

Himalayan glaciers, changing surface water regimes and groundwater resources: connecting the dots

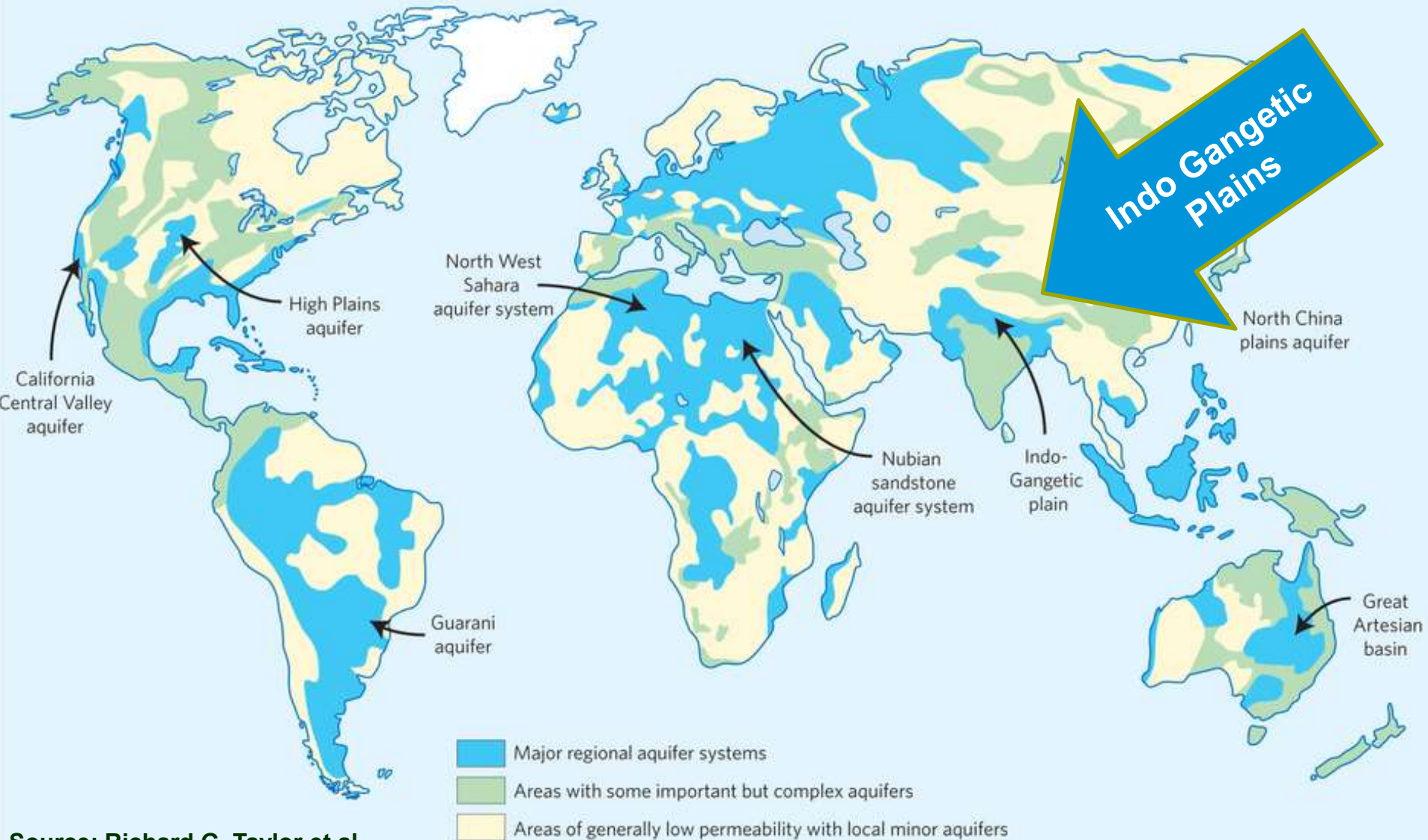
Anjal Prakash &
Arun B Shrestha

Paper presented at
Workshop on regulation and management of groundwater in the
age of climate change: need for legal reforms in India

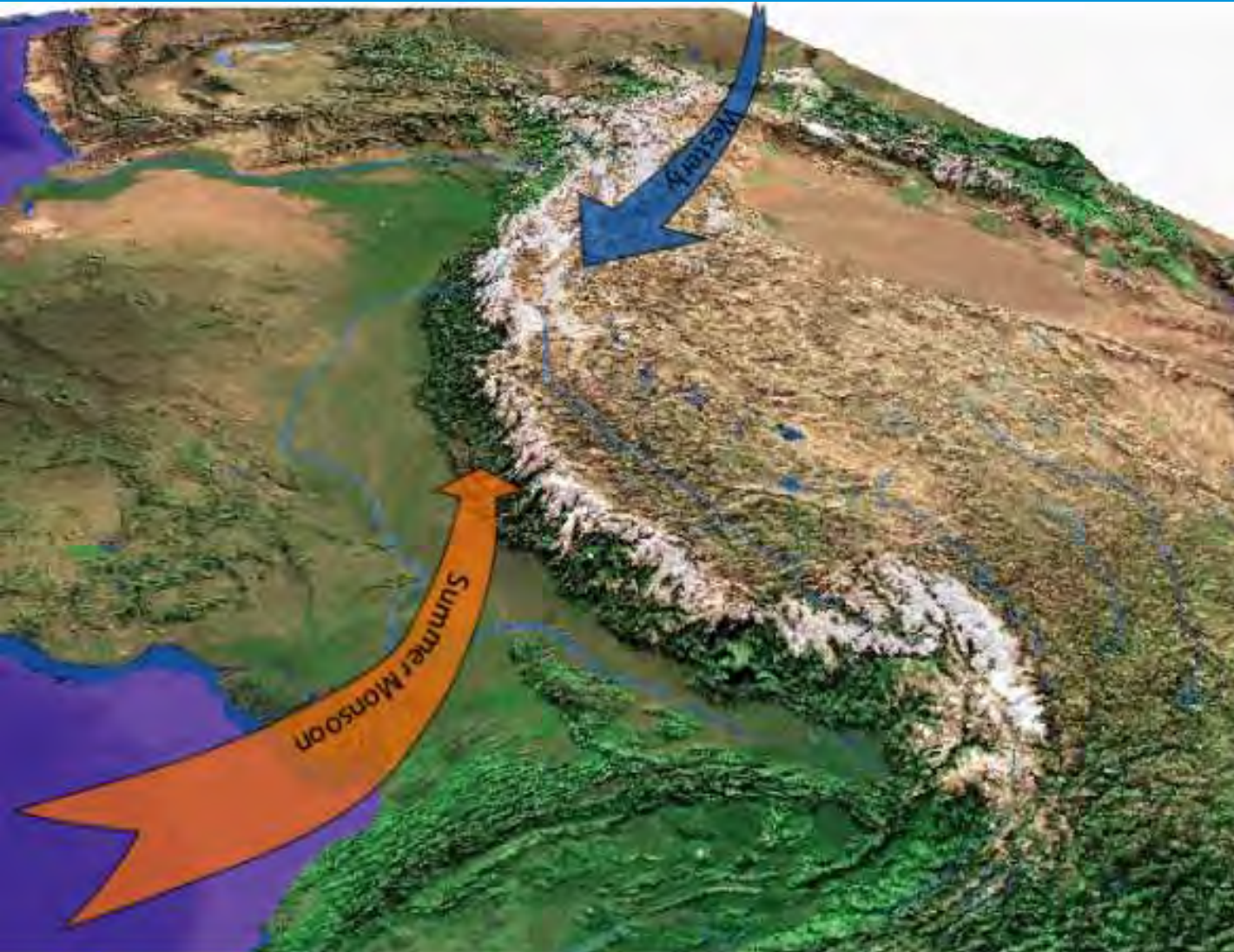
APRIL 10, 2015



Global groundwater resources map: locations of regional aquifers systems



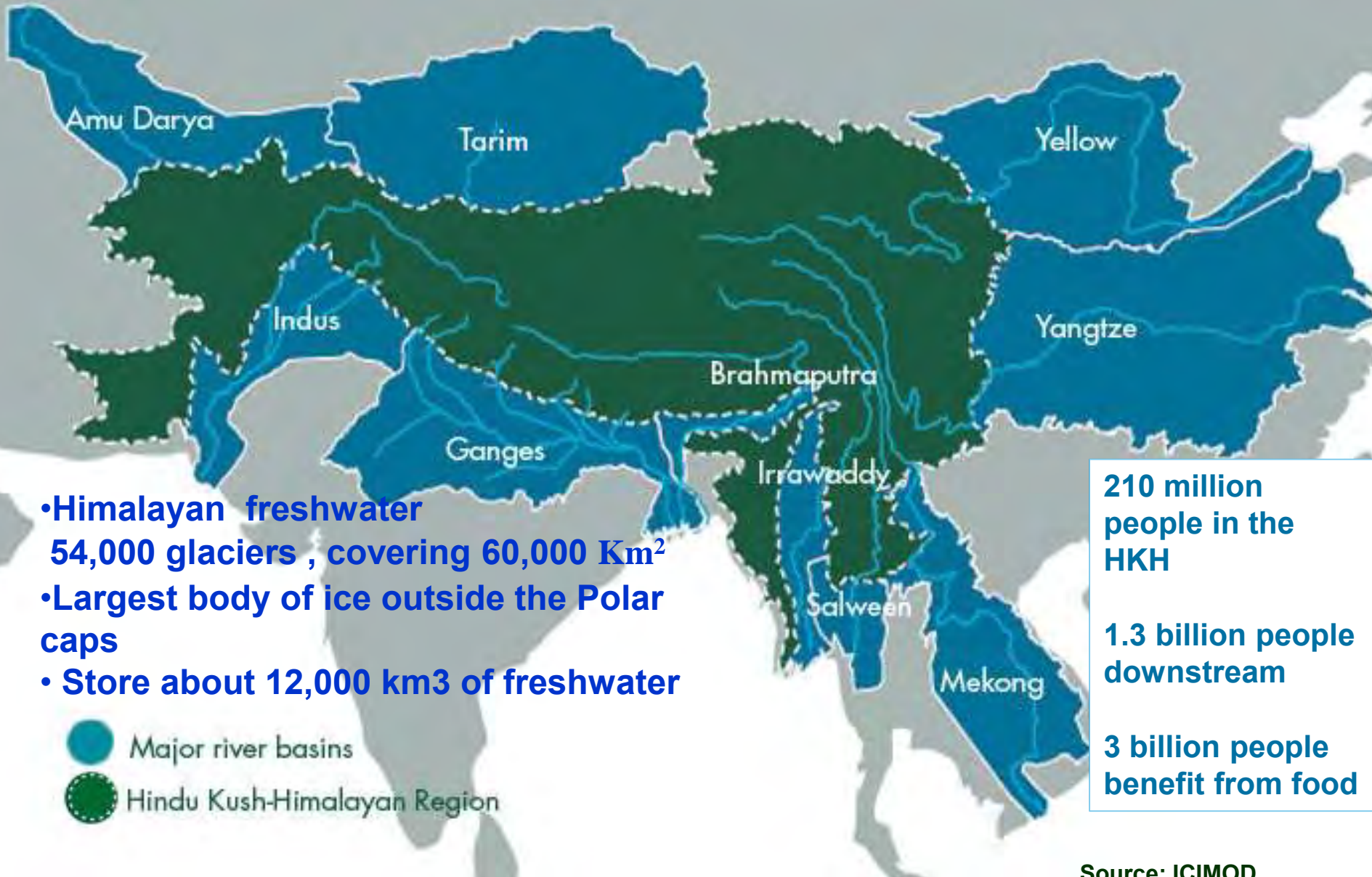
The Hindu Kush Himalayan Region “water tower”



Source: ICIMOD

Largest reserve of snow and ice outside the polar regions

HKH - Source of Ten Major River Basins Upstream Downstream Relationships



- Himalayan freshwater
54,000 glaciers , covering 60,000 Km²
- Largest body of ice outside the Polar caps
- Store about 12,000 km³ of freshwater

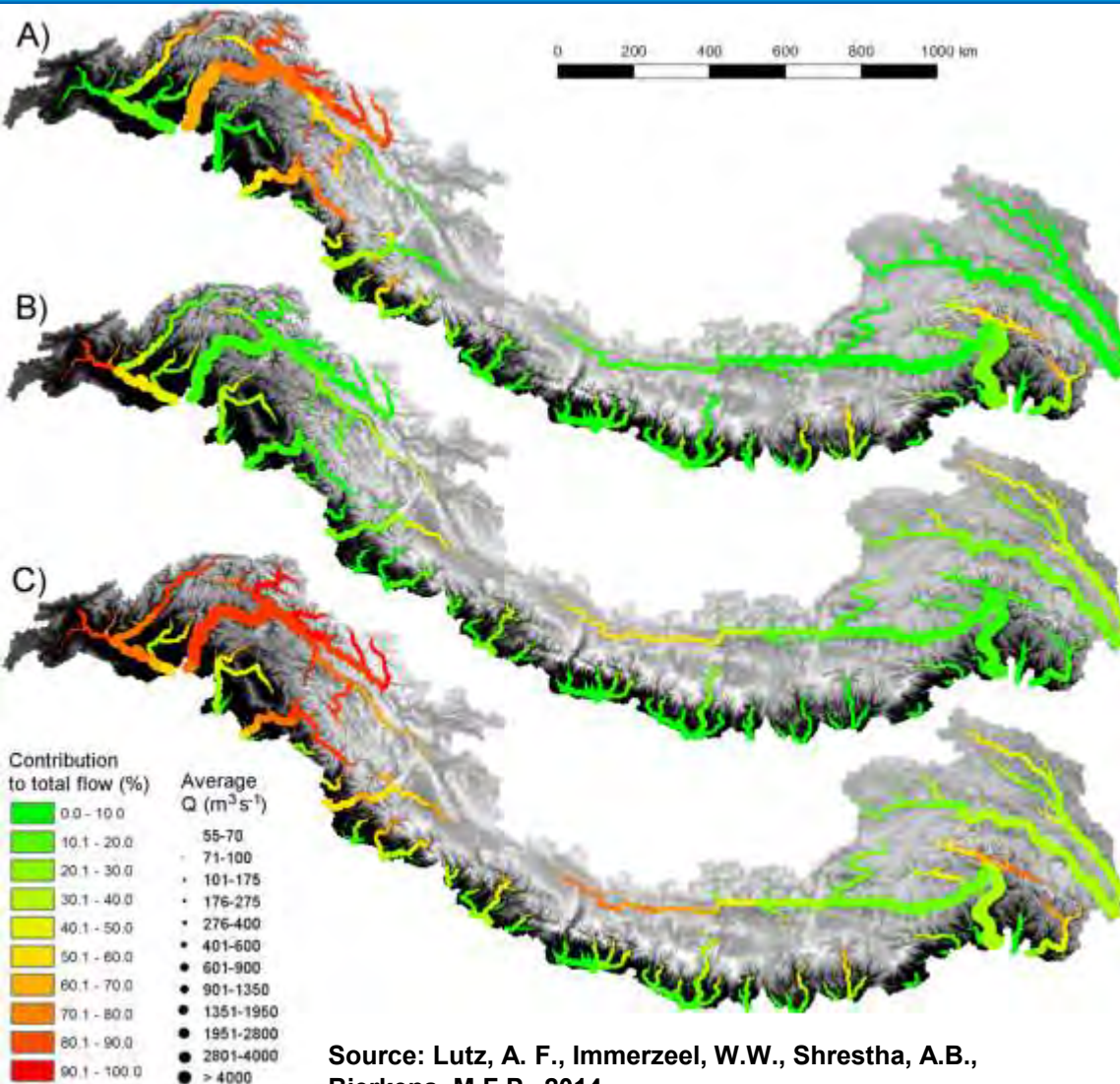
- Major river basins
- Hindu Kush-Himalayan Region

210 million
people in the
HKH

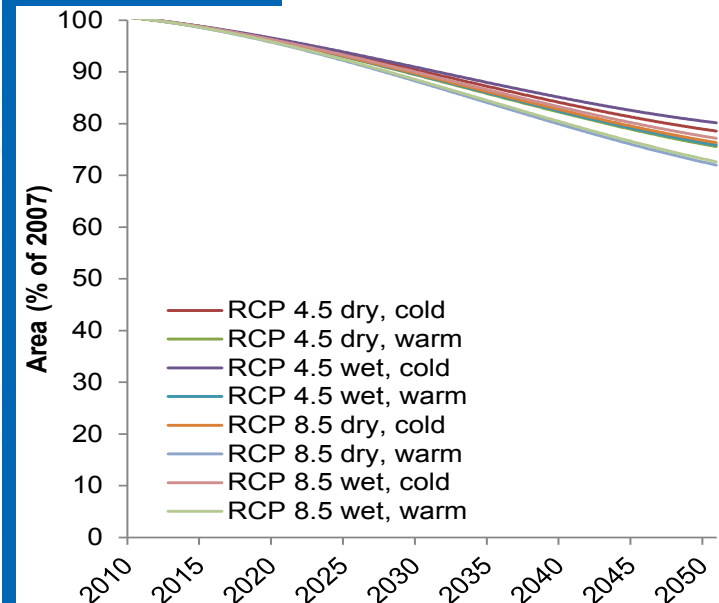
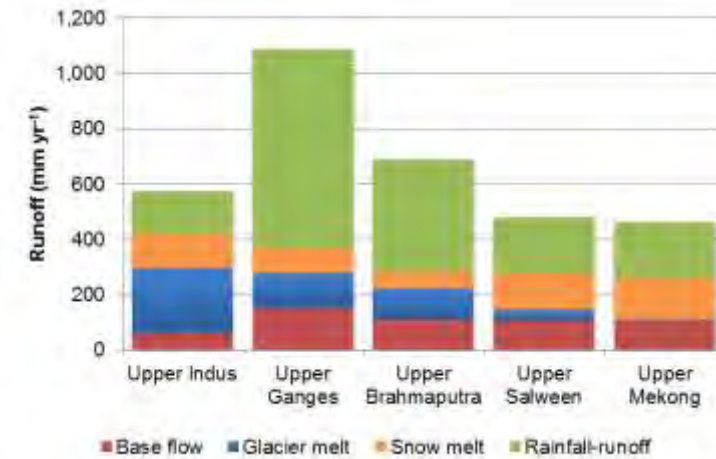
1.3 billion people
downstream

3 billion people
benefit from food

Glacier melt's contribution to stream flow



Source: Lutz, A. F., Immerzeel, W.W., Shrestha, A.B., Bierkens, M.F.P., 2014



2009



Photography: David Breashears, GlacierWorks

Source: ICIMOD

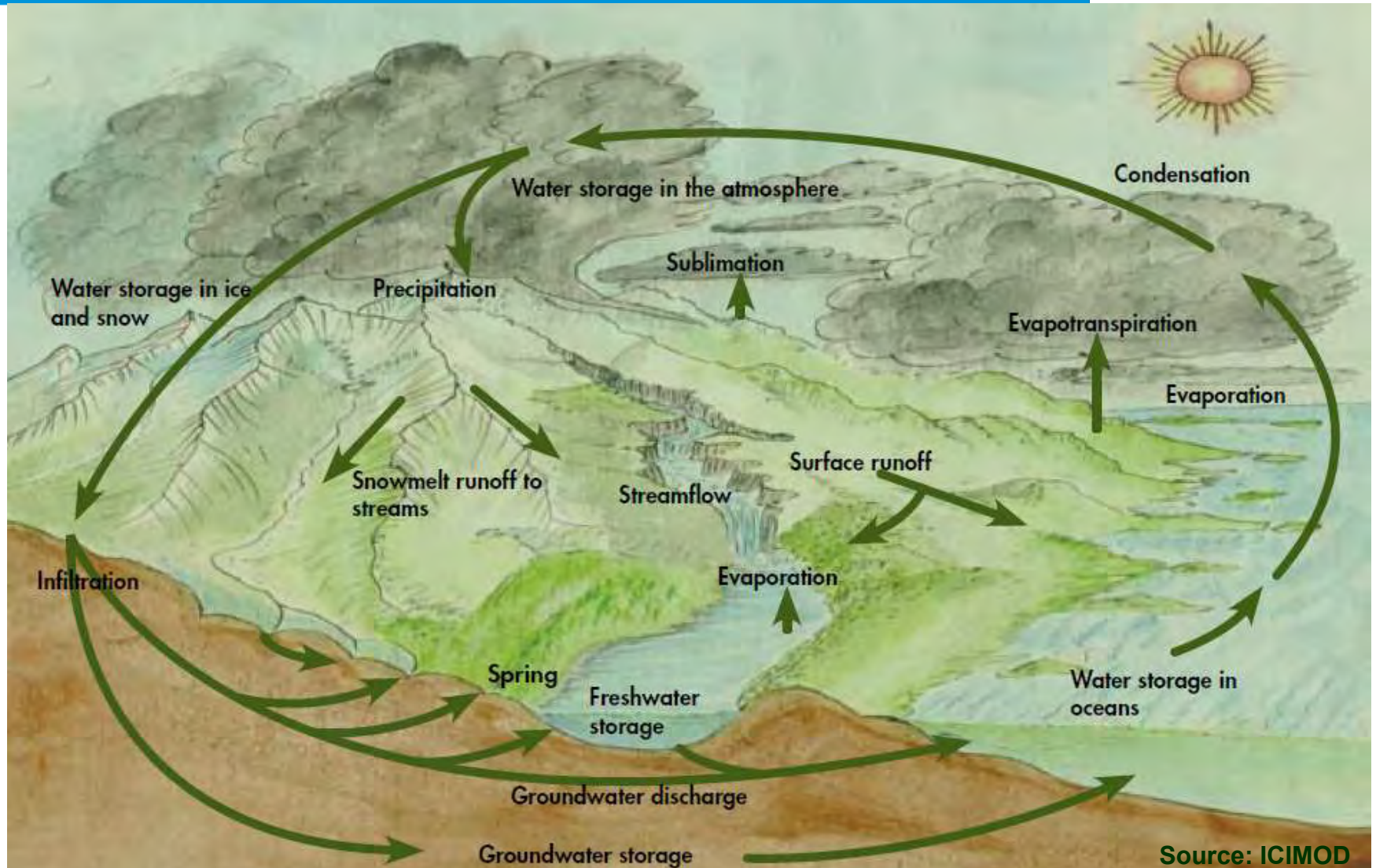
Retreating glaciers



2008

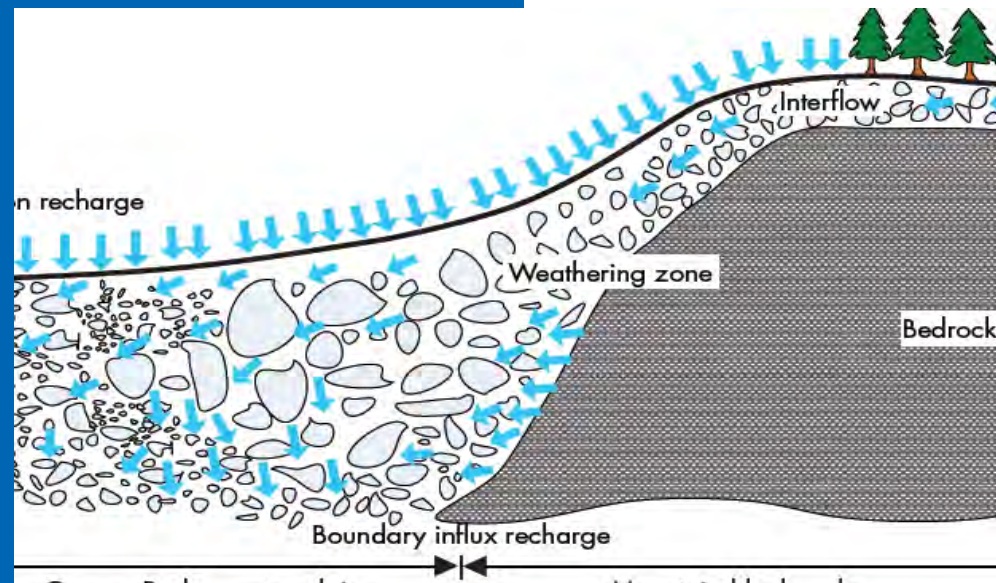
Photography: David Breashears, GlacierWorks

Surface-groundwater interrelations in Himalayas



Ground water recharge from surface water

- Himalayan watersheds are natural storage of water
- Himalayas influences the ground water condition of IGBP - Recharge deep aquifers
- IGBP is rich in ground water – replenish by rainfall, snow & ice melting & seepage from Himalayan watershed



Supports Extensive Irrigation Systems

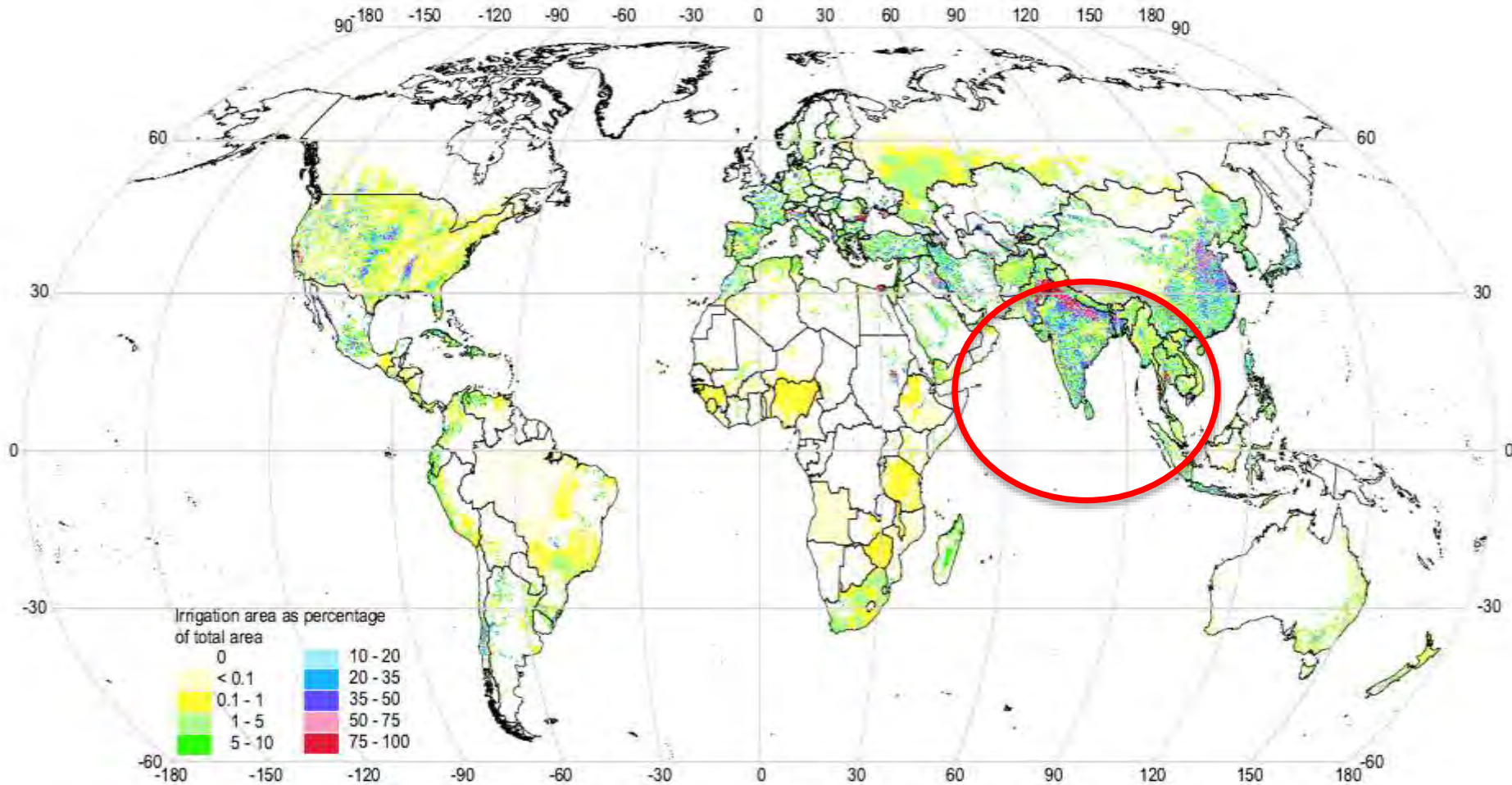
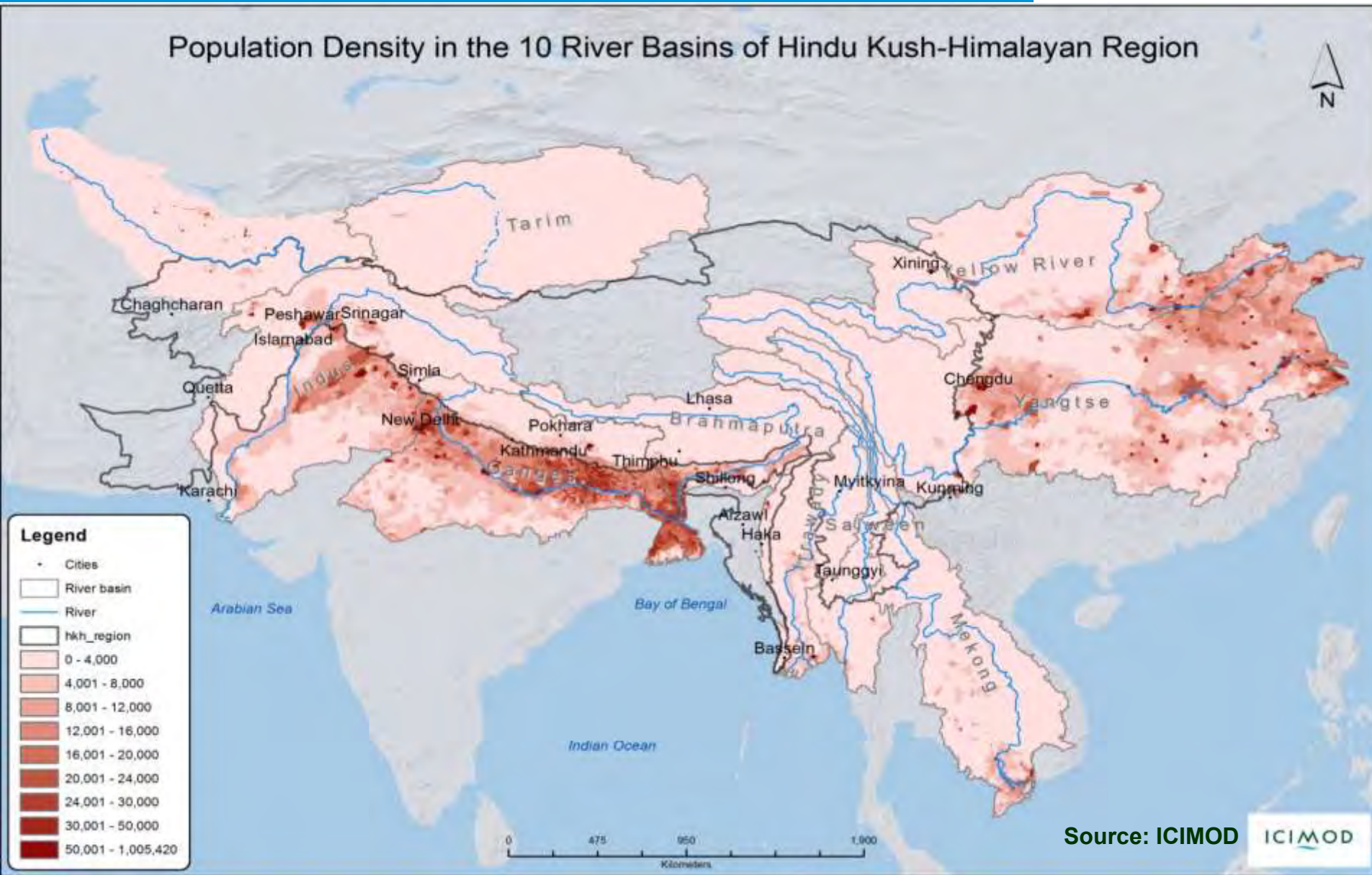


Fig. 3. Global Map of Irrigation Areas Version 3: Percentage of 5-min grid cell area that was equipped for irrigation around the year 2000 (Robinson projection).

Basins Support Some of the Most Populated Areas on the Globe

Population Density in the 10 River Basins of Hindu Kush-Himalayan Region



Connecting the dots..

- Water flow within the Himalayas - surface phenomenon that contributes to recharge of groundwater
- Water that falls on the Himalayas is temporarily stored in different types of reservoirs before being discharged into rivers - soils, snow, glaciers and groundwater.
- Groundwater storage within catchments forms an important component of the Himalayan water budget (Andermann et al., 2012)
- Receding glaciers has an impact on the rates of groundwater recharge in some areas
- Groundwater storage in a fractured basement influences the Himalayan river discharge cycle- its decline is affecting the springs on which most of the mid hills survive.

Difference of perspective..

Glaciers

Rivers

Snow

(Lowland perspective)

Lakes

Streams

Springs

(Mountain perspective)

Major issues from mountain perspective

- Springshed management for better groundwater recharge for the hill communities
- Reviving lakes to function as recharge structures
- Enhance water storage infrastructure

5 major concerns

- 1. Lack of coherent perspectives and regional cooperation**
- 2. Lack understanding of the interrelations between surface and groundwater**
- 3. Lack of coordinated, comprehensive research – data deficiency**
- 4. Lack of recognitions of the contribution of HKH region**
- 5. Lack of planning for restoration of springsheds**

Acknowledgement

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Thank you



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Photography: David Braashears, GlacierWorks