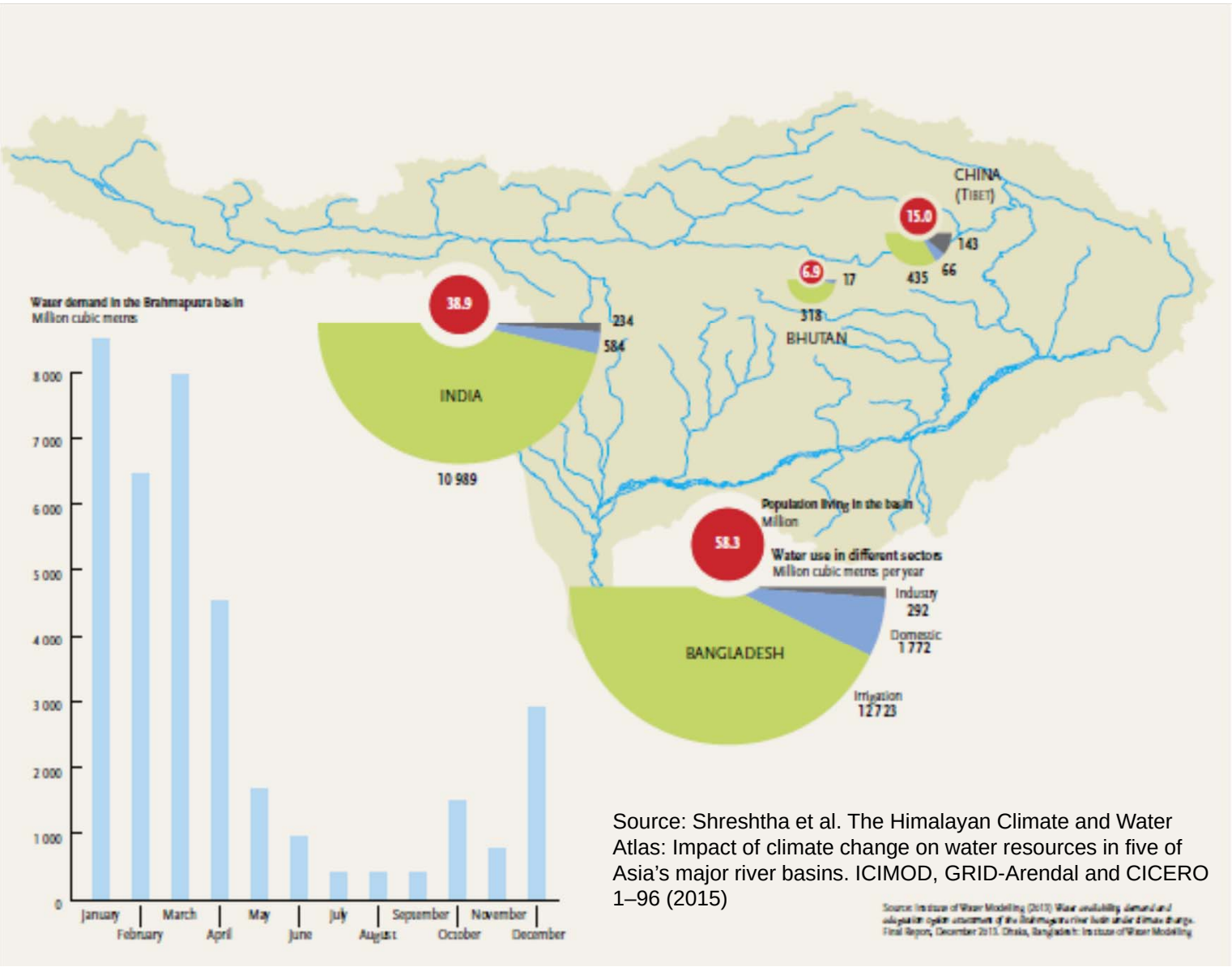


Source: Shreshtha et al. The Himalayan Climate and Water Atlas: Impact of climate change on water resources in five of Asia's major river basins. ICIMOD, GRID-Arendal and CICERO 1–96 (2015)

Brahmaputra river basin



Source: Shreshtha et al. The Himalayan Climate and Water Atlas: Impact of climate change on water resources in five of Asia's major river basins. ICIMOD, GRID-Arendal and CICERO 1–96 (2015)

Water demand in the Brahmaputra basin

Water resource management challenges

- **Too much water**

✓ Projected **increase in rainfall** = likely **increase in flooding** and **landslides**: risk to lives and infrastructure

✓ More **persistent standing water** + **contamination of freshwater** = increase in morbidity/mortality from malaria, and water-borne diseases

Identifying opportunities

- ✓ Harmonize water resources management policies
- ✓ Strengthen probabilistic and timely forecasting
- ✓ Strengthen technical capabilities of the District Disaster Management Authority (DDMA)
- ✓ Identify possible improvement in crop yield due to likely increase in rainfall in currently rain-deficit areas
- ✓ Mixed cultivation of crops in a flood/drought year
- ✓ Reuse of wastewater for irrigation

Water resource management challenges

- **Unsustainable ecosystem services, insecure livelihoods**

✓ Likely **shift in latitude of forest boundaries**, movement of tree lines and changes in species' composition

✓ **Commercially important fish species** likely to be affected as temperature critical for their physiology

Gupta et al. (2017). Climate change and human-wildlife conflicts in the Indian Himalayan biodiversity hotspot. *Current Science,* 113(5): 846-847

Gupta, et al. (2017). Climate change and species distribution in the Indian Himalayan biodiversity hotspot. *NeBIO,* 8(1): 1-5

Identifying opportunities

- ✓ Strengthen climate vulnerability studies of forests and species
- ✓ Support the closure of forest areas, and promote sustainable fishing
- ✓Develop nurseries for commercial plants, (e.g. bamboo, indigenous fruits, medicinal)

Water resource management challenges

- **Increasing temperature – diminished adaptation, increased vulnerability**

✓ **Water bodies** likely to evaporate more quickly, and greater water requirements for crops

✓ Likely **increase in forest fires**

✓ **Decrease in yields of winter crops**

✓ **Heat stress**, and **transmission window** for vector-borne diseases open for longer periods

Identifying opportunities

- ✓ Assess water demand, and identification of ‘hot zones’ for forest fires
- ✓ Sustainable use of available water
- ✓ Research and development of temperature-tolerant crop varieties
- ✓ Intercropping farming matching seasonal water availability

Water resource management challenges

- **Warming climate, melting glaciers**

✓ **More glacial lakes** with the potential of generating dangerous outbursts of floods (GLOFs)

✓ **Glacial melt** likely to lead to increased summer flows in some rivers

Identifying opportunities

Source: http://icestupa.org/gallery

- ✓ **Drain dangerous glacial lakes** (Imja Lake, Nepal)
- ✓ **Water storage techniques** at high altitudes (Ice Stupa, Ladakh, India)

Need of the hour

- **Mainstreaming climate concerns** in cross-sectoral planning
- **Teamwork among neighbours** to address adaptation

  ✓ Specific knowledge network
  ✓ Decentralized/and coordinated approach for capacity building
  ✓ Joint adaptation projects formulation and implementation
  ✓ High-level coordination mechanism
  ✓ Creation of an adaptation portal

Gupta et al. (In Press). Inter-State cooperation to address climate change adaptation in the Indian Himalayan region – need of the hour. *Economic and Political Weekly*


Thank you!