

From Fragmented to Integrated Knowledge for Sustainable Water and Land Management and Governance in Highland–Lowland Contexts

u^b

b
**UNIVERSITÄT
BERN**

CDE
CENTRE FOR DEVELOPMENT
AND ENVIRONMENT

The crucial role mountain ecosystems play for mountain communities and people living in the lowlands is emphasized by the 3 mountain-specific targets of Agenda 2030 (targets 6.6, 15.1, and 15.4). To achieve these targets, sound and integrated knowledge is needed for policy- and decision-making that fosters sustainable management of water and land resources in mountain areas, including equitable negotiation of trade-offs between stakeholders. The Water and Land Resources Centres in Kenya and Ethiopia and the recently approved Global Land Programme working group on Land Systems for Mountain Futures are just 2 of a number of initiatives launched by the Centre for Development and Environment and its partners to integrate and share knowledge for evidence-informed policies and practices aimed at safeguarding key mountain ecosystem services.

An integrative focus on highland–lowland interactions

The number of people living in mountains or depending on natural resources from mountains is constantly on the rise. Hence, competition for these resources is increasing, and it is even more important than in the past to focus on the governance of natural resources in mountains. Governance approaches have to consider the complex linkages between land and water uses, current dynamic changes, and highland–lowland interactions in order to allow equitable benefit- and cost-sharing and foster conservation of mountain ecosystems. While the global Agenda 2030 (UN 2015) sets meaningful targets in this respect, it does not offer comprehensive

insights into the challenges involved, nor is its purpose to provide knowledge on how to accomplish the internationally agreed goals in sustainable ways. Knowledge of socio-ecological conditions, interactions, and dynamics, and of ways to shape sustainable and just use of water and land resources in mountain regions, is urgently needed. Currently, the relevant information is often fragmented, organized by sectors, based on case studies, and not easily accessible and comprehensible by the wide range of stakeholders involved in water and land resource management. Science has an important role to play in compiling, validating, and analyzing such information and making it accessible in a way that supports learning processes and effectively informs policy- and decision-making. Together with its partners, the Centre for Development and Environment (CDE) believes that such efforts are crucial. It is therefore seeking innovative solutions, as illustrated by the following 2 examples.

Effectively informing policy and practice in Ethiopia, Kenya, and Tanzania

Transboundary river basins in the Horn of Africa (Ethiopia) and East Africa (Kenya and Tanzania) face multiple environmental, social, and economic challenges that have impacts on hydro-political relations both within and beyond national borders. To support hydro-political negotiations and decision-making, CDE and its partners in the 2 regions established hydro-meteorological

observatories that feed rich data into open-access repositories, produce tailor-made information products for various stakeholder groups, and implement innovative and transformative land and water management activities.

Since 2011 the Water and Land Resource Centres (WLRCs), supported by the Swiss Agency for Development and Cooperation, have been serving as national knowledge hubs. With tailor-made knowledge products, the WLRCs reach out to local community members, policymakers, and professionals at governance levels ranging from the subnational to the national, regional/transboundary, and international level. For example, targeted communication products inform resource and land users, thematic guidelines target the development community, and policy briefs address the knowledge needs of policy- and decision-makers. Two web-based platforms—the Water and Land Resource Information System in Ethiopia (<http://walris.wlrc-eth.org/>) and the Socio-hydrological Information and Knowledge Platform in Kenya (<http://wlrc-ken.org/>)—provide the scientific basis of the WLRCs by bringing together data from different sectors and levels. Both platforms are openly accessible to all interested stakeholders.

The learning watershed approach in Ethiopia

The WLRC-AAU (Addis Ababa University) in Ethiopia focuses on the Blue Nile Basin in the Ethiopian Highlands and is associated with Addis Ababa University and CDE.

FIGURE 1 Learning watersheds used as live learning platforms: (A) regional policymakers led by the regional president appreciating progress in a learning watershed; (B) farmers checking a newly introduced crop variety and comparing it with their local variety. (Photos by Dr Gizaw Desta, WLRC-AAU Ethiopia)



Over the last centuries, water and land resources in the Ethiopian Highlands have been subject to increasing demand from subsistence farming and other forms of agriculture. This has had negative on- and off-site effects, both in Ethiopia and in downstream countries. Increased sediment load in the Nile River, leading to siltation of downstream hydropower and irrigation dams in Ethiopia, Sudan, and Egypt, poses a major threat to infrastructure investments as well as to local livelihoods. At the same time, the loss of fertile soil and nutrients has reduced the productivity of rain-fed agriculture in the Ethiopian Highlands.

Against this background, knowledge generation and sharing of best practices in the application of integrated water and land management technologies are essential in order to significantly increase food production, enhance water productivity, improve the livelihoods of subsistence farmers, and reduce the potential impacts of siltation downstream and related conflicts. The WLRC-AAU-Ethiopia established 6 model “learning watersheds” in the Abbay Basin (Blue Nile). These watersheds serve as interactive learning platforms based on research-supported participatory integrated watershed development activities. The platforms bring together researchers, development actors (eg extension workers and policymakers), and communities, with a view to enhancing livelihoods and improving environmental quality in a

holistic way (Figure 1). Lessons learned from these activities have been scaled up for interventions elsewhere in Ethiopia and in other suitable locations in the Eastern Nile Basin.

Equitable negotiation and use of water resources in Kenya and Tanzania

The WLRC in Kenya focuses mainly on the Ewaso Ng’iro Basin (Kenya and Somalia) and the Pangani Basin (Kenya and Tanzania). It is facilitated and implemented by the Centre for Training and Integrated Research in ASAL Development in Nanyuki, Kenya. Both basins are severely water stressed, and pressure on water is expected to continue to build as a result of economic development and population growth. The Kenyan devolution process and the 2016 Water Act delegated responsibility to, and reaffirmed the key role of, the Basin Water Committees and grassroots organizations (Water Resources Users Associations or WRUAs) in water resources management and governance at the basin and subbasin levels. The WLRC supports these actors in fulfilling their crucial task by providing them relevant water- and land-related information as well as developing the capacity to effectively use this knowledge to produce more sustainable solutions. For example, in a pilot project, WRUAs in Kenya receive real-time stream flow and climate data to regulate water abstraction in upstream and downstream areas. This enables

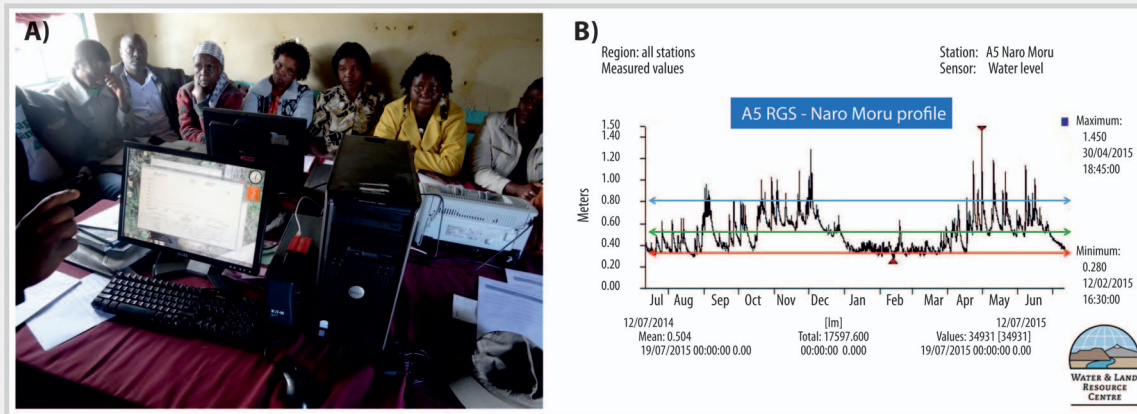
actors at the grassroots level to negotiate water allocation, enhancing equity among different user groups and ultimately reducing user conflicts, especially during dry seasons when water scarcity is greatest and demand is at its peak, thereby contributing to more evidence-informed and equitable water governance (Figure 2).

Land system knowledge to guide transformation toward sustainable mountain futures

The Global Land Programme (GLP) is an interdisciplinary community of science and practice that conceives of land systems as the result of human interaction with the natural environment (GLP 2016). It seeks to better understand drivers of and trends in land change, as well as the impacts of change on societies and the functioning of ecosystems. Given the large share of mountain people in developing countries who are assessed to be vulnerable to food insecurity (FAO 2015) and the increasing influence of global change processes on mountain land systems, in-depth and integrated understanding of patterns of land system changes in mountain areas is urgently needed. Such synthesis can serve as a basis for land governance schemes co-designed with stakeholders and for sustainable management practices at different levels.

With its more than 2000 members worldwide, GLP is an unprecedented

FIGURE 2 (A) Members of the management committee of the Naro Moru River Water Resources Users Association are trained in the basics of interpreting the water flow curve and decide on (B) jointly negotiated thresholds-based Q values to guide evidence-based spatiotemporal allocation of river water among different user groups in the subcatchment. (Photo by CETRAD Photo Gallery; graph courtesy of WLRC Kenya)



source of knowledge on land systems and land dynamics, not only in lowlands but clearly also in mountain regions worldwide. To capitalize on this source of multidisciplinary scientific findings and translate it into actionable information for policy and practice in mountains, CDE—together with partners in Argentina, China, and Japan—established the first working group of its kind within the GLP in 2017 (<https://glp.earth/how-we-work/working-groups/land-systems-mountain-futures>). The working group, entitled Land Systems for Mountain Futures, aims to synthesize case-study-based research findings and co-produce land systems knowledge specific to mountains, with the goal of supporting agenda setting and actions promoting more sustainable mountain development. Thanks to the worldwide networks of GLP with international, governmental, and nongovernmental organizations, scientific societies, and a wide range of stakeholders, the insights elaborated by the working group can reach out far beyond GLP, for example to the International Panel on Climate Change, the International Platform on Biodiversity and Ecosystem Services, or the Sustainable Development Solutions Network.

Outlook

The WLRCs and the GLP working group are just 2 of CDE's lines of

action that also contribute to the SDC-funded program Sustainable Mountain Development for Global Change (SMD4GC). This program seeks to advance international, regional, and national development agendas for the benefit of mountain people and regions. Activities include conferences, networking, and numerous publications for a variety of audiences, jointly organized and produced with partners around the world. The most recent publication of the SMD4GC program, entitled *Safer Lives and Livelihoods in Mountains: Making the Sendai Framework of Disaster Risk Reduction Work for Sustainable Mountain Development* (Wymann et al 2017), was shared with a broader public at the Global Platform for Disaster Risk Reduction in Cancun in May 2017. The next issue in this series, also coordinated by CDE, will highlight the contributions and challenges of migration in relation to sustainable development in mountains.

As part of its strategy for 2016–2021 (CDE 2016), CDE will continue to commit to fostering sustainable development in mountain regions. This implies continuation of disciplinary, interdisciplinary, and transdisciplinary research together with its regional and international partners in mountain contexts as well as support for policy- and decision-making that pays special attention to the specific potentials and challenges of mountain societies and regions.

FURTHER READING

Websites and online platforms

Land Systems for Mountain Futures. <https://glp.earth/how-we-work/working-groups/land-systems-mountain-futures>
 Socio-Hydrological Information and Knowledge Platform, Kenya and Tanzania. <http://wlrc-ken.org/>
 Water and Land Resource Center Project. http://www.cde.unibe.ch/research/projects/the_water_and_land_resource_centre_project_wlrc/index_eng.html
 Water and Land Resources Centre, Ethiopia. www.wlrc-eth.org
 Water and Land Resources Information System, Ethiopia. <http://walris.wlrc-eth.org/>

Policy brief

Lanari N, Liniger HP, Kiteme BP. 2016. *Commercial Horticulture in Kenya: Adapting to Water Scarcity*. CDE Policy Brief No. 8. Bern, Switzerland: Centre for Development and Environment. http://www.cde.unibe.ch/research/products/policy_briefs/index_eng.html

REFERENCES

- CDE [Centre for Development and Environment]**. 2016. *Strategy 2016–2021*. Bern, Switzerland: Centre for Development and Environment. http://www.cde.unibe.ch/unibe/portal/fak_naturwis/g_dept_kzen/b_cde/content/e65019/e580489/e580498/e580493/CDE_Strategy_2016-2021_eng.pdf; accessed on 14 July 2017.
- FAO [Food and Agriculture Organization]**. 2015. *Mapping the Vulnerability of Mountain Peoples to Food Insecurity*. Edited by Romeo R, Vita A, Testolin R, Hofer T. Rome, Italy: FAO.
- GLP [Global Land Programme]**. 2016. *Science Plan and Implementation Strategy 2016–2021*. Bern, Switzerland: GLP. <https://glp.earth/sites/>

default/files/uploads/glpscienceplan_25_10_16.pdf; accessed on 14 July 2017.

UN [United Nations]. 2015. *Transforming our World: The 2030 Agenda for Sustainable Development*. A/RES/70/1. New York, NY: United Nations. <https://sustainabledevelopment.un.org/post2015/transformingourworld/publication>; accessed on 14 July 2017.

Wymann von Dach S, Bachmann F, Alcántara-Ayala I, Fuchs S, Keiler M, Mishra A, Sötz E, editors. 2017. *Safer Lives and Livelihoods in Mountains: Making the Sendai Framework for Disaster Risk Reduction Work for Sustainable Mountain Development*. Bern, Switzerland: Centre for Development and Environment (CDE), University of Bern, with Bern Open Publishing (BOP). http://www.cde.unibe.ch/research/projects/mountain_agenda/safer_lives_and_livelihoods_in_mountains/index_eng.html; accessed on 3 July 2017.

AUTHORS

Isabelle Providoli^{1*}, Gete Zeleke², Boniface Kiteme³, Andreas Heinimann¹, and Susanne Wymann von Dach¹

* Corresponding author: isabelle.providoli@cde.unibe.ch

¹ Centre for Development and Environment, University of Bern, Hallerstrasse 10, Bern, Switzerland

² Water and Land Resource Centre – Addis Ababa University (WLRC-AAU), Rahem Building, Diaspora Square, Megegnagna, PO Box 3880, Addis Ababa, Ethiopia

³ Centre for Training and Integrated Research in ASAL Development, Buttsons Complex Building, Off Hospital Road, 2nd Floor, PO Box 144–10400, Nanyuki, Kenya

© 2017 Providoli et al. This open access article is licensed under a Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>). Please credit the authors and the full source.

Reproduced with permission of copyright owner. Further reproduction prohibited without permission.