UNIVERSITY OF CENTRAL ASIA
GRADUATE SCHOOL OF DEVELOPMENT
Mountain Societies Research Institute

MSRI Brief

September 2020

Figure 1a: Pamir mountains.
Photo: Roy Sidle

# Rethinking the nexus of Climate change, Development and Discourse of danger in Central Asia

## Introduction

There is a prevailing understanding that the impact of climate change for Central Asia will be overwhelmingly negative and is the primary driver in these mountain societies. The situation is more complicated because of the interconnected effects climate change imposes on water-land-energy systems and local populations. Studies have shown how intertwined the effects of climate change and human activities are on the environment in this region, particularly before and after the collapse of the Soviet Union (Lioubimtseva and Henebry 2009; Zhou et al. 2015). Nevertheless, it is extremely difficult to separate these effects with any degree of confidence (Oliver and Morecroft 2014). In addition to land use, some of the key anthropogenic stressors in Central Asia appear to be migration, land-use policy changes, and social upheaval since the early 1990's. The widespread perception that climate change is the primary vulnerability factor for local communities shifts development agenda away from complexity and uncertainty that climate change brings to the region.

This policy brief takes a critical look at this approach based on the following assertions. Firstly, the importance and role of dynamic water sources and supplies in mountainous terrain on hydrological regimes and natural hazards has been almost ubiquitously viewed through a negative lens related to climate change in Central Asia. In fact, such scenarios have not been well analyzed and bring into question some of the negative generalizations associated with climate change scenarios on ecosystems and communities in the region. Practically, this means that development efforts need to

## Key Messages

- Including spatial and temporal components into planning and agenda-setting for development activities related to mitigating impacts of climate change in Central Asia are crucial. Locally based environmental and social data are essential for assessing climate change effects on mountain communities; thus, it is important improve our knowledge on dynamic water sources and micro- and meso-scale climatic processes in the context of mountain topography and hydrology. Recent improvements in remotely sensed observations can help address these issues.
- Interstate tensions associated with use of water resources have decreased in the region. The dry years, 2000, 2014, and 2019, had an important impact on this reduction. While in 2000, regional water cooperation was essentially paralyzed, in subsequent years countries learned to jointly overcome the situation. This shows that regional cooperation is very meaningful and can help overcome some of the climate change issues. We need further inquiry on similar relational effects in current and realistic climate trajectories that can enrich the development agenda.

properly account for reliable climate change effects on environment and society linked to both spatial and temporal scaling issues. These are significant challenges, as concurrent land use/land management changes also evoke spatial and temporal scaling challenges related to hydrogeomorphic change (Sidle et al. 2017) . Secondly, from a political perspective, focusing on negative effects and conflict risks of climate change draws attention away from cooperative practices that have started to take shape between countries as a result of growing demands for water resources in region.

## Perceptions, misunderstandings, and realities of climate change and its impacts on water resources in Central Asia

While it is generally recognized that climate change is disproportionately affecting high elevation environments, the complexity of mountainous terrain and paucity of climate data in Central Asia make predictions of climate change on water resources very difficult at community or even district levels. Even downscaled climate models are too coarse-scale and unable to adequately capture how warming trends affect hydrological processes; thus, runoff and water yield predictions are often inaccurate (Sellami et al. 2016). An equal concern is our current inability to effectively disaggregate climate change from other anthropogenic impacts (e.g., land use, roads, urban development) on hydrological processes that affect streamflow (Yuan et al. 2015). Further complicating the dynamics of water resources in this mountainous region are the diverse sources of water – i.e., rainfall, snowmelt, glacier melt, and even melting of permafrost. These sources are all affected differently in a warming climate and each has its unique response regime. Additionally, runoff contributions from these different sources vary greatly from catchment to catchment, even neighboring catchments. For example, one catchment may contain a glacier, which contributes on average 30% of the annual runoff, while a neighboring catchment has no glacier. Climate warming effects on water flows from these neighboring catchments will likely be very different.

Much confusion and misinformed generalizations surround perceptions of the role of glacial melt induced by climate change on stream and river flow. While most evidence in the region shows water flow in rivers fed by melting glaciers has increased (Chen et al. 2016; Knoche et al. 2017), recent findings in partly glacierized catchments in the upper Columbia River basin of southeastern British Columbia suggest that the glacial melt contributions to late summer streamflows have already passed the so-called peak water tipping point (Moore et al. 2020), where flows due to glacial melt begin to decline as glaciers disappear. This uncertainty of how rapidly water sources will diminish once glacial melt declines or becomes partially disconnected from streams (Wu et al. 2013; Frans et al. 2018) is a challenge for projecting water supply trends in Central Asia, and it is unknown whether this will persist for years, decades, or longer, and if such trends are also occurring in small streams that support local agriculture and community water supplies.

An important aspect that is typically ignored in most studies is the connectivity of glaciers to stream and river systems. For example, some of the high elevation glaciers (> 4000 m a.s.l.) in Badakhshan National Park, Tajikistan, are located above a high plateau where the glacial melt discharges into a small stream that eventually disperses within nearby pastures (Figure 1a). In other areas of the Pamirs, glacial melt discharges more or less directly into streams (Figure 1b). In the former scenario, glacial melt due to climate change will have little effect on future stream and river flow due to the lack of connectivity; in the latter connected scenario, the effect of glacial melt will have a greater influence on streamflow depending on its relative contribution.

A global investigation on glacial melt contributions to streamflow using an energy balance approach showed that, in most cases, glacier melt constitutes less than 17% of streamflow, considerably smaller than previous estimates (Schaner et al. 2012). Some reasons for these discrepancies are that many past estimates included snowmelt on glaciers and the effect of interannual variability. Additionally, not all glaciers in Central Asia are melting at the same rate, and a few in the Pamirs are accumulating mass (Knoche et al. 2017). Thus, it is imperative that agriculture and livelihood adaptation measures are based on local-scale data that reflect changes in glacial mass and that these dynamics are considered in future assessments.

Snow accumulation, snow water content, and melt are highly variable from year to year and throughout the Central Asia region, complicating future predictions. Snowmelt contributes far more to stream runoff than glacial melt, even in highly glacierized catchments; the difference is the melt timing, whereby glacial melt contributes to peak runoff in late summer and snowmelt contributes to peak runoff in late spring to mid-summer (Pohl et al. 2015). Because mountain snowpacks are transient, the annual variability in snow accumulation may completely control the supply of surface water in some catchments. In the Pamirs, the winter of 2016-2017 experienced very heavy snowfall producing abundant runoff, flooding, and various water-initiated hazards throughout the region. In contrast, the winter of 2017-2018 had little of snowfall, causing water shortages in summer 2018. The winter of 2018-2019 had a deep and wet snowpack, which generated earlier melting. And the 2019-2020 winter season again had very little snow that mostly disappeared by June. Thus, better knowledge of both long-term trends, as well as interannual variability, areal extent, and water content of snowpacks are needed to provide communities with appropriate climate change adaptation measures, particularly for planning agricultural operations in the forthcoming growing season. As such, simple climate warming scenarios that predict decreasing snow coverage with time will not be useful for mountain communities.

Climate change trajectories and anomalies that affect rainfall also impact water availability. Typical of dry regions, rainfall is rather episodic in both time and space. These temporal, and especially spatial, trends are poorly documented due to very limited measurements in the region. Nevertheless, rainfall contributes much less to water supplies and recharge in the Pamirs compared to snow and glacial melt (Pohl et al. 2015). However, even small episodes of high-intensity rainfall can exacerbate erosion processes in drylands, depending on the spatial distribution and connectivity of runoff and geomorphic processes within the catchment (Sidle et al., 2017). It has been projected that the proportion of rainfall precipitation compared to snowfall will increase as climates warm, although only weak evidence for this trend exists in the low to mid elevations of Central Asia (1500-3500 m) since the mid-1990's; above 3500 m trends are very weak or even reversed (Li et al. 2020). Before the mid-1990's, the contribution of snow to total precipitation increased slightly, although the 57-year record was characterized by very high interannual variability (Li et al., 2020). This once again points to the lack of veracity of climate change projections that affect water resources in Central Asia and suggests that trends in climate variability need to be more intensively investigated rather than using generalized climate change predictions.

Figure 1b: Pamir mountains.
Photo: Roy Sidle

## Relational mechanism: Climate change as discourse of danger and push for regional cooperation

Relying solely on generalized climate change scenarios invokes important discursive effects where water conflicts are perceived as the most likely conflict scenario for the region. This vision fits well with the 'discourse of danger' that describes the region as a place of high vulnerability where violent conflicts will likely occur (Heathershaw and Megoran 2011). Although there were periods when water cooperation was frozen between countries at the political level, at the local level it continued to function even during the acute period of closed borders (Murzakulova and Mestre 2018). Water tensions in the region primarily developed due to political and economic reasons, such as failure to honor their commitments, rather than being triggered by climate change impacts (World Bank, 2004; Pohl, et al. 2019). Moreover, these tensions opened a relational mechanism when water and energy cooperation became increasingly important in the context of water stress, such as the dry years of 2000, 2014, and 2019. Governments realized that instead of calling for adaptation, it is necessary to act differently. Bilateral agreements that extend beyond the local level, such as those between Kyrgyzstan and Kazakhstan on the Chu and Talas Rivers, have started to develop. At the transboundary local level, the Intergovernmental Commission and the Council of Heads of Administration of the border regions between Uzbekistan and Kyrgyzstan, which solves water issues at the local level, have started to work.

The downstream countries have significantly expanded the network of reservoirs in their territories to counteract river runoff changes, protect against winter flooding, and accumulate water for the growing season; Uzbekistan has built seven hydropower plants and will complete four more by the end of 2025. Kazakhstan has announced the construction of 28 reservoirs for a total of 3.8 $km^3$ of water storage by 2030. At the same time, the governments understand that these are costly decisions at the national level and the continuation of such structural solutions is limited; thus, countries are gradually returning to the regional negotiating table to address development issues where water is the core issue.

Regional development dialogues resumed on water issues between 2016 and 2020 after 10 years of suspension. A Central Asian Head of State Summit, Consultative Meetings of Heads of State, and, although Kyrgyzstan froze its participation in the International Fund for Saving the Aral Sea in 2016, the country participated in the last IFAS meeting and expressed its readiness to resume participation.

However, it is noteworthy that the volume of agriculture, which accounts for about 90% of water consumption, is gradually declining in the region's GDP. And the most densely populated country in the region, Uzbekistan, is actively introducing water-saving technologies for agriculture. According to the Conception of Development of Water Sector in Uzbekistan, during the period 2020-2030, the Government will increase the land area where water-saving technologies are implemented for crop irrigation to 2 million hectares and about 600,000 hectares of land will receive drip irrigation. These changes do not mean that painful water allocation issues in region have been resolved, but they signal that countries have started talking about them and are taking constructive measures aimed at agricultural change.

Regional partnership is crucial for Central Asia in all aspects of development, and climate change can be the effective mechanism to reset regional cooperation in a full-scale format. At the same time, as demonstrated by the dynamics of processes in the region, climate change requires a more detailed and localized development agenda that connects applied knowledge, local needs, and political interests. A generalized and often simplified understanding of the impact that climate change on physical and social structures may shift our focus from the relationships that are being formed or rehabilitated in the region to a model which does not reflect local dynamics. In that sense, the development agenda itself must become more adaptable to the context in which it is introduced and operates.

## References:


Chen, Yaning, Weihong Li, Haijun Deng, Gonghuan Fang, and Zhi Li. 2016. "Changes in Central Asia's Water Tower: Past, Present and Future." *Scientific Reports* 6. https://doi.org/10.1038/srep35458.

Frans, Chris, Erkan Istanbulluoglu, Dennis P. Lettenmaier, Andrew G. Fountain, and Jon Riedel. 2018. "Glacier Recession and the Response of Summer Streamflow in the Pacific Northwest United States, 1960–2099." *Water Resources Research* 54 (9). https://doi.org/10.1029/2017WR021764.

Heathershaw, John, and Nick Megoran. 2011. "Contesting Danger: A New Agenda for Policy and Scholarship on Central Asia." *International Affairs* 87 (3). https://doi.org/10.1111/j.1468-2346.2011.00992.x.

Knoche, Malte, Ralf Merz, Martin Lindner, and Stephan M. Weise. 2017. "Bridging Glaciological and Hydrological Trends in the Pamir Mountains, Central Asia." *Water (Switzerland)* 9 (6). https://doi.org/10.3390/w9060422.

Li, Zhi, Yaning Chen, Yupeng Li, and Yang Wang. 2020. "Declining Snowfall Fraction in the Alpine Regions, Central Asia." *Scientific Reports* 10 (1). https://doi.org/10.1038/s41598-020-60303-z.

Lioubimtseva, E., and G. M. Henebry. 2009. "Climate and Environmental Change in Arid Central Asia: Impacts, Vulnerability, and Adaptations." *Journal of Arid Environments*. https://doi.org/10.1016/j.jaridenv.2009.04.022.

Moore, R. D., Ben Pelto, Brian Menounos, and David Hutchinson. 2020. "Detecting the Effects of Sustained Glacier Wastage on Streamflow in Variably Glacierized Catchments." *Frontiers in Earth Science* 8. https://doi.org/10.3389/feart.2020.00136.

Murzakulova, A., and I. Mestre. 2018. "Border Change and Conflict in Central Asia: The Case of Agro-Pastoral Communities in Cross-Border Areas of the Ferghana Valley." In Crisis and Conflict in Agriculture, edited by Rachel Bahn Rami Zurayk, Eckart Woertz, 176–89. *CAB International*. https://doi.org/10.1079/9781786393647.0176.

Oliver, Tom H., and Mike D. Morecroft. 2014. "Interactions between Climate Change and Land Use Change on Biodiversity: Attribution Problems, Risks, and Opportunities." *Wiley Interdisciplinary Reviews: Climate Change*. https://doi.org/10.1002/wcc.271.

Pohl, Benjamin, Annika Kramer, William Hull, Sabine Blumstein, Iskandar Abdullaev, Jusipbek Kazbekov, Tais Reznikova, Ekaterina Strikeleva, Eduard Interwies, and Stefan Görlitz. "Rethinking Water in Central Asia–The costs of inaction and benefits of water cooperation." *Bern: Swiss Agency of Development and Cooperation (SDC). Retrieved* 22 (2017): 2019.

Pohl, E., M. Knoche, R. Gloaguen, C. Andermann, and P. Krause. 2015. "Sensitivity Analysis and Implications for Surface Processes from a Hydrological Modelling Approach in the Gunt Catchment, High Pamir Mountains." *Earth Surface Dynamics 3* (3). https://doi.org/10.5194/esurf-3-333-2015.

Schaner, Neil, Nathalie Voisin, Bart Nijssen, and Dennis P. Lettenmaier. 2012. "The Contribution of Glacier Melt to Streamflow." *Environmental Research Letters 7* (3). https://doi.org/10.1088/1748-9326/7/3/034029.

Sellami, Haykel, Sihem Benabdallah, Isabelle La Jeunesse, and Marnik Vanclooster. 2016. "Climate Models and Hydrological Parameter Uncertainties in Climate Change Impacts on Monthly Runoff and Daily Flow Duration Curve of a Mediterranean Catchment." *Hydrological Sciences Journal 61* (8). https://doi.org/10.1080/02626667.2015.1040801.

Sidle, Roy C., Takashi Gomi, Juan Carlos Loaiza Usuga, and Ben Jarihani. 2017. "Hydrogeomorphic Processes and Scaling Issues in the Continuum from Soil Pedons to Catchments." *Earth-Science Reviews*. https://doi.org/10.1016/j.earscirev.2017.10.010.

Water energy nexus in Central Asia: improving regional cooperation in the Syr Darya Basin. Washington, D.C.: World Bank Group 2004. Accessed 9 September 2020. Available: http://documents.worldbank.org/curated/en/122241468232522184/Water-energy-nexus-in-Central-Asia-improving-regional-cooperation-in-the-Syr-Darya-Basin

Wu, Shanshan, Zhijun Yao, Heqing Huang, Zhaofei Liu, and Yuansheng Chen. 2013. "Glacier Retreat and Its Effect on Stream Flow in the Source Region of the Yangtze River." *Journal of Geographical Sciences* 23 (5). https://doi.org/10.1007/s11442-013-1048-0.

Yuan, Xing, Eric F. Wood, and Zhuguo Ma. "A review on climate-model-based seasonal hydrologic forecasting: physical understanding and system development." *Wiley Interdisciplinary Reviews: Water* 2, no. 5 (2015): 523-536.

Zhou, Yu, Li Zhang, Rasmus Fensholt, Kun Wang, Irina Vitkovskaya, and Feng Tian. 2015. "Climate Contributions to Vegetation Variations in Central Asian Drylands: Pre- and Post-USSR Collapse." *Remote Sensing* 7 (3). https://doi.org/10.3390/rs70302449.


## Researchers/Authors


**Asel Murzakulova**
*Senior Research Fellow*
*Mountain Societies Research Institute*
University of Central Asia



**Roy Sidle**
*Director, Mountain Societies Research Institute*
*Professor, Earth and Environmental Sciences*
University of Central Asia


**Mountain Societies Research Institute**

The University of Central Asia Graduate School of Development's Mountain Societies Research Institute (MSRI) is an interdisciplinary research institute dedicated to addressing the challenges and opportunities within Central Asian mountain communities and environments. MSRI's goal is to support and enhance the resilience and quality of life of mountain societies through the generation and application of sound research.

MSRI has five objectives: To generate knowledge on mountain societies through original scientific research; to serve as a knowledge hub for scholars, development practitioners, and policy makers; to enhance regional capacity to conduct sound research relevant to mountain societies; to inform policy and practice through engagement with key development partners; and to disseminate knowledge among mountain stakeholders, including the co-development and co-teaching of UCA's academic programmes. MSRI, together with its partners, actively works to transfer knowledge to policy and practice aimed at improving the quality of life for people of the mountain areas in Central Asia. For more information on MSRI, please visit: http://www.ucentralasia.org/msri.


University of Central Asia
Mountain Societies Research Institute (MSRI)
138 Toktogul Street, Bishkek, 720001, Kyrgyz Republic
Tel.: +996 (312) 910 822; Fax: +996 (312) 910 835
info@ucentralasia.org
www.ucentralasia.org