RésEAU Webinar: On thin ice: Adapting water resources management to a vanishing mountain cryosphere


Photo credit: Alain Bonnardeaux – unsplash.com

This webinar was held on the 10th of May 2021 as part of the RésEAU webinar series. It highlighted the second output of the Trend Observatory, an initiative led by SDC's Global Programme Water to anticipate new themes and emerging opportunities for development cooperation in the water sector.

The objective of this webinar was to give an overview of the state of research on how climate change effects on the mountain cryosphere impact water resources, and to provide insights on why and how water resources management should adopt more risk-based and transformative approaches to deal with related uncertainties and rapid change.

Key takeaways:

- 25% of the world's population depend on the mountain cryosphere for water supply. However, these important water towers are vanishing almost everywhere in the world as a result of global warming.
- Water resources management needs to be based on integrated and regional assessments of climate risks. However, these come with uncertainties - hence the need for robust solutions.
- Transformative adaptation responses are needed to anticipate and adapt to the effects of climate change on water resources. These would fundamentally change social-ecological systems to address the root causes of vulnerability.

First speaker: Annika Kramer, Head of Water Programme, adelphi

The mountain cryosphere encompasses glaciers, snow, permafrost and ice in mountain areas. It is an important component in the hydrological cycle as it stores water in solid form during the winter and releases it as melting water in warmer periods, supplying billions of people in mountain areas and downstream with freshwater. However, recent research highlights that the world's most important water towers are also among the most vulnerable to climatic and socio-economic changes.

Global warming leads to slow onset changes as well as hydrological extremes, but the cause and effect relationships are complex and impacts vary considerably across regions and seasons. In general, as glaciers melt progressively, summer and annual run-off increases for a few years but at some point, reaches what is called "peak water", a point beyond which annual run-off decreases due to glacier decline. Alarmingly, projections forecast that peak water will have been reached already by the end of this century in many regions. Winter run-off, on the other hand, is expected to increase due to more precipitation falling as rain instead of snow. In terms of extreme events, frequency of rain-on-snow floods is expected to increase at higher elevations and decrease at lower elevations.

The consequences of a changing cryosphere will affect water resources and their uses, including for agriculture and hydropower. Climate and hydrological models can help water resources management, but we must also keep in mind that these come along with uncertainties, not only about future change but also about the socio-economic conditions that shape water dependency. Hence, water resources management needs to be based on integrated and regional assessments of climate related risks. Several tools have been developed and need to be used more broadly in water resources planning. Two examples are:

- The Climate, Environment and Disaster Risk Reduction Integration Guidance (CEDRIG) tool developed by the Swiss Agency for Development and Cooperation;
- The Climate Risk Informed Decision Analysis (CRIDA) approach by UNESCO and partners

While risk assessments help better factor in uncertainties related to future conditions, they cannot eliminate these uncertainties. Mountain areas often involve a high degree of uncertainty, because of insufficient monitoring networks and difficulties related to data collection and fieldwork in remote high mountain areas. Therefore, management of water resources that depend on mountain cryosphere need to involve robust solutions. Robustness means that water-related management solutions can perform efficiently in various scenarios and changing conditions. Examples are solutions that bring multiple benefits or no-regret solutions. Building up water storage capacity is crucial to dealing with the lost storage capacity of glaciers. For multiple benefits, integrated storage concepts should consider enhancing natural storage potential. Nature-based solutions for adaptation have in general proven to be more resilient and flexibly adapted than hard infrastructure.

In the face of expected fundamental changes in the quantity and seasonality of flows, there is a need for more transformational adaptation, meaning more substantive, systemic changes. Decision-makers should anticipate radical impacts and prepare for them by overcoming technical path dependencies and working towards institutional and societal change.

Second speaker: Natalia Acero, Water and Cities Director, Conservation International – Colombia

Natalia provides an example of Integrated Water Resource Management (IWRM) in high mountain ecosystems in Bogota, Columbia. Conservation International (CI) has developed a sustainable landscape approach in an area, called the Páramos Conservation Corridor, which aims at: promoting the conservation of key ecosystem services, restoring freshwater ecosystems and their services, and fostering sustainable agriculture production systems. The main goal is to provide water supply to the Bogota area of 22 municipalities (and 8 million people). The project supports regional, national, and local protected areas to conserve a unique ecosystem of high Andean wetlands, called Páramos.

The high Andean mountains used to be a glacier until around 3000 BC. Over time, the glaciers turned into the Páramos ecosystem, which now has a similar function to the glacier: that of storing water. This ecosystem works as a sponge and provides an essential function for water storage and supply to the region: it stores water during the wet season and provides water downstream during the dry season.

CI evaluated the climate change risks in the Páramos Conservation Corridor, to understand where water storage capacities will be reduced, and how to adapt to ensure water supply to the surrounding urban and agricultural areas. A transformative adaptation strategy based on ecosystem-based approaches is applied. Transformative adaptation is defined as a set of responses that fundamentally change social-ecological system states and interactions (structures, functions, ways of thinking) and address the root causes of vulnerability. There are six main concepts that characterise transformative adaptation:

1. Persistent – across generations
2. System-wide – cover an entire landscape with socio-ecological links
3. Innovative – try to introduce new relations, technology, and behavior
4. Multi-scale – should involve multiple spatial, governmental, and sectoral involvement
5. Path-shifting – shift in development trajectory towards resilience and equity
6. Restructuring – changing environmental values and how ecosystems are being used

To illustrate, restructuring water use is addressed with automated irrigation systems, fog traps and reservoirs. Reversing the trends of the Páramos degradation (path-shifting) is done through various restoration approaches. In terms of a system-wide and multiscale approach, CI has tried to involve multiple water users upstream and downstream with different responsibilities. The biggest challenge was not only technical capacity, but also the coordination and involvement of all stakeholders involved. Innovative and persistent strategies include the integration of climate information systems, strengthening institutions to include ecosystem-based adaptation into their plans, and establishing restoration agreements with farmers in the watershed.

Reflections from discussant: André Wehrli, Regional Water Advisor for Central Asia, SDC

Central Asia is a fascinating region which is semi-arid, but not a water-scarce region per se. Water is very relevant for agriculture as well as for the energy sector. Currently in the Aral Sea Basin, almost 95% of the available water resources are utilised. Water is unequally balanced between Central Asian countries:

there are 5 former Soviet republics in the region, which share two major river basins originating from the mountains in Kyrgyzstan and Tajikistan. Meltwater from the cryosphere supplies about 80% of the total water runoff. In the past half century, up to 30% of the glaciers in these mountains have melted; an equivalent amount is projected to disappear by 2050. This puts entire communities and economies at risk, and highlights the crucial role of the mountain cryosphere as water towers in Central Asia. However, this understanding has not become engrained yet in the population, and with decision-makers in particular. We must work on improving data, move away from information to action towards transformation, and develop and strengthen integrated and regional cooperative approaches. It's a long endeavour but we must do our best to continue supporting these countries to transform.

Discussion with participants

(AK – Annika Kramer, NA – Natalia Acero)

Q: You mentioned transformative adaptation as potentially more effective and necessary, what should be the objectives and principles underlying transformative adaptation, and how do you convince stakeholders to adopt this approach? Can you share good examples how to convince decision-makers?

AK: Starting with an earlier question about uncertainties and good practices on how to deal with them: Communication is key - communicating uncertainties openly in a way that is understandable is very important. In addition, capacity-development on how to include uncertainties into decision-making needs to be included. Probabilistic forecasts have shown to be helpful in this regard. Communication is also key with regards to transformation. In order to motivate people to change, it can also be helpful to draw a potential positive picture of the future and highlight opportunities instead of just focusing on the threats. The objective of transformational change is to prevent reaching the point where a system collapses. In order to foresee when transformational change will be required, risk assessments are helpful: for communication this can even be relatively simple risk assessments, highlighting, for example, the point in time when there is a high probability that water demands can no longer be met. If you can demonstrate the water security risk along with potential consequences, it will help to convince people that there is a need to change on a systemic level.

Q: Natalia, you managed to engage with a wide range of stakeholders and convince them for the need of transformative approaches. Can you tell us about the challenges you experienced? What worked well and what did not work?

NA: Providing a clear picture of the water resources dynamics and of how each stakeholder will be affected in different ways was crucial to engaging everyone. What has to be developed is a collective vision of what will happen if water supply cannot meet all demands, making stakeholders aware of their role in the watershed, their demands in comparison to others, and ways to support water ecosystem conservation. As Annika said, communication is key. Perhaps one of CI's biggest successes in the last years was the economic valuation of ecosystem services to show their importance in terms of economic growth of the city or region. This is a good tool to engage the public.

Q: How did you define the Páramos Conservation area? What elements were considered?

NA: We used hydrological modeling to identify watershed boundaries of Bogota's sources for water supply. Based on that, we tried to understand which water utilities in the rural areas benefited from the same watershed, which led us to identify the strategic watersheds that we should work on. We then combined this analysis with the administrative boundaries to determine the boundaries of the conservation area; in Colombia, municipality boundaries are not aligned with watershed boundaries.

Q: Irrigation systems in the Andes are usually very old so it's necessary to improve them., Is it the same in Colombia?

NA: Yes, although we do not have big irrigation areas here. In this area, the average annual precipitation is around 800mm, and sometimes in the upper watershed it is up to 5000 mm per year, so we have a lot of water. However, due to climate change, we have now experienced some water scarcity and as a result some water conflicts in the dry season, between January and March. We have therefore been promoting irrigation systems and reservoirs, but firstly we need to move to better irrigation technology and improve agriculture practices to reduce water demand.

Q: Can you observe/predict climate tipping points related to melting glaciers. When do you know that business as usual is no longer acceptable?

AK: I think these are two separate questions. The question of when business as usual is no longer acceptable is a political and societal decision. It should be up to the stakeholders to decide what their goals of water resources management are - do they want to provide water to 10% of their farms, or 20% or 30%? So that's more of a political decision and stakeholders should define those criteria.

The tipping point for glaciers is a bit difficult to define specifically. There is the tipping point of peak water, which can be projected. Then there's another tipping point associated with the irreversibility of the glaciers' disappearance. Glaciologists can model both, but of course with uncertainty.

Closing remarks by Daniel Maselli, RésEAU focal point

What we can take out of this webinar and the recent trendsheet is the urgent need to quickly adapt and transform. What we have left as a cryosphere, except for the poles, is in high mountain regions. Even in Switzerland, we have irrigation systems, channeling glacial water to distant places where water is needed for agriculture. In places where glaciers have disappeared a long time ago, new ways of storing water, mostly small-scale, have been developed, for example in the Atlas Mountains. Similar solutions have also been applied in Central Asia. We need to move fast to anticipate the disappearing water storage in the cryosphere and find alternative ways to store this water. We do not have the time that the Páramos have had to develop and grow, we need to be smarter and faster.

Webinar Resources

The recording of the webinar, as well as the presentations, are available on:
https://www.shareweb.ch/site/Water/reseau-resources/webinars