Local knowledge and citizen science for climate change adaptation at the bolivian andes

YATIÑ UTA
EXPANDIENDO EL SABER DE LOS ANDES

Paula Pacheco Mollinedo
La Paz, Bolivia

Opening remarks

❑ An unknown number of low- and medium-altitude glaciers have already disappeared, and projections indicate that many others are also likely to vanish over the next few decades.

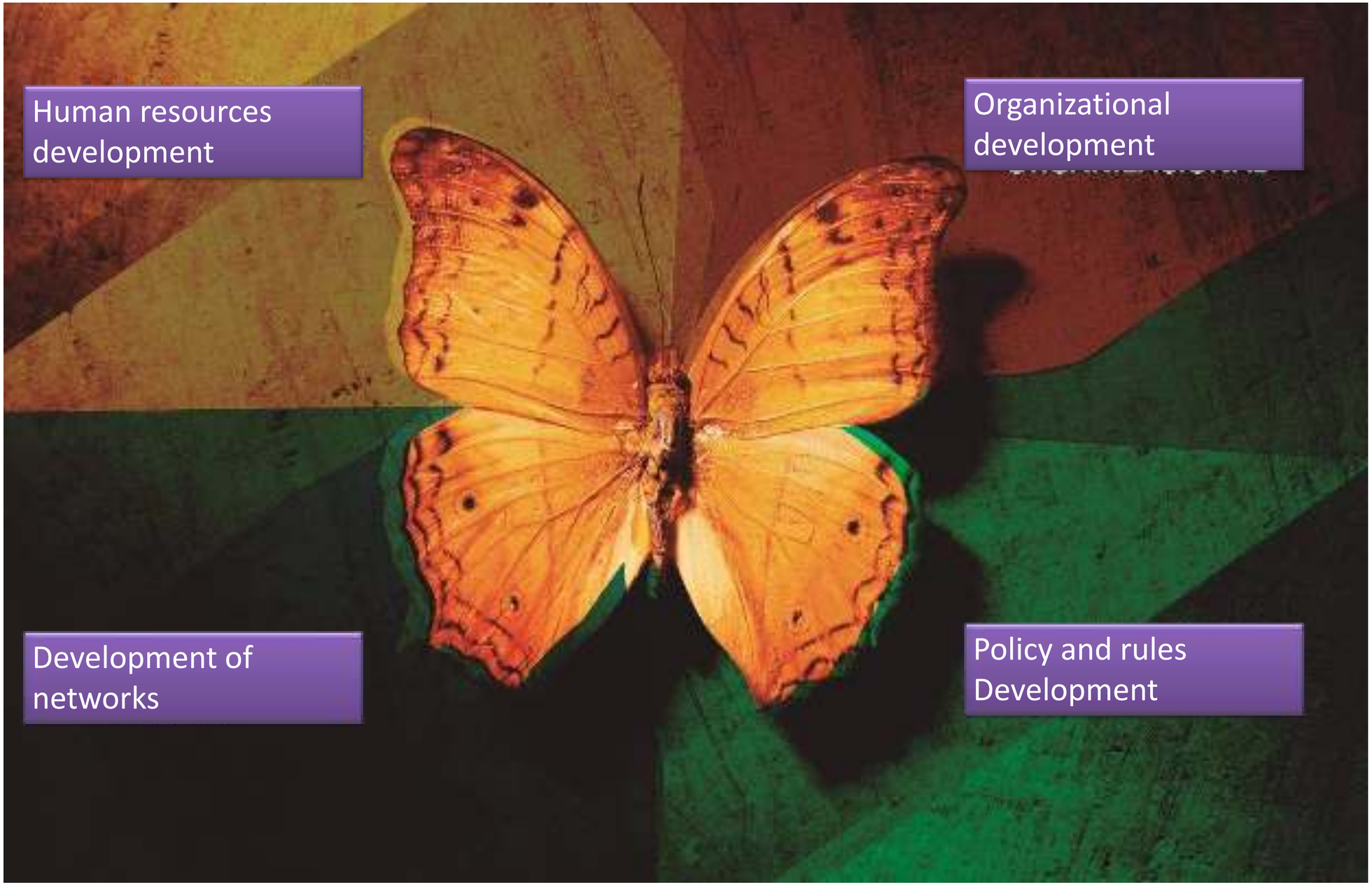
❑ In the Bolivian Andes, more than 50 percent of the glaciers has been lost in the last 40 years due to climate change.

❑ This may significantly decrease the amount of glacial meltwater available to streams and aquifers which are critical to ecosystems and farming communities in the region.

❑ In addition, the rural communities of this region are also threatened by economic uncertainty.

❑As a response to these situations, many farmers have chosen both temporary and permanent migration to nearby urban centers as adaptation strategies.

INTEGRATED CAPACITY BUILDING



ORGANIZATION DEVELOPMENT

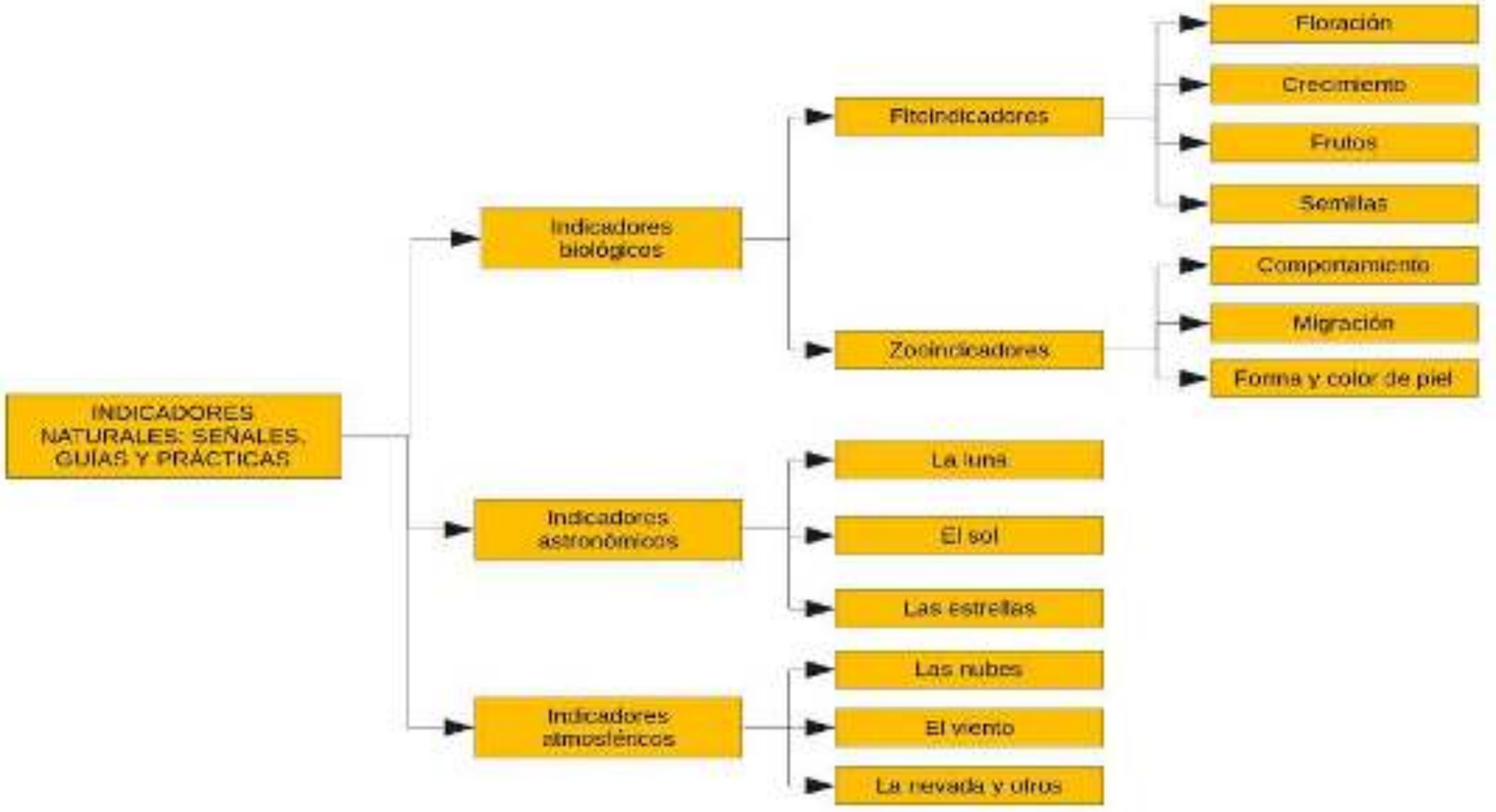
Traditional Practices or knowledges for different hazards

- **Droughts**
  - Rituals in the hills accompanied by prayers, fasting and offerings to Pachamama.
  - According to the Agrecol Andes Foundation (2006), the Andean man is in a permanent search for balance between four factors: production, wisdom, destiny and way of life, this search is closely related to ritual.
  - They used to carry water from the springs or lagoons, in containers called puli, accompanied by rituals and they placed them in the aynoqas (farms) and sometimes it used to rain, or they carried toads and made them cry on the hills, then they returned them to the river.

Traditional Practices or knowledges for different hazards

- Excavation of manual wells and q'ochas
- Construction of vigiñas manually and mechanically.
- Construction of terraces, channels and infiltration ditches.
- Transportation of water from the Desaguadero river for consumption.
- Mulch the soil two or three times, as smaller particles hold more water.
- Crop diversification.
- Purchase of corn and dry beans to have food.
- Forage planting on the banks of rivers and lakes.
- Planting in furrows transversally to the slope.

Practice	Features of traditional knowledge
Q’otañas o vigiñas	They are reservoirs built in the water collection area of the micro-basins, with the purpose of harvesting rainwater, to use it in irrigation, drinking troughs and for domestic use (Chilon, 2008).
Q’ochas o q’otas.	They are excavations built to enable rainwater harvesting and production in arid areas, minimizing the risks of frost and drought (Chilon, 2008).
Terrazas, taqanas o andenes	They are infrastructures built on the slopes, formed by a stone, earth or vegetation retaining wall and a cultivation platform, which form microclimates, to protect crops from frost, drought and hailstorm (Chilon, 2008).
Kurmi cotas	They are rainwater traps for harvesting water an producing native grasses (Ayala, 2014).


INDICADORES NATURALES: SEÑALES, GUÍAS Y PRÁCTICAS
Indicadores biológicos
Indicadores astronómicos
Indicadores atmosféricos
Fitoindicadores
Zooindicadores
Floración
Crecimiento
Frutos
Semillas
Comportamiento
Migración
Forma y color de piel
La luna
El sol
Las estrellas
Las nubes
El viento
La nevada y otros

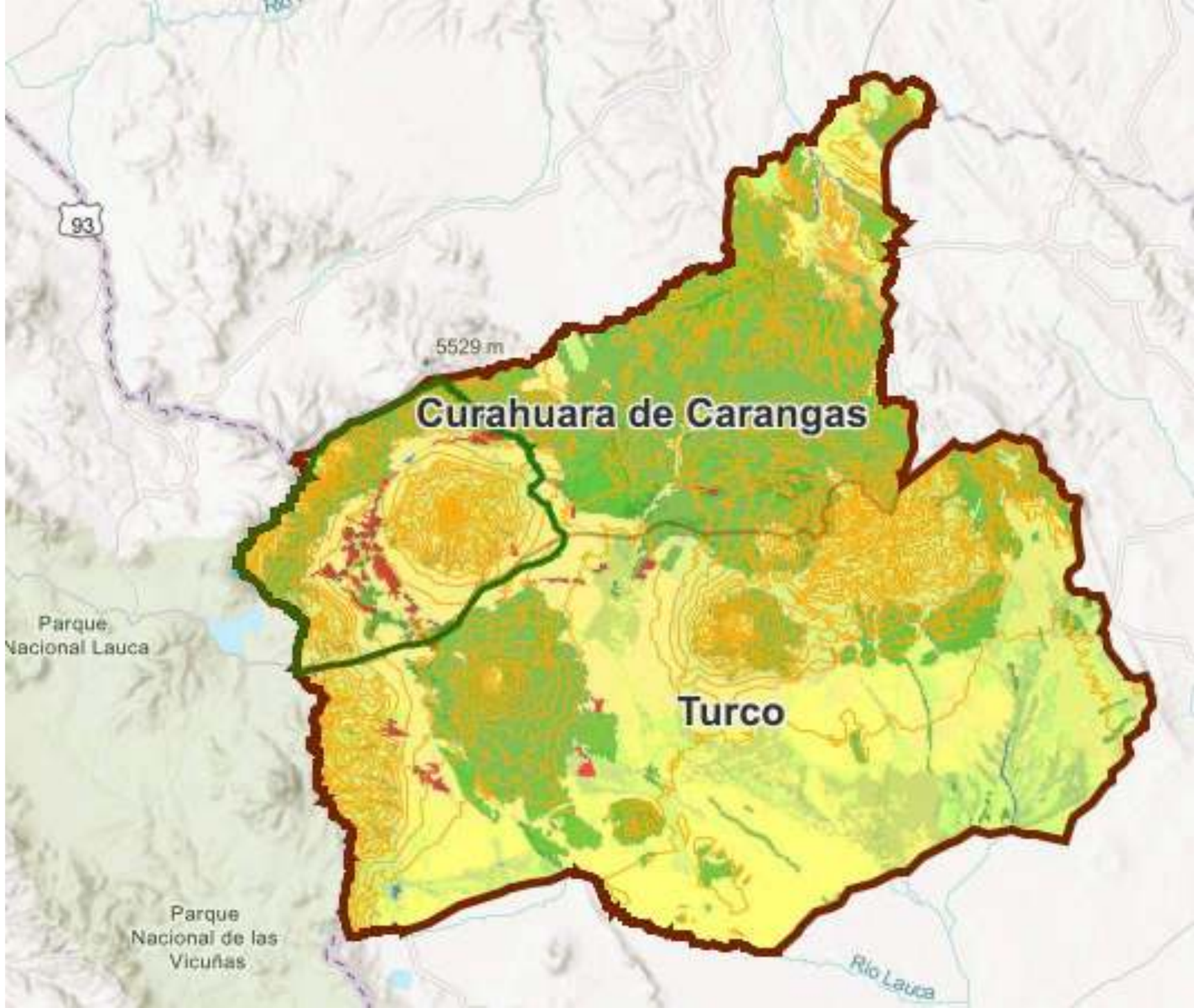
Bio-indicators

- Use of bioindicators Phytoindicators:
  - thola (Parastrephia lepidophylla), the flowering season and seed quality are observed, bad seed is an indicator of a bad year accompanied by droughts.
- Zooindicators:
  - fox (Pseudalopex culpaeus), observed in the month of September, when it howls and stalls, it means that it is going to be a bad year with droughts.
  - Spider (Amaurobius sp.), when it makes its nest and does not cover it, it means that it will not rain that year.
  - Pichitanka or Chijta camachisi (Zonotrichia capensis) nested in low parts is a sign of a dry year.
  - Pampa huancu - Tuju (Ctenomy sopimus), if it builds its burrow in places where the river flows in the rainy season, it means that there will be no rain.
- Atmospheric indicators:
  - clouds, it is used for planting quinoa, if the movement of the clouds was monitored on August 1, if there were no clouds on August 1, 2 and 3, then it was planted in October or November.
- Astronomical indicators:
  - stars, the southern cross and the Pleiades (Qutu) are observed in June and August, if the Pleiades appear small) there will be droughts.
- Festivals and rituals:
  - San Andrés (November 30) and San José (March 19), if it does not rain on those days there will be droughts.

Yatiñ Uta

It is a physical space in the Sajama National Park and also a virtual space whose purpose is to promote and take advantage of research and knowledge. In addition, develop innovative tools and practices to strengthen resilience to climate change in different mountain regions.

Queremos recopilar y mostrar toda la información que se tiene sobre el PNS para que sea aprovechada por todos nosotros.


93
5529 m
Curahuara de Carangas
Turco
Parque
Nacional Lauca
Parque
Nacional de las
Vicuñas
Rio Lauca

Conclusions

All traditional knowledge is relevant and are strategies that should be implemented in policies and plans for adaptation to climate change and combined with other current knowledge such as early warning systems, integrated management of water resources, application of geographic information technologies, and others that will increase the adaptive capacities of communities in the Bolivian Altiplano.

The studies found that traditional knowledge is being lost, which is why it is recommended that most traditional practices should be recovered. Recover crop diversification and management of varieties to face climatic, pest and disease threats.


THANK YOU FOR YOU

Faith and traditional knowledge for preserving Biodiversity and Water resources: “Sacred” Forests and Water Bodies

Working Group on Nature Based Solutions

Water and Climate Change Task Force, IWRA

CONTENTS

INTRODUCTION

- Biodiversity loss: The Earth has lost ~70% of its wildlife populations since 1970 on an average (WWF 2022).
- 83% decline in freshwater species.
- Climate Change is increasing the pressure on global natural resources.
- Faith communities: more than 80% of the world population identifies with a religious group (PEW Res 2012).
- Faith communities have historically played a role in environmental stewardship and conservation efforts.

Faith and its Relationship with Nature

- Interconnectedness: Many religious and spiritual traditions recognize the interconnectedness of all living beings.
- Sacredness of nature: Faith traditions across the globe view nature as sacred and deserving of protection.
- Inspiration for stewardship: Faith-based teachings and texts inspire followers to care for the environment and its creatures.
- Rituals and practices: Various faiths incorporate rituals and practices that foster a sense of reverence and responsibility towards nature.

Traditional Knowledge and its Role in Conservation

- Indigenous knowledge: Indigenous and local communities possess valuable knowledge about ecosystems and natural resources.
- Sustainable practices: Traditional knowledge includes sustainable resource management practices developed over centuries.
- Ecosystem guardians: “Indigenous Land” encompass approximately 20% of the Earth's land surface and support 80% of global biodiversity (IISD 2022).

Importance of Sacred Forests and Water Bodies

- Biodiversity hotspots: Sacred forests and water bodies are often biodiversity hotspots, hosting unique and endangered species (Smithsonian Mag 2018).
- Cultural and spiritual values: These sites hold deep cultural and spiritual significance for communities around the world.
- Ecosystem services: Sacred forests and water bodies provide vital ecosystem services, such as water filtration and climate regulation.
- Conservation legacies: Sacred sites act as living museums, preserving not only biodiversity but also cultural and spiritual heritage.

CASE STUDIES AND EXAMPLES
Mijikenda people's sacred groves:

- Mijikenda people's sacred groves: The Kaya forests of Kenya protected as sacred groves harbour a rich diversity of endemic plant species.
- The site is inscribed as bearing unique testimony to a cultural tradition and for its direct link to a living tradition (UNESCO heritage, 2009).
- Issues: felling of trees and threat to caretakers of Kayas

The Ganges River in India

- The Ganges River in India: Revered as sacred, the Ganga River inspires millions to participate in rituals that honour and protect its waters.
- City populations along the Ganges have grown at a tremendous rate, while waste-control infrastructure has remained relatively unchanged.
- Yamuna, the second holiest river of India, remains highly polluted due to untreated effluents.

Maasai community's land management:

- Maasai community's land management: The Maasai people in Eastern Africa practice holistic land management to maintain biodiversity and water resources.
- Droughts have become increasingly severe, many of the wild plants disappeared and occasional heavy rainfall had washes away the soil.
- Maasai people had to abandon their pastoralist nomadic lifestyle and their cattle.

Native American tribes

- Sacred natural sites of the Native American tribes: Numerous Native American tribes protect and conserve sacred sites, including water bodies, that are integral to their cultural and environmental well-being
- Issues: legal and cultural barriers to conservation, water contamination, development, etc.

Balinese water temple system:

- Balinese water temple system: The subak irrigation system, managed by Balinese water temples, demonstrates the integration of spiritual beliefs and sustainable water resource management.
- Water temples provide a fascinating insight into how farmers combine religion and engineering to manage water.

CHALLENGES: let’s do something

- Threats to sacred sites: Rapid urbanization and industrialization pose significant threats to sacred forests and water bodies.
- Cultural erosion: Globalisation and modernisation often lead to the erosion of traditional cultural practices and knowledge.
- Indigenous partnerships: Collaborating with indigenous communities and recognising their rights and knowledge can lead to successful conservation efforts.
- Policy and advocacy: Governments and organizations can support policies and initiatives that integrate faith and traditional knowledge into biodiversity and water resource conservation

COLLABORATION

- Research and documentation: Conducting research and documenting traditional knowledge to enhance scientific understanding and inform conservation strategies.
- Capacity building: Empowering local communities and indigenous peoples through capacity building programs to strengthen their role in conservation efforts.
- Sustainable practices: Encouraging sustainable practices at individual and community levels, such as responsible consumption and waste reduction.

CONCLUSION

- Indigenous traditions should be respected. These peoples have a deep connection with the natural resources and have been using them cautiously and sustainably for a very long time.
- Fortress Conservation efforts should be avoided and traditional knowledge should lead the path to conservation.
- Collaborating with indigenous peoples and creating such awareness among local communities and conservators will be helpful in a harmonious conservation strategy.
- “Leave no one behind” should be the motto of conservation.


«We don't inherit the Earth from
our Ancestors;
we borrow it from our children»
Ancient Native American Proverb

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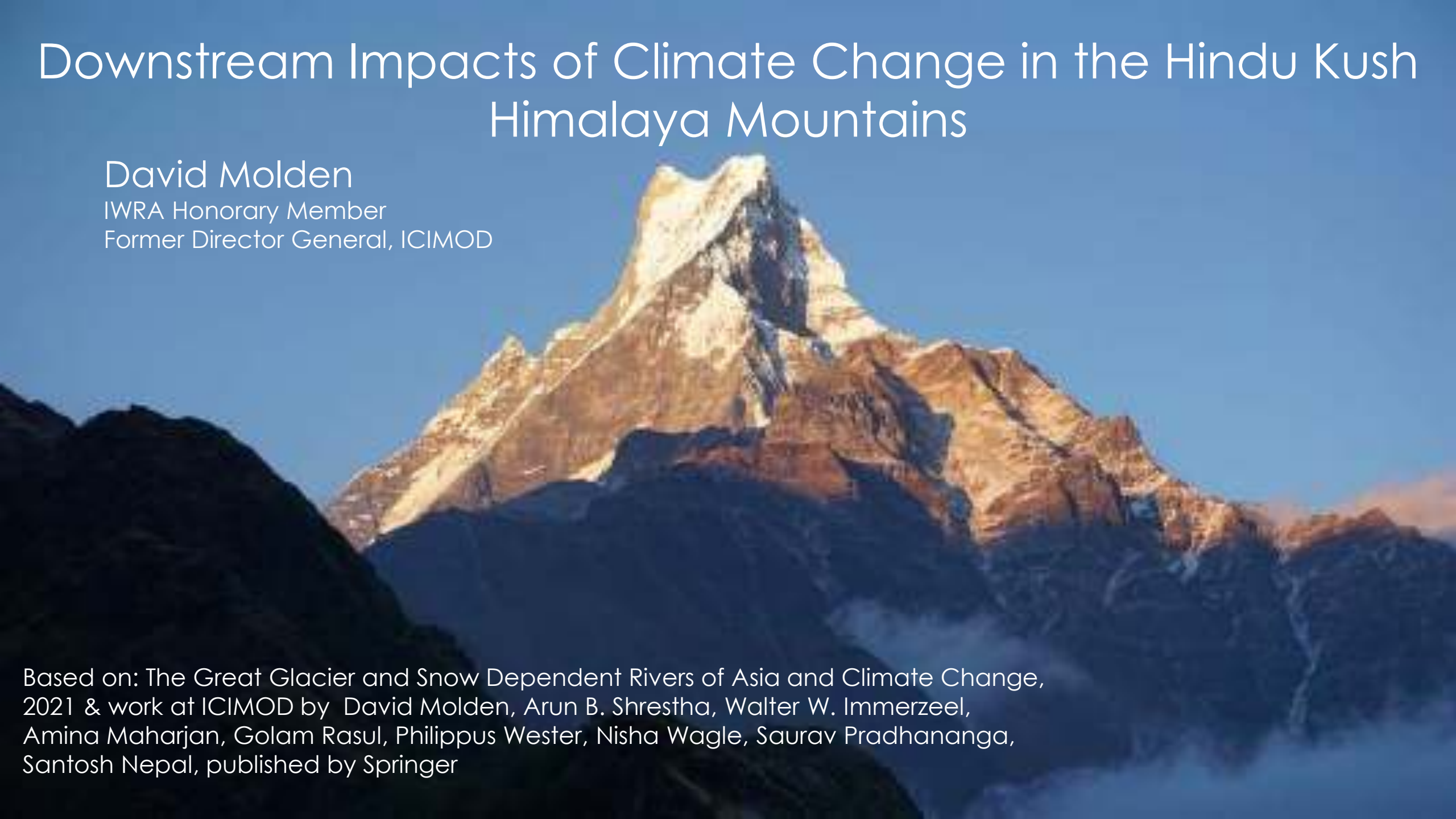
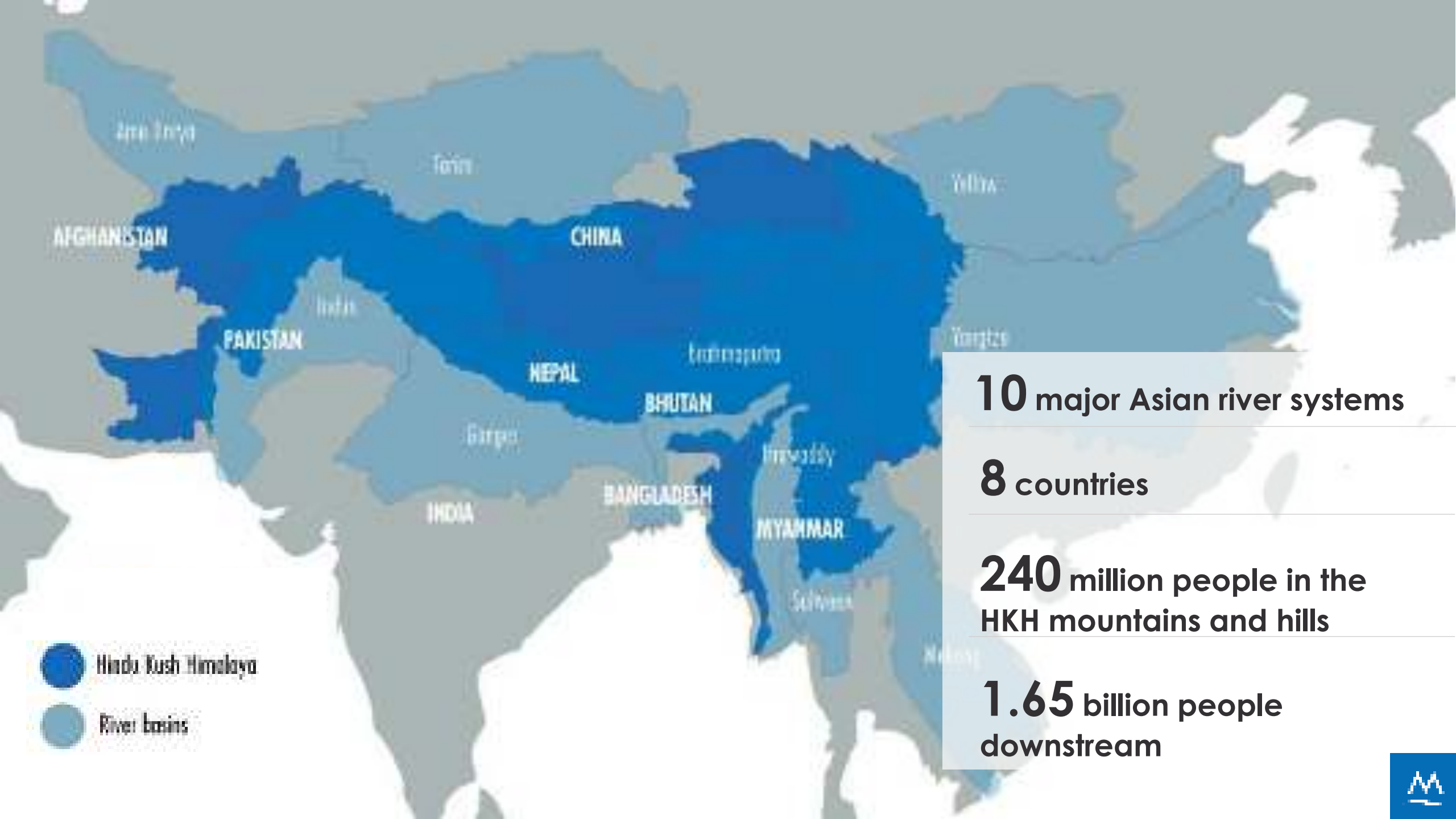
Downstream Impacts of Climate Change in the Hindu Kush Himalaya Mountains

David Molden
IWRA Honorary Member
Former Director General, ICIMOD



Based on: The Great Glacier and Snow Dependent Rivers of Asia and Climate Change, 2021 & work at ICIMOD by David Molden, Arun B. Shrestha, Walter W. Immerzeel, Amina Maharjan, Golam Rasul, Philippus Wester, Nisha Wagle, Saurav Pradhananga, Santosh Nepal, published by Springer



10 major Asian river systems

8 countries

240 million people in the HKH mountains and hills

1.65 billion people downstream


What happens here
affects one-fourth
of humanity

Food Insecurity

30% **of HKH population suffers from food insecurity**

50% **malnutrition, and one-fifth to one-half of children >5 suffer from stunting**

Energy Poverty

500 GW **hydro potential = energy for half a billion homes**

80% **rural population in HKH countries lacks access to clean energy for cooking**

High Out-Migration

Labor migration contributes significantly to poverty reduction in HKH region, but depends on who is able to move and under what conditions

Poverty

1/3 **in mountains** compared to

1/4 **national average**

HIMAP

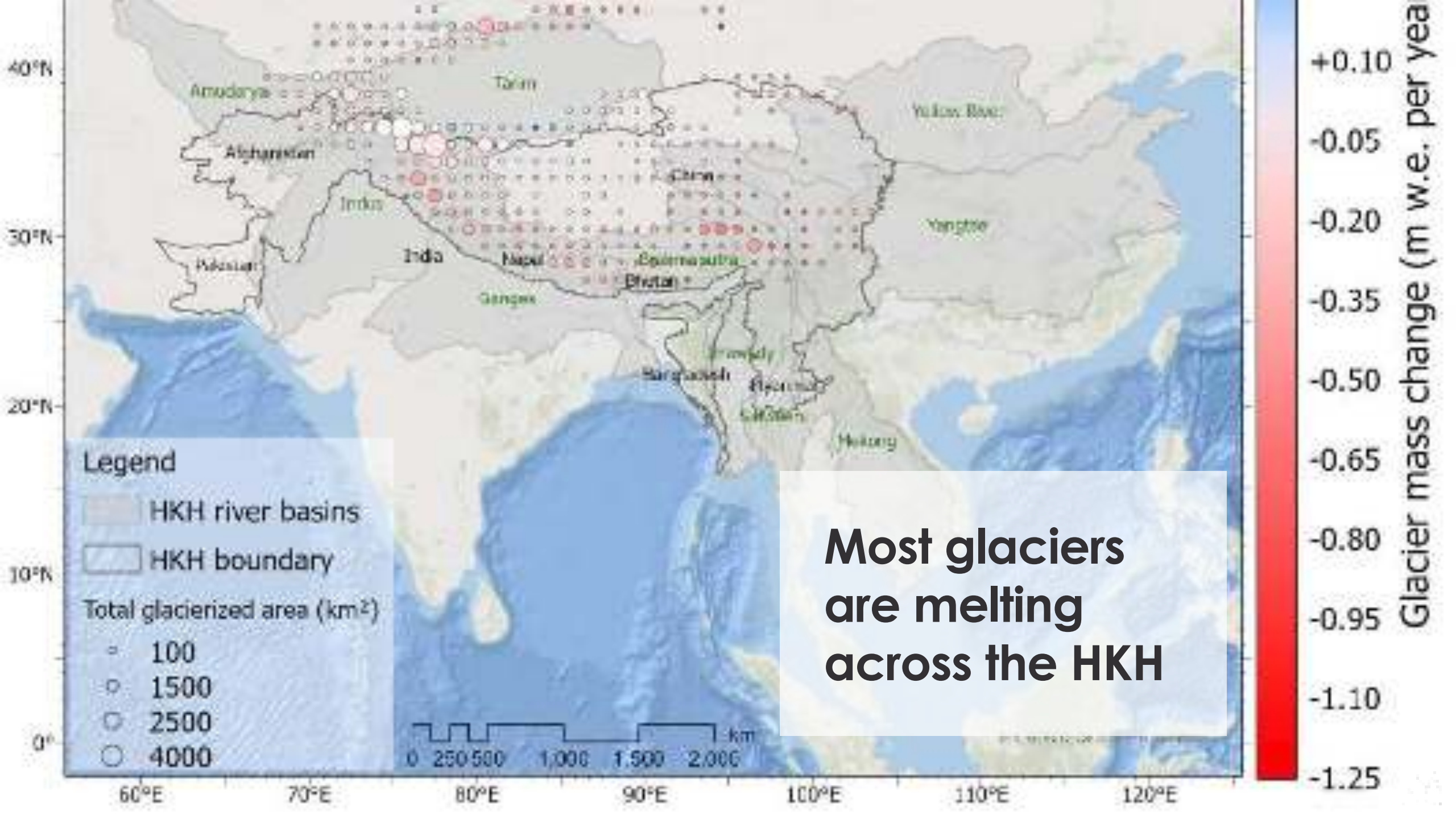
Temperature rise is amplified at altitude and latitude

Even 1.5 degrees is too hot for the HKH

- 5.5 ± 1.5˚C by 2100 relative to 1976-2005 at current emission trends
- 2.5 ± 1.5˚C by 2100 relative to 1976-2005 (RCP 4.5)
- 2.1 ± 0.1˚C (PI) in a 1.5 degree world

HIMAP


What is happening to the glaciers?


Most glaciers are melting across the HKH
Legend
HKH river basins
HKH boundary
Total glacierized area (km²)
100
1500
2500
4000
0 250 500 1,000 1,500 2,000 km
Glacier mass change (m w.e. per year)
+0.10
-0.05
-0.20
-0.35
-0.50
-0.65
-0.80
-0.95
-1.10
-1.25
40°N
30°N
20°N
10°N
0°
60°E
70°E
80°E
90°E
100°E
110°E
120°E
Amudarya
Tarim
Afghanistan
Indus
China
India
Nepal
Bhutan
Pakistan
Ganges
Yangtze
Yukon River
Mekong

In a 1.5˚C world, glaciers in the HKH will lose 1/3 of their volume by 2100

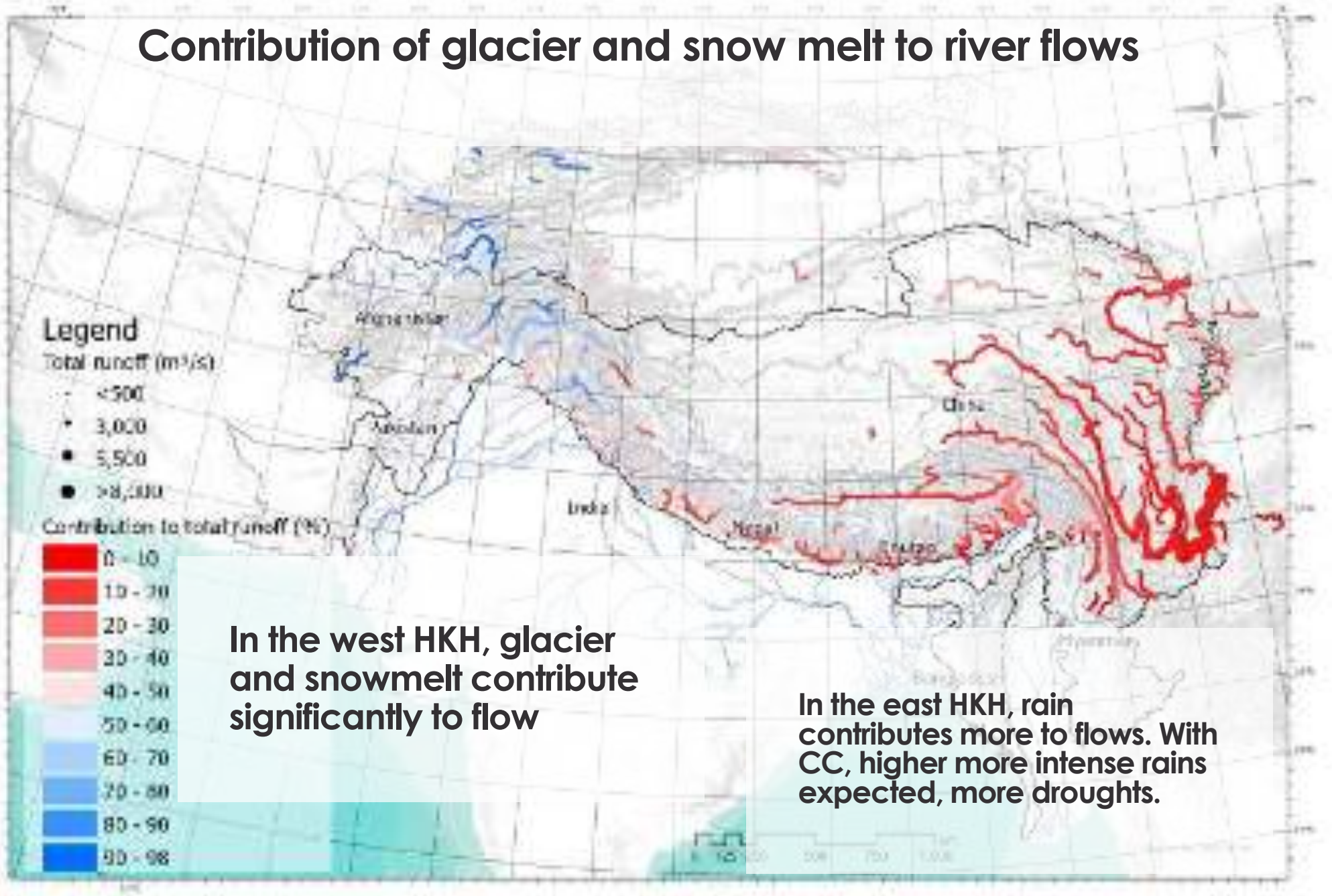
And 2/3 of their volume under current emission trends

Snow covered areas and snow volumes will decrease and snowline elevations will rise;

Snow melt induced run-off peak will be stronger and occur earlier in the year

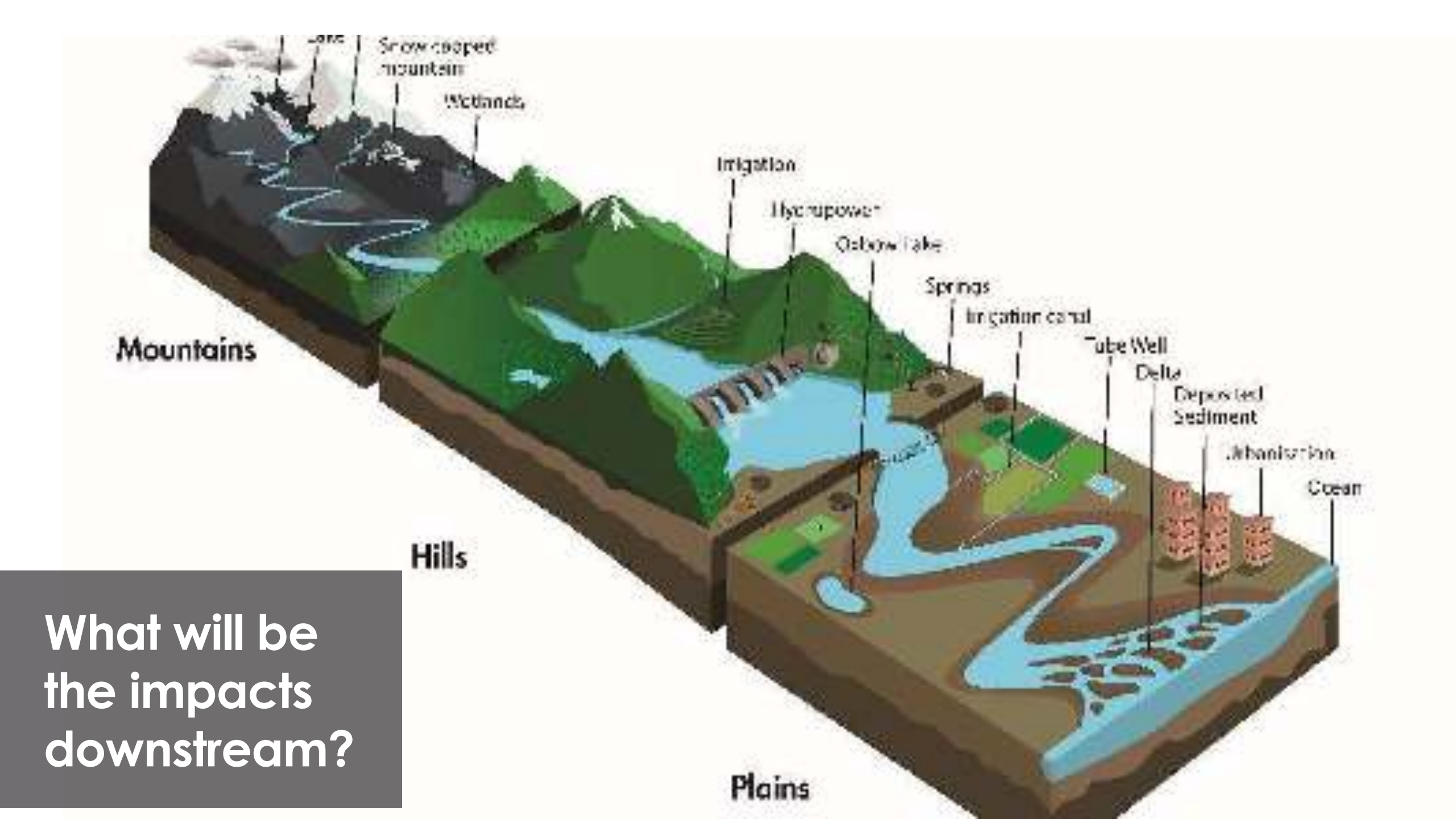
Source: HIMAP climate change and cryosphere chapters and Kraaijenbrink et al. 2017, Nature

Contribution of glacier and snow melt to river flows



In the west HKH, glacier and snowmelt contribute significantly to flow

In the east HKH, rain contributes more to flows. With CC, higher more intense rains expected, more droughts.



What will be the impacts downstream?

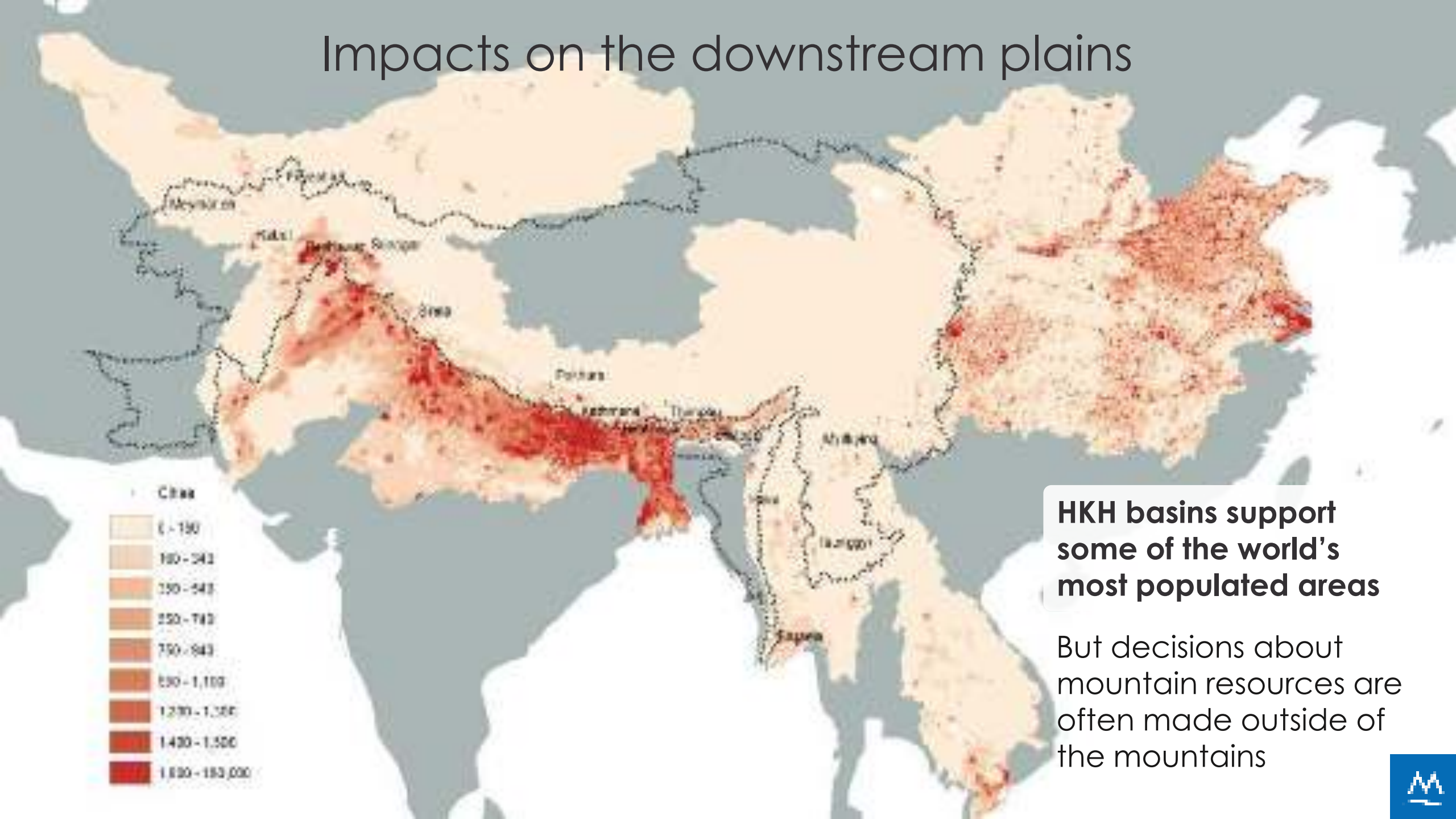
Communities dependent on glaciers and snow melt are highly vulnerable

Nang, Ladakh, India
Photo Karen Conniff


Mountain Communities are already feeling the impact, and more literature points to climate change as a factor of outmigration due to water shortage or disasters


High potential for hydropower, but vulnerabilities to floods increasing

Impacts on the downstream plains



HKH basins support some of the world's most populated areas

But decisions about mountain resources are often made outside of the mountains

Growing megacities downstream already under water stress

Irrigated agriculture, important for food security, will need to adapt

In Indus 90% of crops are irrigated, 60% of withdrawals from glacier and snow melt , Biemens et al 2019

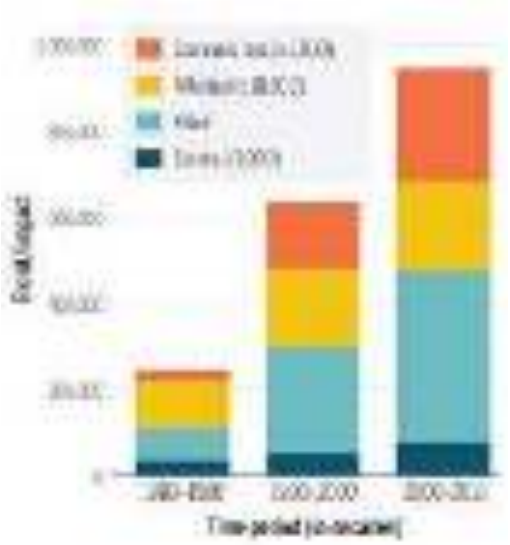
Disaster risk is increasing

Floods, droughts, landslides, glacial lake outburst floods

One-third of disasters are floods, many crossing national borders

More than 1 billion people at risk of exposure to increasing frequency and intensity of natural hazards

Women more susceptible to natural disasters then men



Oct 20, 2021

The Guardian

At least 150 dead in flooding and landslides in India and Nepal

Himalayan state of Uttarakhand suffers heaviest rainfall in more than 100 years, with Nepal also badly affected

Key Actions

Photo: Karen Conniff

Community Level: Investments needed to adapt and build resilience

Regional Cooperation is required

Improved shared science base

Flood early warning

Link upstream and downstream activities

Coordinate water supply, energy, transport

United voice for mountains and water

Thank you

Acknowledgement to the work of the International Centre for Integrated Mountain Development (ICIMOD) and to the IWRA Task Force on Climate Changel

Photo: Karen Conniff

Water Resources & Adaptation to Climate Change

IWRA Climate Change Task Force

Malcolm J. Gander, Ph.D.

June 2023

PowerPoint Orientation

- Our H2O resources are being increasingly exploited by many factors including population growth & increased agricultural production; **we are using more H2O than the amount being replenished**

- **Climate change poses compounding factors in the depletion of H2O resources, and degradation of H2O quality – What are these factors?**

- What are the adaptation approaches that can be implemented to **counteract H2O resources depletion and H2O quality degradation?**

Fundamentals of Climate Change & H2O Resources

- Higher average T & changes in precipitation, T extremes, and prolonged drought are already affecting the availability of H2O resources through changes in rainfall distribution, soil moisture, glacier and ice/snow melt, and river and groundwater flows (UN Water 2022). Higher T also trigger increases in diseases, e.g., malaria.

- CC influences when, where & how much rain falls. Higher global Ts cause water to evaporate in larger amounts, resulting in more atmospheric water vapor leading to more frequent & intense storms & flooding

7 Adaptation Strategies-Main Message of Presentation

Sea level rise, extreme storm events causing more runoff and less aquifer recharge, and extreme heat waves are manifestations of climate change. The following are adaptation strategies that can counteract these climate change realities:

1)**Protect Coastal Wetlands**: Salt marshes, mangroves & seagrasses are marine coastal ecosystems that naturally filter water; act as a buffer against sea level rise and storm surges & floodwaters, & store tons of carbon in their roots and soil.

2) **Promote Sustainable Agroforestry**: This is the integration of diverse trees or shrubs with diverse blend of crops & simultaneously raising livestock using significantly less land & less H2O for irrigation.

3) **Decentralize Energy Distribution**: Global warming adversely affects grid reliability. Large, centralized power plants/infrastructure are more vulnerable to extreme heat or prolonged cold weather in the winter months that can cause brown outs or power failures from stressed large power plants.

Adaptation Strategies continurd)

4) **Secure Indigenous Peoples' Land Rights**:

Indigenous communities manage almost 50% the earth's land surface, & up to 2.5 billion people depend on this land for their livelihoods.

- These communities have practiced adaptation principles for generations.

-Where indigenous people do have legal rights to their land, deforestation is at least two times lower than similar areas

5) **Improve Mass Transit**:

-**Road transport accounts for 72% of global transportation-related emissions.**
-Significant disruptions to transportation infrastructure can be caused by climate change-induced extreme storms & heat. -Low-carbon mass transit will help relieve disruptions.

6) **Agricultural Optimization Strategies** - Improve on-farm soil and water management through modifying tillage regimes, or utilizing mulching ot lower evaporation.

7) Counteract ***temperature pollution*** in streams and rivers by **planting more trees to shade/cool waterways**

Fundamentals of Climate Change & H2O Resources

- Excess runoff from extreme storms will collect excess nitrogen & phosphorus from fertilizers & deposit these nutrients into water bodies (eutrophication), causing algal blooms of green, blue-green, red, or brown algae (National Geo 2022).
  -Toxins from the blooms kill fish & other aquatic animals
  -Toxins can also survive purification processes of drinking water, causing human sickness
- Large glacier melt-off at accelerated rates results in less surface water for drinking & agriculture in lower elevations, & more runoff & less aquifer recharge. The increased runoff raises sea levels, inundating coastal cities & requiring costly repairs/changes to infrastructure.

Temperature Pollution, Climate Change, & Ecosystem Degradation

- ***Temperature pollution, or thermal pollution,*** is the degradation of H2O quality by any process that changes ambient H2O temperature
- It could result in lower T from the release of cold water from large impoundments or industrial facilities, or higher T from solar radiation
- **Example: In Seattle/Washington, too many trees have been cut along streams & rivers, allowing solar radiation to increase H2O T**
  -Warm streams harm salmon by reducing oxygen and allowing diseases and bacteria to spread
- This adversely affects not only salmon but other species dependent on them, such as Orcas whales (and humans)
- **Global warming/climate change exacerbates the increasing T problem**

Distressed Columbia River Salmon Washington, Pacific Northwest, USA

Realities of H2O Resources Management Challenges

- Data sharing between nations needs improvement
- Data sharing/interdisciplinary scientific collaboration (Molden et al 2022) throughout either regions within a country – or between neighboring nations - can help cooperatively manage surface H2O shortages in the dry season; flooding/storage problems in rainy season; and potentially ease groundwater overpumping
- Formalized collaboration between water-sharing nations

Adaptation via Nature-Based Solutions

It has been estimated that global crop production could be increased by nearly 20% as a result of on-farm soil and water management practices in rain-fed agriculture alone (e.g., improved water harvesting through modifying tillage regimes or mulching)

Adaptation to Climate Change Requires Better H2O Management

Adaptation approaches will require additional funds

- Upgrade infrastructure to:

-prepare flood-prone areas in floodplains by expanding floodplains or preserving wetlands or constructing levees/artificial embankments

-prepare coastal cities for inundation from sea level rise

-prepare wastewater treatment systems and sewage systems for inevitable overloads from flooding/monsoons

-counteract ***temperature pollution*** in streams and rivers by planting more trees to shade/cool waterways

7 Strategies for Climate Change Adaptation (World Resources Institute 2020)

1)Protect Coastal Wetlands: **Salt marshes**, mangroves & seagrasses are marine coastal ecosystems that naturally filter water; act as a buffer against sea level rise and storm surges & floodwaters, & store tons of carbon in their roots and soil.

2) Promote Sustainable Agroforestry: This is integration of **diverse trees or shrubs with crops and livestock**. Pastures with trees sequester 5 – 10 times more carbon than treeless areas of the same size. Farmland can be more productive by growing a diverse blend of crops & raising livestock simultaneously using significantly less land & less H2O for irrigation.

3) Decentralize Energy Distribution: Global warming adversely affects grid reliability. Large, centralized power plants/infrastructure are more **vulnerable to climate change-induced weather events** that can interrupt the grid power transmissions. Decentralized systems powered by renewable energy with shorter transmission lines and smaller distribution areas are more climate-resilient and can recover from disasters more quickly.

5 Strategies for Climate Change Adaptation (World Resources Institute 2020)

4) Secure Indigenous Peoples' Land Rights: -

Indigenous communities manage almost 50% the earth's land surface, & up to 2.5 billion people depend on this land for their livelihoods.

-These communities have practiced adaptation principles for generations.

-Where indigenous people do have legal rights to their land, deforestation is at least two times lower than similar areas without such ownership, as has unfortunately been observed in Bolivia, Brazil and Columbia.

-5) Improve Mass Transit: -

Road transport accounts for **72% of global transportation-related emissions.**
-Significant disruptions to transportation infrastructure can be caused by climate change-induced extreme storms & heat.
-Disruptions will disproportionately affect low-income population, or urban dwellers with few mobility options.
-Low-carbon mass transit will help relieve problems posed by these disruptions.

6) Agricultural Optimization Strategies - Improve on-farm soil and water management through modifying tillage regimes, or utilizing mulching ot lower evaporation.

7) Counteract *temperature pollution* in streams and rivers by **planting more trees to shade/cool waterways**