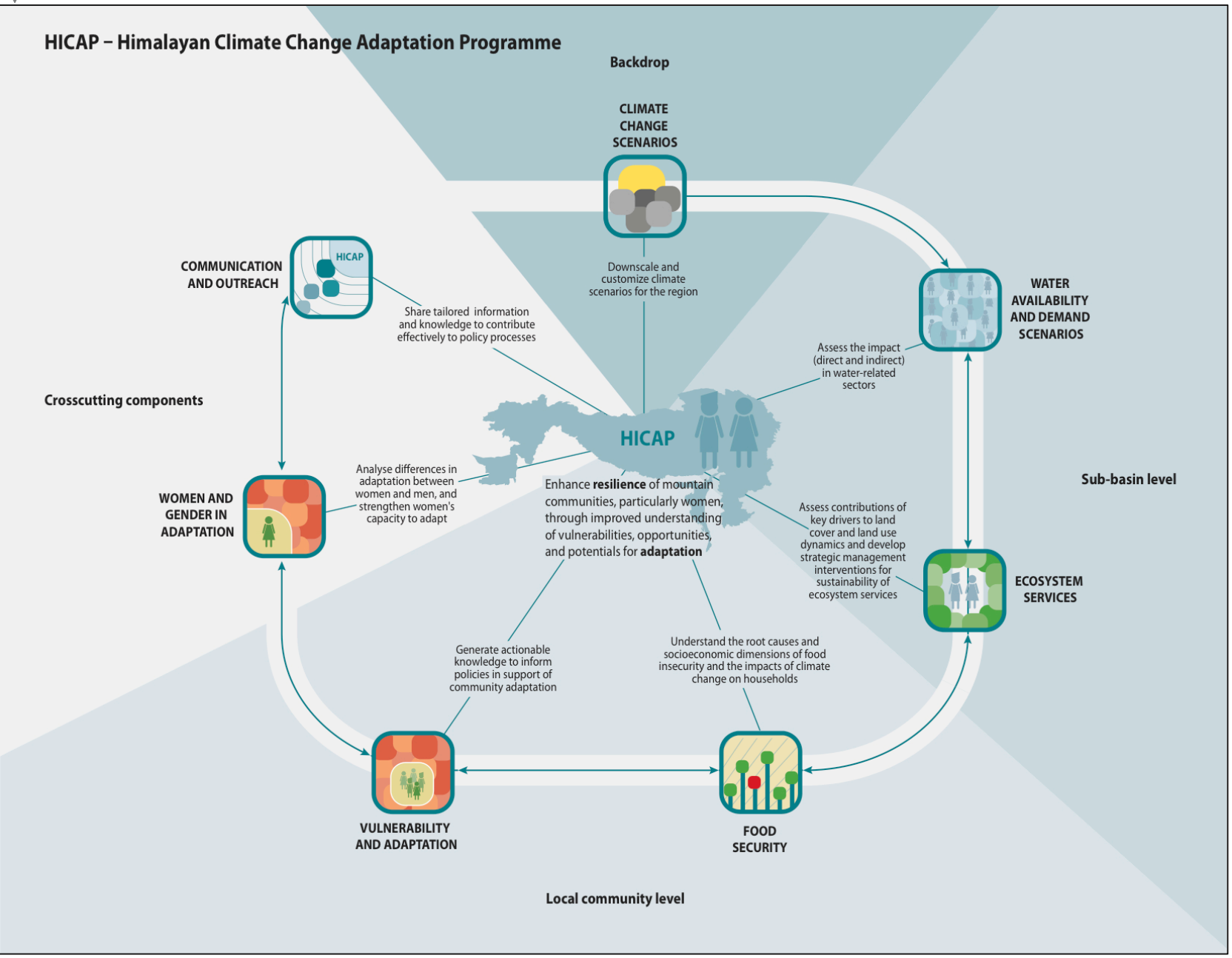
HICAP

Himalayan Climate Change Adaptation Programme

- Water atlas, local downscaling, and some other findings-

NVE, INDICE workshop, Tuesday 24. May 2016

Bob van Oort, CICERO



Funding: MFA Norway, SIDA
Period: 2012-2017

ICIMOD (coordinator)
CICERO, GRID-Arendal

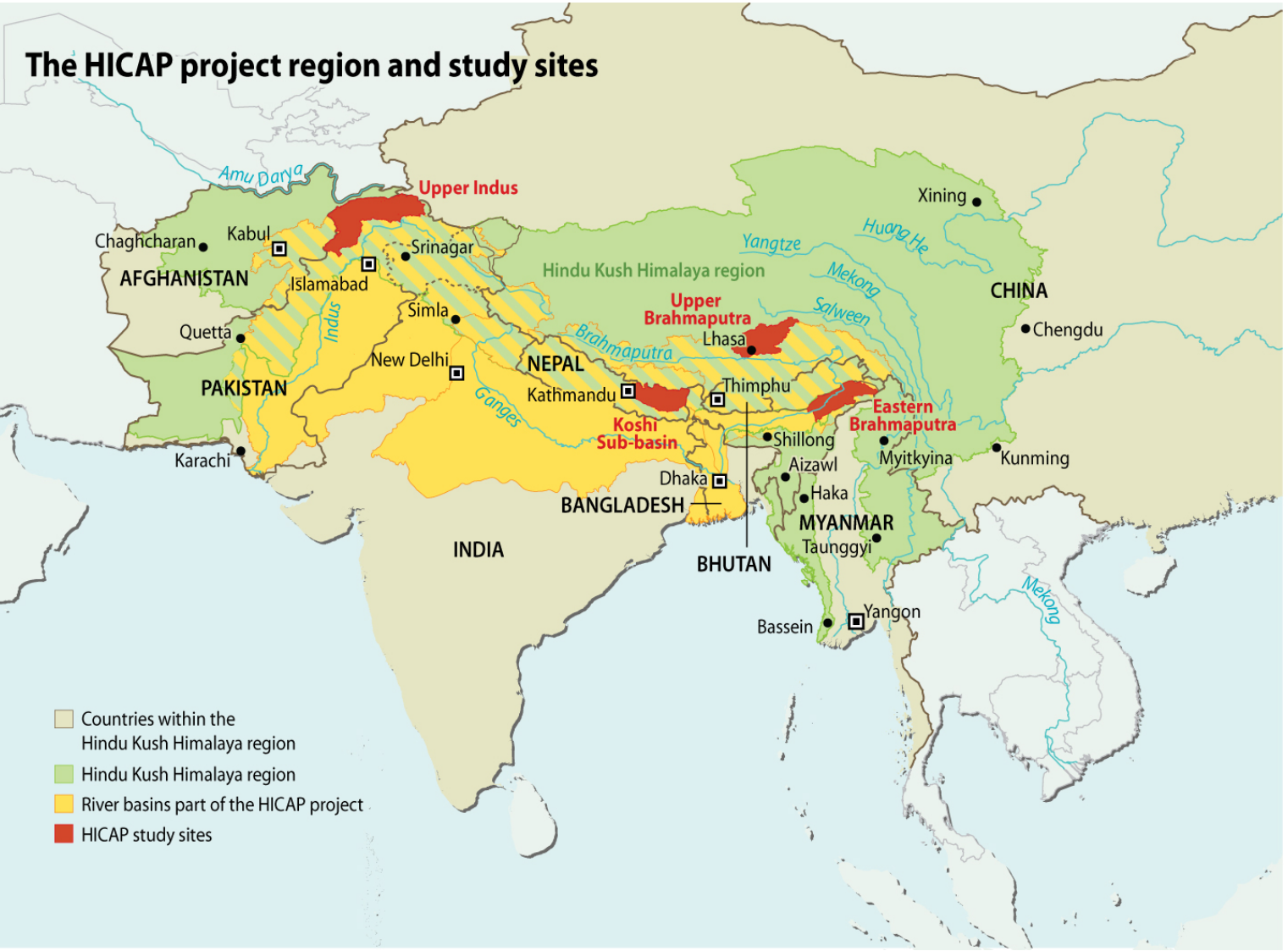
+ 25 local partners

Bjerknes Centre for Climate Research (BCCR), Norway
FutureWater, the Netherlands

Different levels (regional-basin-local, decisionmakers, agriculture, river-near communicties)

Different scales (temporal, spatial)

WP targeted, and WP integrated approaches

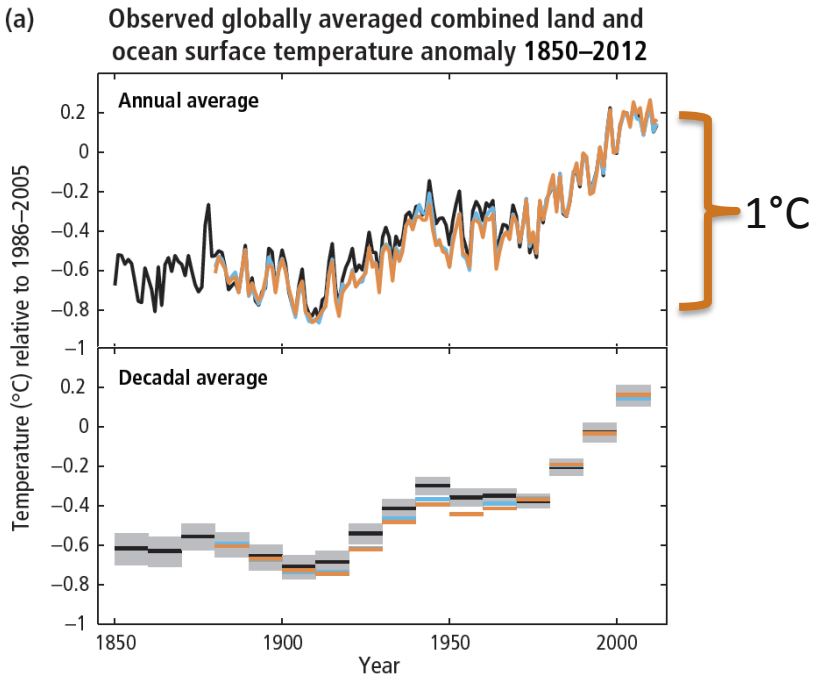


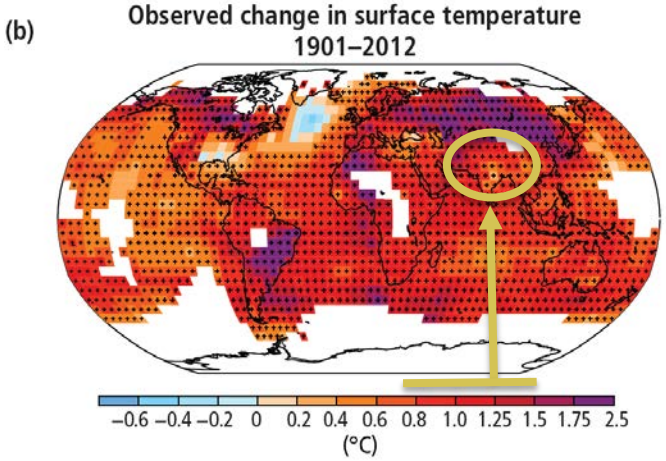
Hindu Kush Himalayas

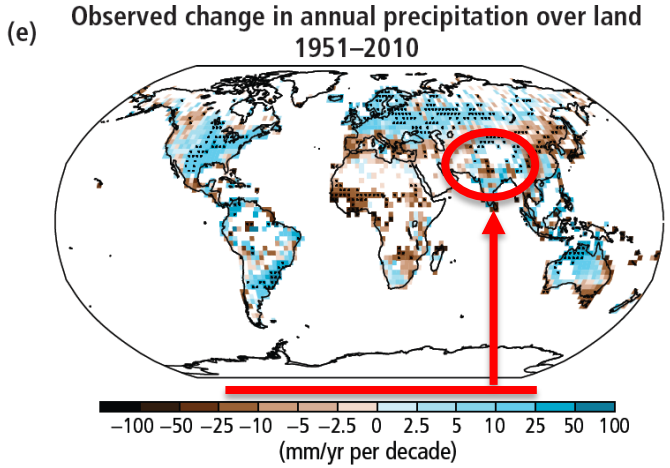
- More than 210 million people
- Rapid socioeconomic, political, cultural, demographic, environmental, and climatic changes
- High poverty and inequality rates
- Marked by rich historical, cultural and religious diversity
- Multiple gender regimes

- Insufficient scientific data & lack of cohesive information

What do we know from global-regional climate trends?







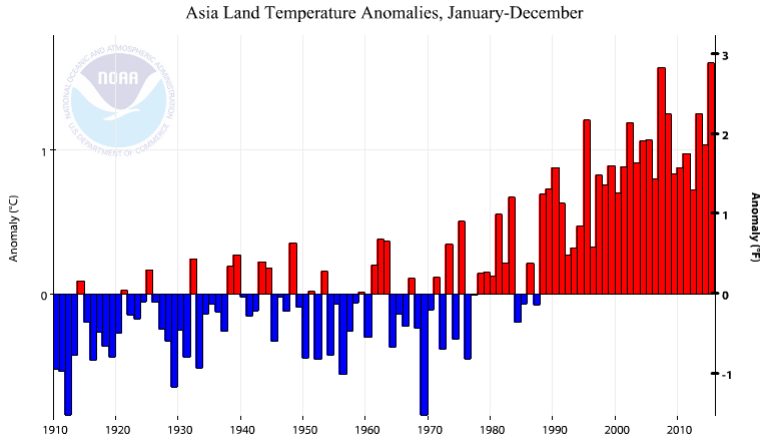
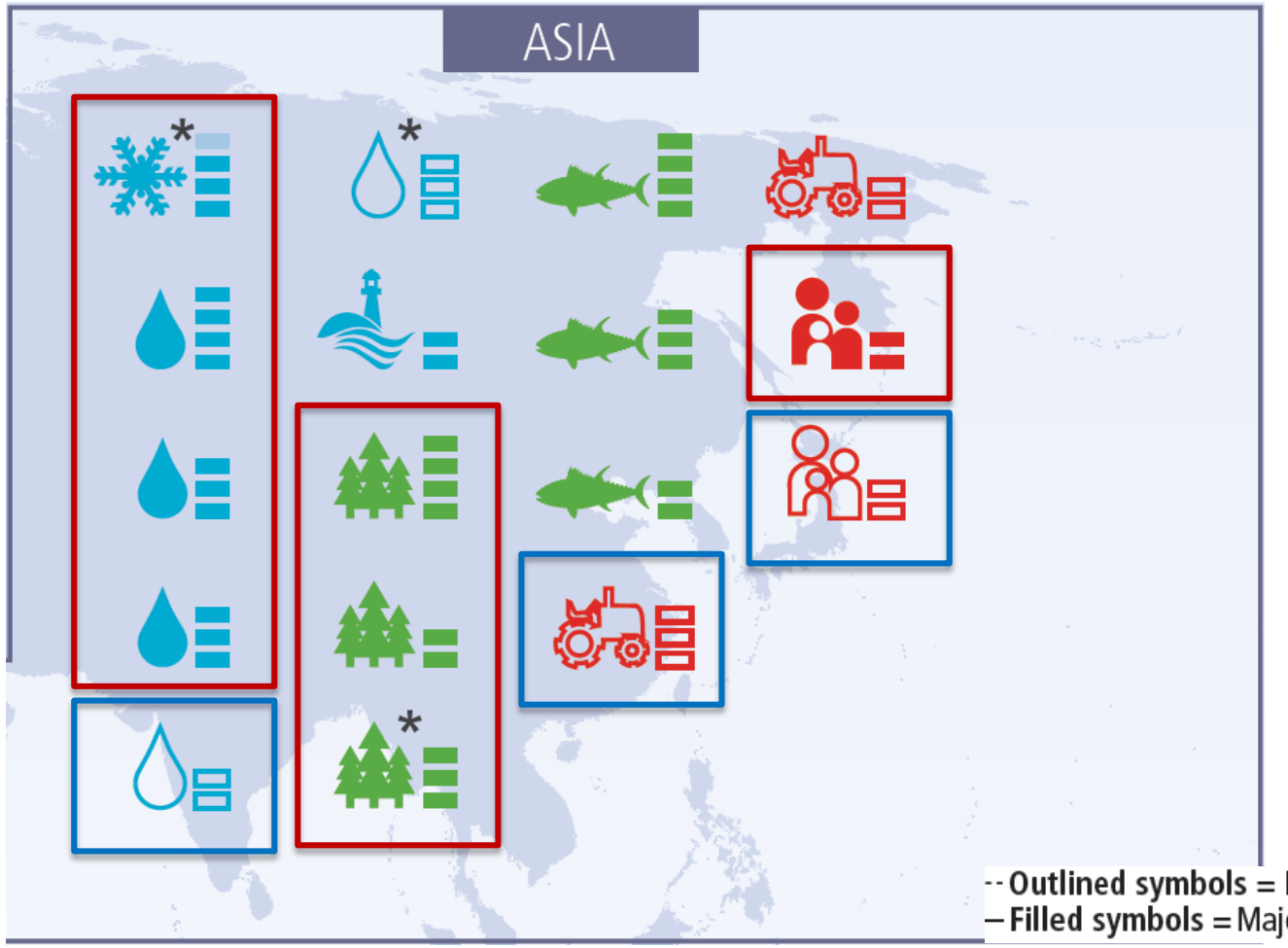


Figure sources: IPCC (2014) Climate Change 2014 – Synthesis Report and NOAA (http://www.ncdc.noaa.gov)

Regional impacts – Climate attribution



Physical systems

- Glaciers, snow, ice and/or permafrost
- Rivers, lakes, floods and/or drought
- Coastal erosion and/or sea level effects

Biological systems

- Terrestrial ecosystems
- Wildfire
- Marine ecosystems

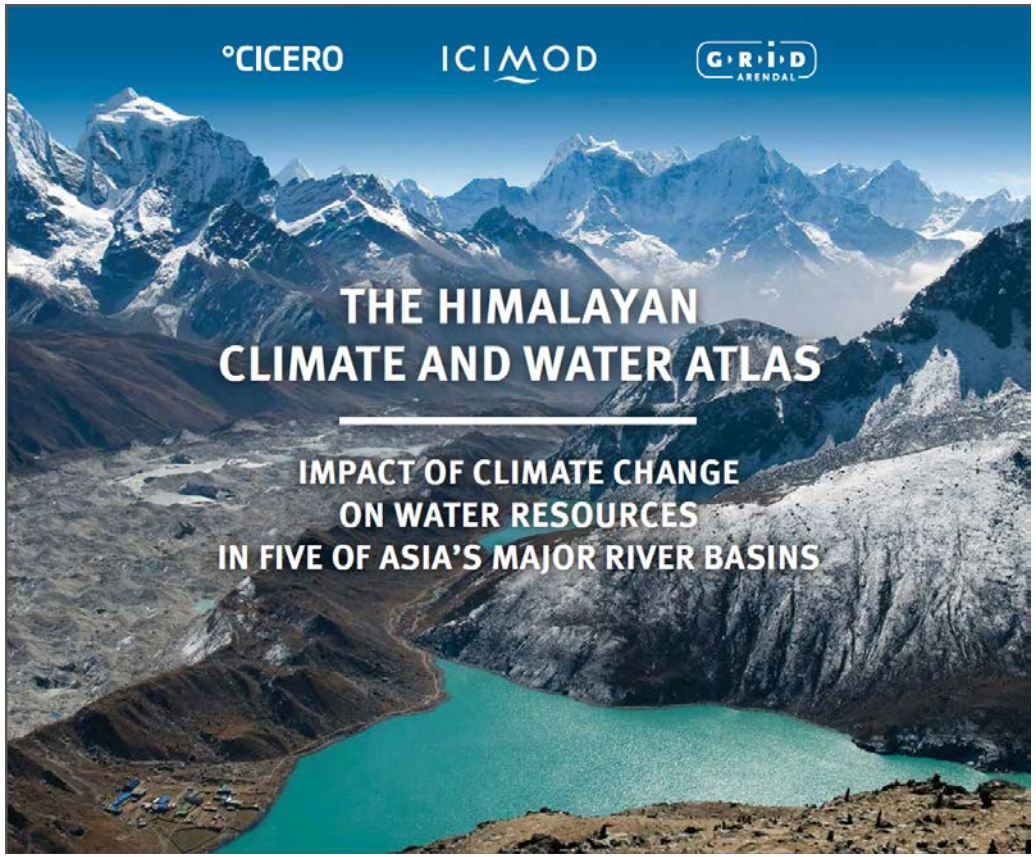
Human and managed systems

- Food production
- Livelihoods, health and/or economics

-- **Outlined symbols** = Minor contribution of climate change
– **Filled symbols** = Major contribution of climate change

Source: IPCC (2014) Climate Change 2014 – Synthesis report. Summary for policymakers.

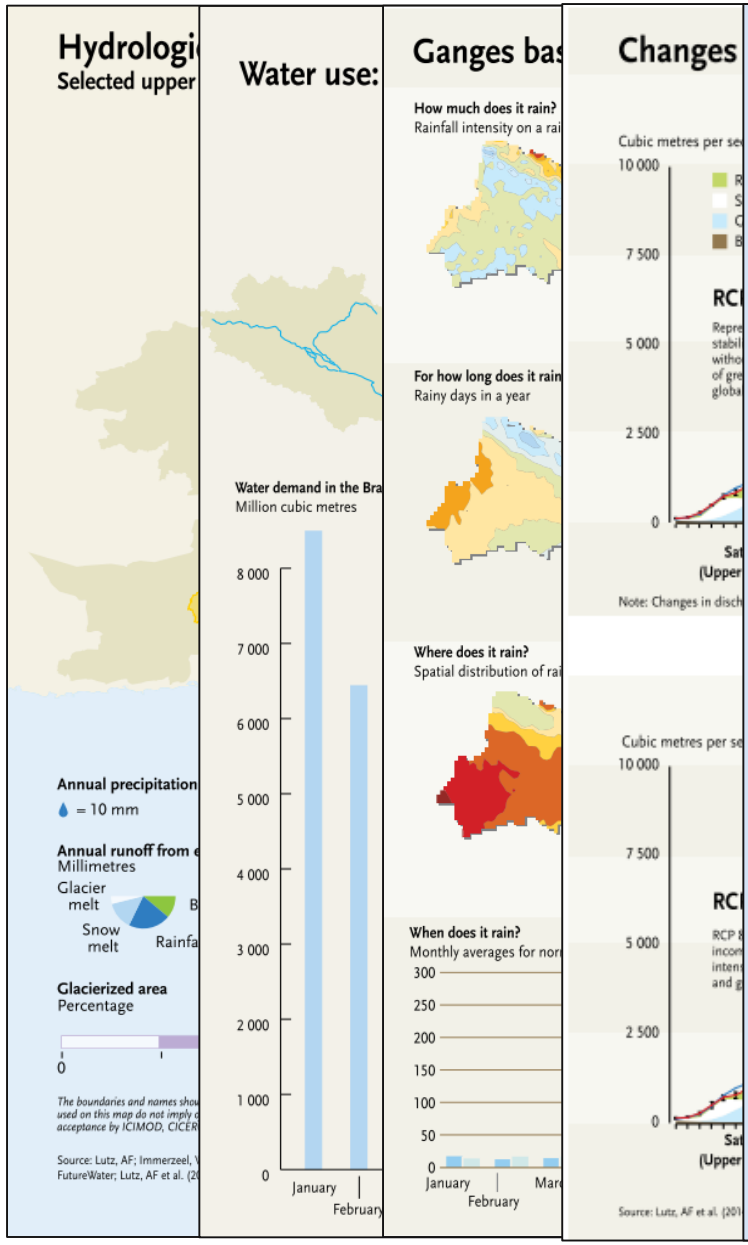
HICAP Climate and Water Atlas



- Accessible via http://www.icimod.org/?q=20533

- 5 Major river basins (Brahmaputra, Ganges, Indus, Mekong, Salween)
- Snow and glacier melt, River discharge, Temperatures (Tmin/max), socio-economic indicators related to water
- Local trends, vulnerabilities and adaptations for past, present and future
- Seasonal to monthly analysis scale

- Himalaya Spatial Processes in Hydrology model (HI-SPHY) - a raster based highly detailed full distributed cryospheric- hydrological model, 1 x 1 km spatial resolution with daily time steps



Water stories

Winter water scarcity in Nepal

Nina Bergan Holmelin, CICERO, Norway

Access to sufficient amounts of water at the right time is of crucial importance for agricultural production. In Dolakha, a mountain district of Nepal, great seasonal variations in rainfall are challenging cultivation, as there as both too much and too little water available for cultivation. During the summer monsoon season there is plenty of water available for irrigated rice cultivation and rainfed maize, millet, potatoes and vegetables. However, the average landholdings are too small to feed the average family throughout the year. Most families in the area are only self-sufficient in food from own production for six months of the year.

In recent years, farmers have started to cultivate winter season vegetables for sale at local and national markets. While most of the fields are planted with winter wheat, the option to cultivate winter vegetables offers a chance to earn additional income during the lean winter season. Cauliflower, soybeans, sugar snaps, radishes, garlic and chilli serve a double purpose as food and cash crops. However, water scarcity in winter creates a problem. Only 2% of the annual precipitation falls from December to February.

People have now begun to take small loans to invest in small water tanks and plastic pipes. Using this simple technology they can irrigate their orchards in the driest period. Said a woman cultivating her plots in the downhill slope:

The water dries up in the winter. But we have built a water tank now, of 7,000 litres. It is enough for two households – for us and our neighbour. We invested and built it together two years ago. It was expensive, but now we have enough water for winter vegetables. The tank recharges from a larger well uphill.

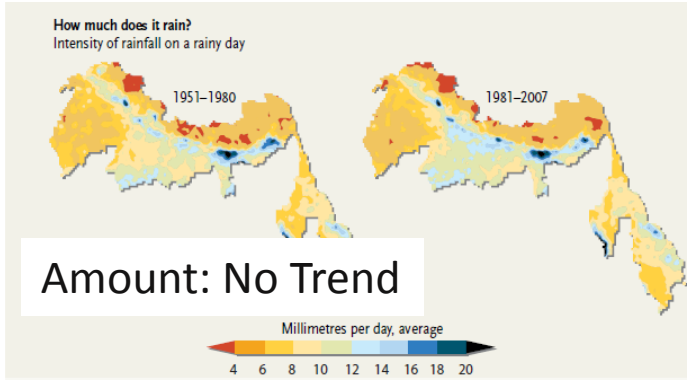
Not everyone lives downstream from a permanent water source. For those who live and cultivate higher up on the ridge, the rainfall is erratic and the wells are small. According to a female farmer:

There is a creek, but no water in it. We could grow vegetables in the winter, if there was more water – cauliflower, soybeans, peas and radishes.

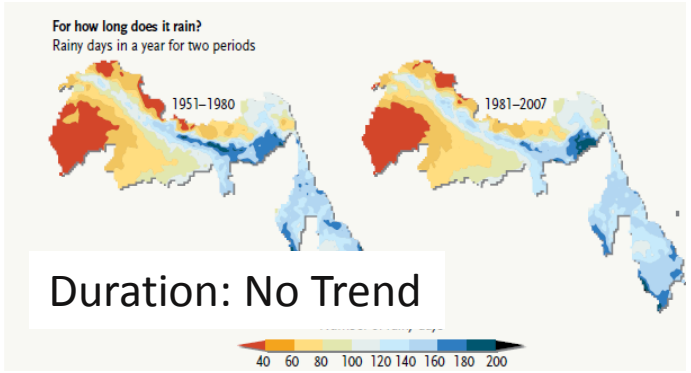
Climate change is expected to increase the average temperatures in Dolakha, especially during night-time, which would improve the conditions for cultivation in the cold season. However, warmer weather is insufficient for cultivation if not accompanied by sufficient water. Water harvesting by means of tanks and pipes can be sufficient to meet the dry season need for water for those who have access to a well. However, the diverse geography of the Himalayas make no single solution universially applicable. The vast differences in micro-climates at the local level call for a diversity of adaptation options, as rich as the diversity of the mountains themselves.

Past to present:

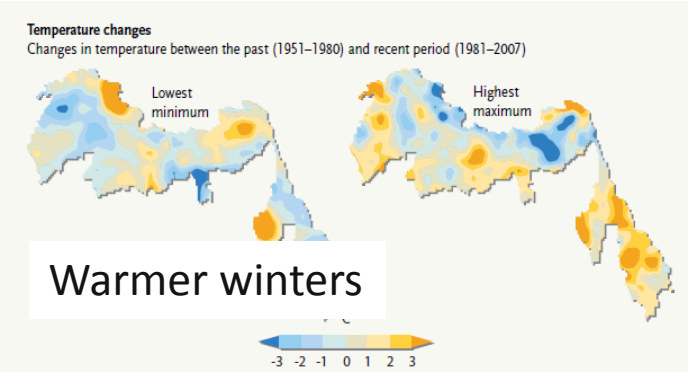
1951-1980 to 1981-2007



Amount: No Trend



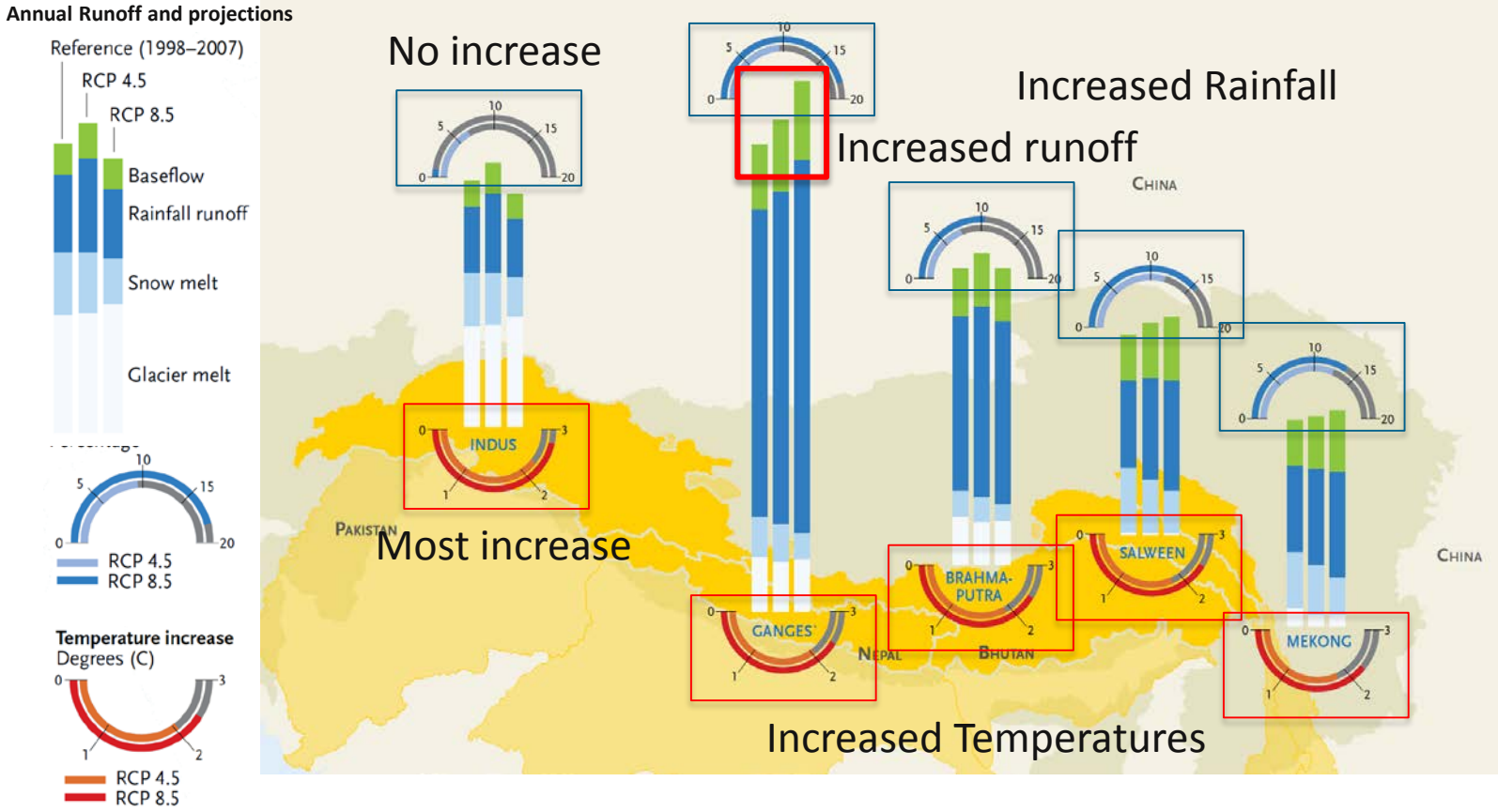
Duration: No Trend



Warmer winters

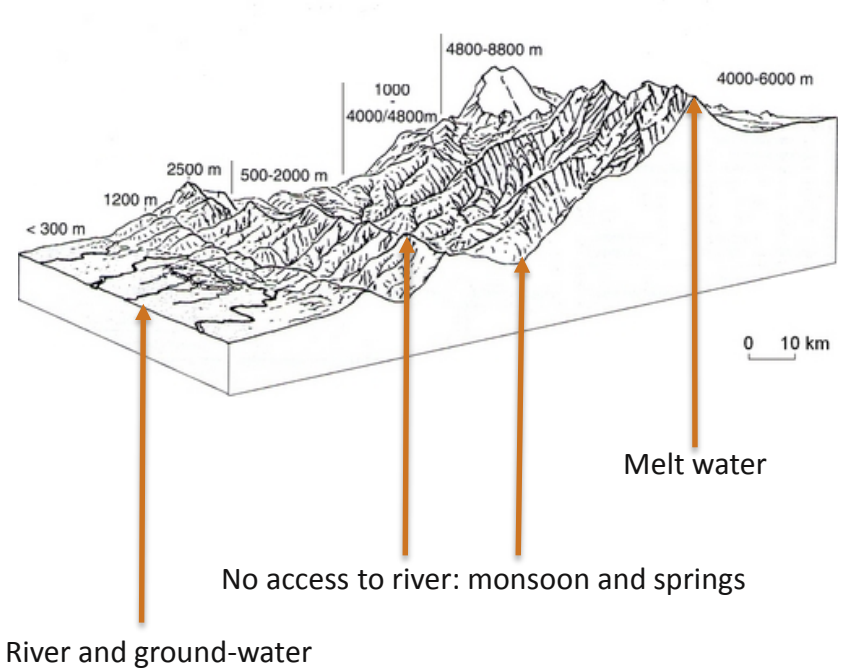
Future trend:

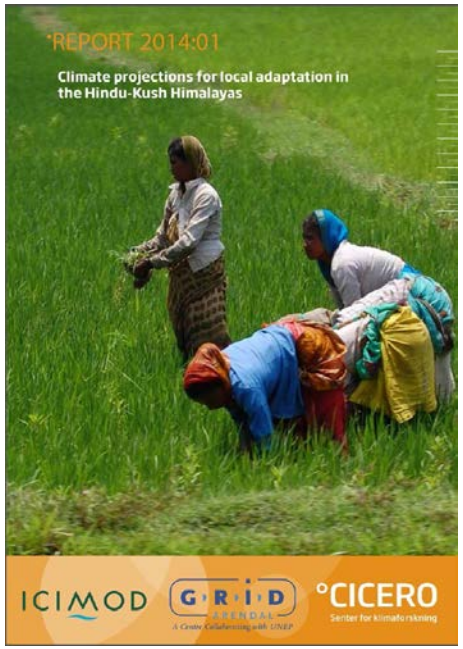
2041-2050, RCP4.5 and 8.5



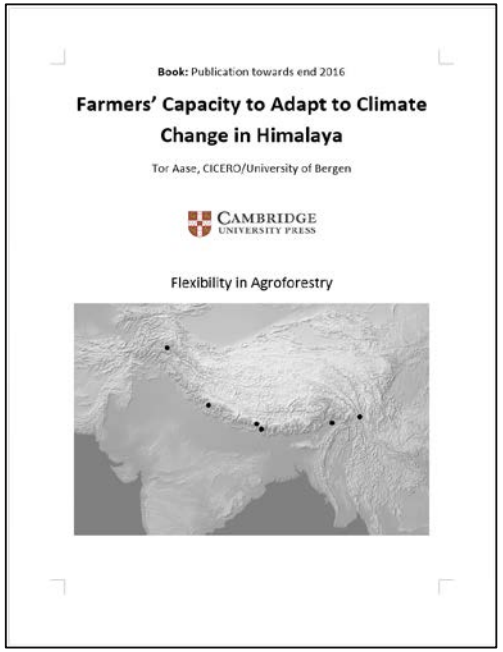
Large local differences demand local approaches

Often great diversity in one analysis domain:





CICERO report 2014:01



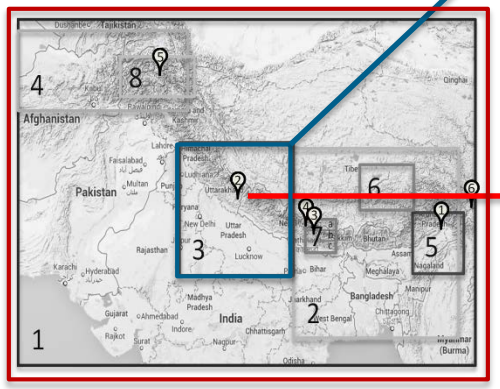
Book: forthcoming

Local climate trends

WRF model (12km x 12km) driven by the NorESM GCM model

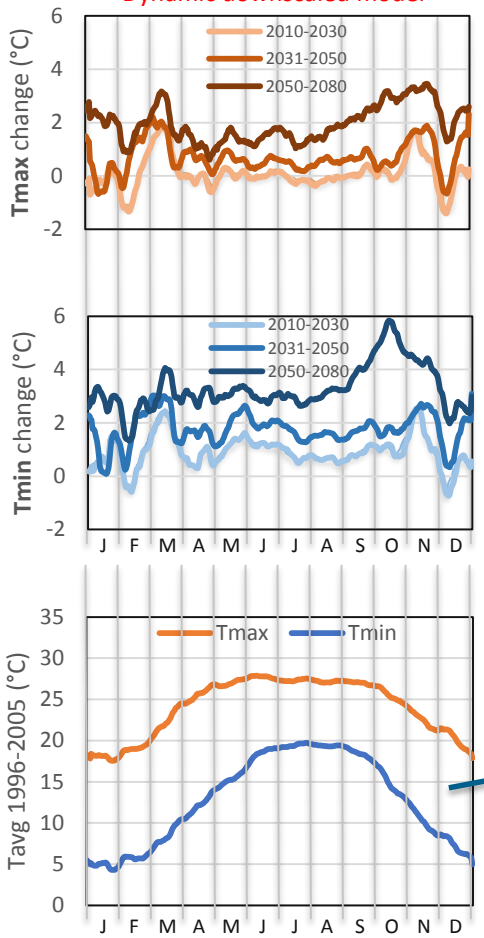
Dynamically downscaled

8 domains



2 Projected change

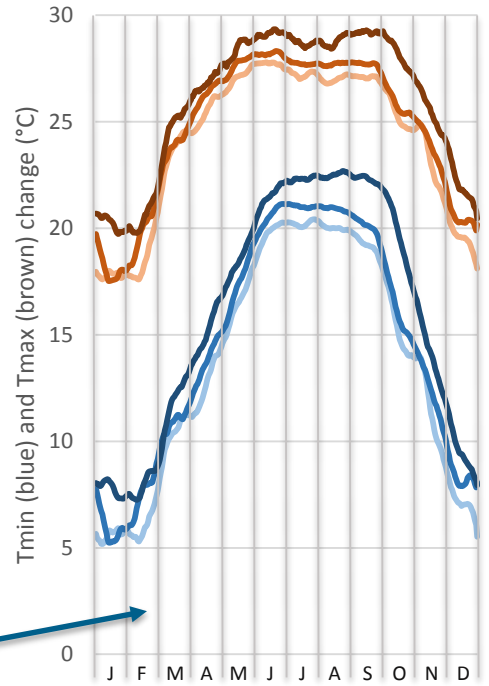
Dynamic downscaled model



1 Current climate

Local relevant conditions

3 Local climate change



Assumption: Local trends follow domain changes

Advantages:
Increased local relevance,
Shows timing, more realistic amount and duration of rainfall, extremes, growing season, and variation, and helps identify new **risks and opportunities**

Some trends:
Nighttime temperature increase
Especially winters warmer
Higher areas warmer

More intense monsoon in east
Mid and west increased winter precipitation

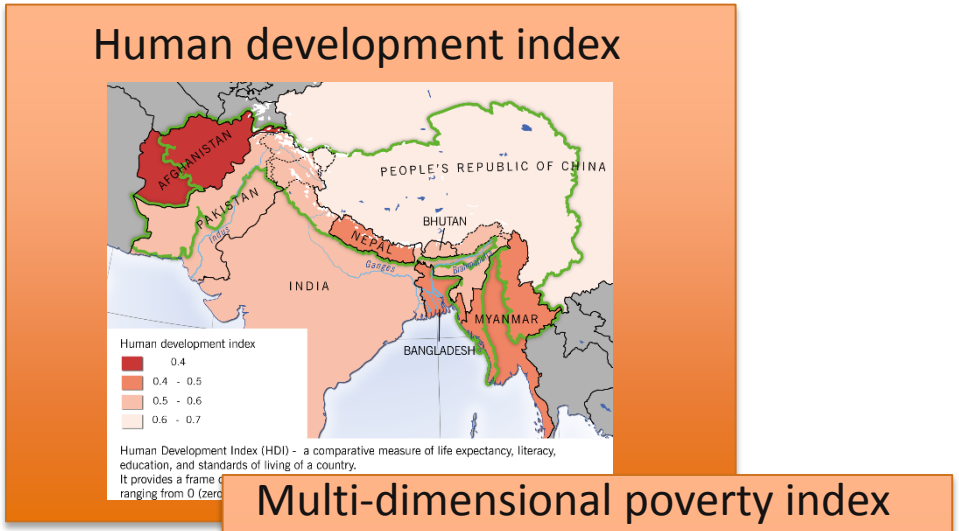
projections are NOT predictions!

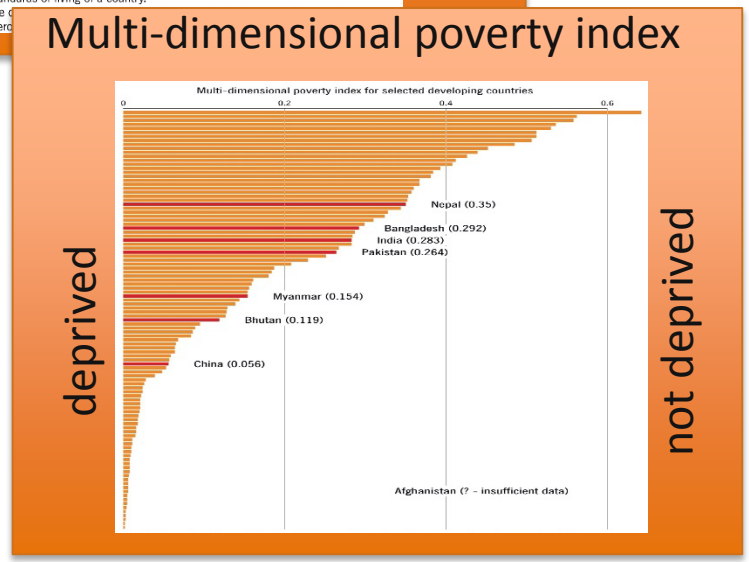
Climate/Hydrology atlas conclusions

- **Temperatures** across the mountainous Hindu Kush Himalayan region will **increase** by about 1–2°C (in some places by up to 4–5°C) by 2050.
- Precipitation will change with **monsoon expected to become longer and more erratic**.
- **Extreme rainfall** events are becoming **less frequent**, but will likely **increase in intensity**.
- **Glaciers** will continue to suffer substantial ice loss, with the **main loss in the Indus basin**.
- Despite overall greater river flow projected, **higher variability in river flows and more water in pre-monsoon months** are expected, which will lead to a **higher incidence** of **unexpected floods and droughts**.

- Changes in temperature and precipitation will have serious and far-reaching consequences for climate-dependent sectors, such as agriculture, water resources and health.

Impacts depend on more than climate change …



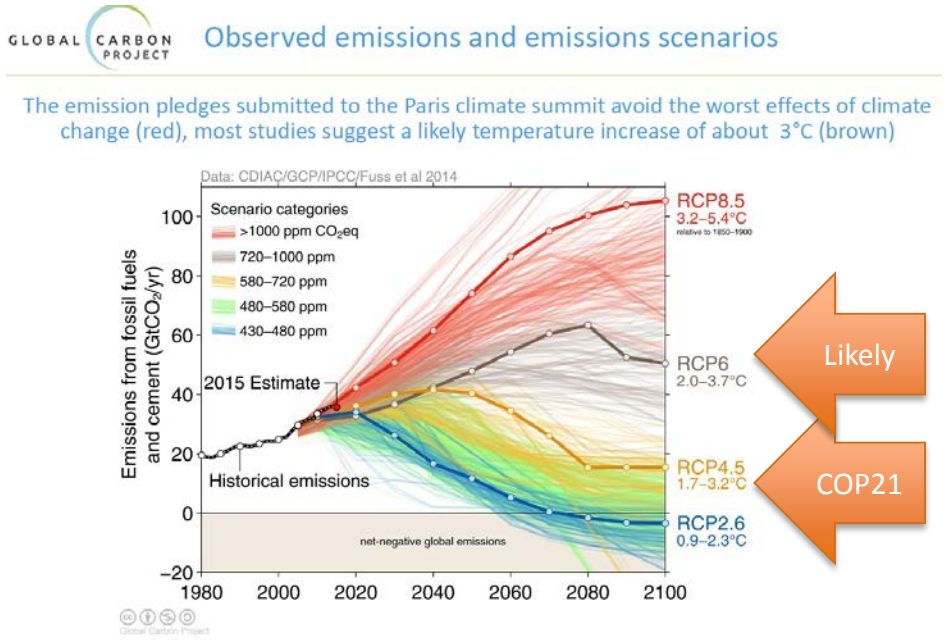


Local futures depend on much more than climate (and hydrology) alone.

Many issues play a role in vulnerability:

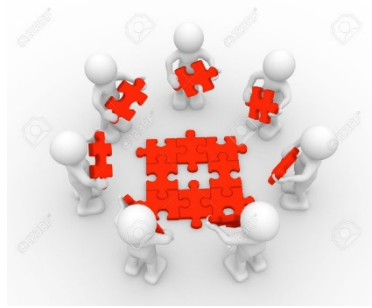
- Literacy, education and standards of living, poverty
- Infrastructure and distance to market
- International food prices and market fluctuations
- Policies and management related to agriculture
- Agricultural practices: (un-)sustainable land- and water use
- Lack of institutional organisation
- Men outmigrate, woman working on farm …

Future trends – a puzzle with many pieces

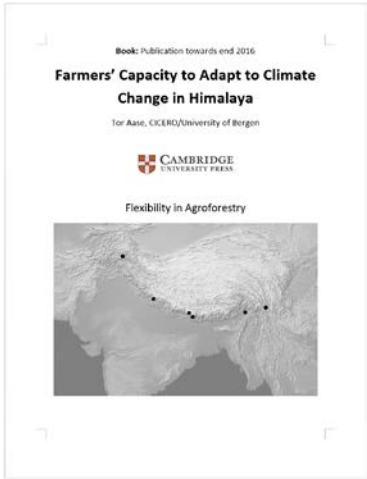


1) Climate info and Climate trajectories are important for local future trends

2) Impacts of (climate) change depend on local vulnerability and resilience and developments in many components:



- Social: Level of development, literacy, education, information access and standards of living, outmigration, ...
- Economic: Infrastructure and distance to market, (international) food prices and market fluctuations, remittances, …
- Political: Policies, management and institutions related to agriculture, …
- Traditional/Cultural/Agricultural practices: (un-)sustainable land- and water use, availability of resistant and productive seeds
- …



Conclusion

- **Note: Socio-economic, political, infrastructure, institutional factors as least as important as climate change**

- **Need (Besides better climate and hydrolgy models and targeted information about these): Sustainable land- and water use, building institutions, enabling market access, education, heat tolerant species, agricultural biodiversity and flexibility, addressing outmigration and gender issues …**

➢ **All** ministries involved in "climate change adaptation", not in the least Finance
➢ **Capacity building at district and local level**

➢ Also about "us": About 70% of the food in developing countries is produced by local and small-scale family farmers

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Climate and Water Atlas:
http://www.icimod.org/?q=20533

Downscaling climate projections

What I superimpose is a domain average. This captures current local climate pattern well, but change over time (level, timing) may be issue at local level:

Underestimation for high lying areas and overestimation of low lying areas: High level sites change differently (greater difference in level and timing?) than lower lying sites?

But: best option, and more realistic (1 step closer to truth) than plain domain level.