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Source: Mountain Research and Development, 28(3) : 196-200

Published By: International Mountain Society

URL: https://doi.org/10.1659/mrd.1038

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Mountain Research and Development Vol 28 No 3/4 Aug–Nov 2008: 196–200 doi:10.1659/mrd.1038

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Water Resource Research and Education in Mountain Communities



High elevation páramo *(wetland) ecosystems in the Andes are important water sources for local communities and downstream agricultural and urban users. These headwater catchments, however, are often impacted by human activities (eg agricultural production) that affect both stream water quality and flow. Knowledge about water availability, quality, and use is essential for effective management but is often lacking, particularly in smaller mountain communities. Studies of natural resources in mountains, conducted jointly with local actors and with the participation of youth, are a way for rural communities to learn about their resources, appropriate this knowledge, and improve their quality of life. Research projects that involve youth in remote rural zones, where education is not of the same quality as in urban centers, represent an important opportunity for youth to acquire skills and relevant knowledge for their personal development and for participation in development processes. The present article presents a process and the results of a project that studied water resources in Bolivia and Colombia with local youth and water users. The research themes in the 2 countries were different, responding to the concerns of their respective communities, but the results had a similar major impact on the lives of young researchers, on the communities' perception of the state of their natural resources—in particular water—and on the role of knowledge in generating creative options for improving resource management and the quality of life in mountain communities.*

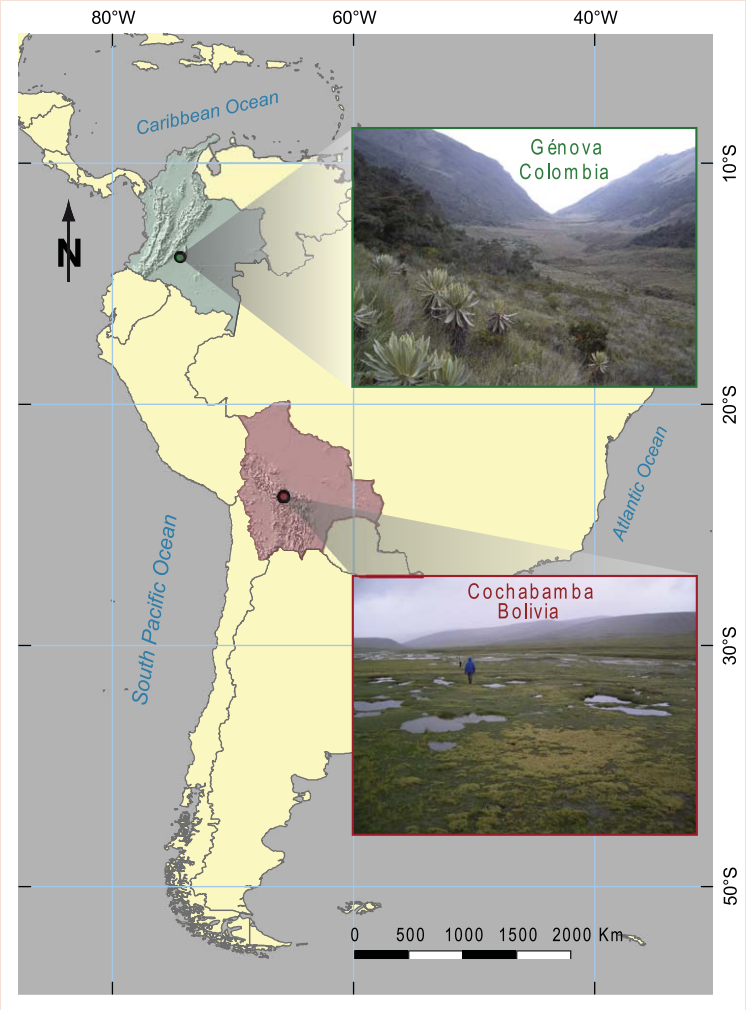


FIGURE 1 Location of the 2 study sites. (Map by the authors and Ulla Gaemperli)

Youth and natural resource research in mountain areas

Research may be directly linked to development by conducting the entire process with local stakeholders. In this case the issues are seen from the point of view of rural youth and the institutions that provide their education. The rationale of targeting the young rural population and their educators is that changes in attitudes and perceptions about environmental sustainability are long-term processes that require changes in educational patterns; and that the process of ownership of resources by local actors can be facilitated when knowledge is generated and communicated by local youth who represent the communities themselves. The focus on water-related issues in the 2 communities involved in this project—Tiquipaya, in the Cordillera of Cochabamba, Bolivia, and Génova, in the Central Cordillera, Colombia (Figure 1)—responds to the perception of water as a basic resource to be managed as a public good, based on equitable access in terms of quality and quantity, and as a component of a healthy environment for human livelihoods.

The research process

The process of research on natural resources with rural youth was conducted with the participation of local actors. Step

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1 was the socialization of the project, clarifying objectives and expected results. The participation of education centers, teachers, students, and local institutions was essential in motivating participation. In Step 2, these actors were important as holders of local knowledge in the definition of relevant research themes and case study sites.

The research themes and sites were clarified with the students (Step 3); participation was voluntary, and their motivation, time constraints, and commitment to the local community were evaluated. The necessary resources and research costs were calculated, and with support from local education centers, interested youth formulated proposals (Steps 4–5). Proposals were revised and approved by the team, and the research implemented by youth (Steps 6–7). The young researchers analyzed the results, elaborated the final report, and presented the results to their peers, participating institutions, and the local community (Steps 8–10). The final phase was to select follow-up research themes based on the knowledge generated.

Water quality and access to water in the highlands of Bolivia

Water use and access to water are central to Bolivia's current water crisis. The water rights of many indigenous communities are not recognized, particularly at high elevations. Seasonal water shortages are extreme, and competition for water between sectors is intense. The Tiquipaya watershed is representative of upstream–downstream water distribution issues within Bolivia. Through working with youth from upland and downstream communities, the project encompassed unequal water rights and access concerns (domestic versus other sectors), and investigated water quality from surface and groundwater sources (Figure 2). The communities of Titiri and Totora, above 4000 m, are poor rural communities in the headwaters. Tiquipaya, downstream at 2600 m, is significantly larger and more "urbanized." Conflicts over access to water exist between domestic and agricultural uses, and water available for irrigation is generally of poor quality.

FIGURE 2 Water quality sampling, Tiquipaya, Bolivia. (Photo by Sandra Brown)



A fundamental component of working on water-related issues in Bolivia is the socialization of projects with local communities and water user committees. After several town meetings and discussions with the irrigation users' committee, both communities agreed to support the project and youth groups were formed in the upper and lower watershed. Diagnostic workshops were conducted with local youth to discuss water issues in both communities and to design research questions that could help to solve those issues (Table 1). Activities were specified and undertaken in the 2 zones, including water source mapping, wetland coring, and greenhouse vegetable production in the upper watershed; water rights' analysis, computing and mapping of distribution systems in

TABLE 1 Issues identified by local youth in Bolivia.

Titiri / Totora (4090 m)	Tiquipaya (2650 m)
Water quantity	Water shortages / quantity
Access and use of water	Water quality / contamination
Water quality	Water use
Food security	Water rights / distribution

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the lower watershed; and water use and quality analysis in both zones.

Pollution of water sources and/or distribution systems was a concern related to animal grazing and the lack of latrines in water sources areas. Water quality analysis showed the highest bacteriological contamination in downstream non-treated portions of the distribution system, while headwater sources and water intake from deep wells were generally free of bacterial contamination. However, diluted wastewater and contaminated canal water is used in peri-urban agriculture, and the microbial contamination of lettuce is of particular concern for human health. Taking advantage of a niche market opportunity and local food security concerns, the youth of the Cordillera (4200 m) initiated a tunnel-type greenhouse project to produce vegetables. The greenhouses provide the possibility for youth to generate a small income and expand lettuce production targeted for the market, taking advantage of the good water quality in the Cordillera.

Impact of agricultural activities on water quality and quantity in Colombia

Water resources in Colombia are abundant in general, but seasonal water shortages are common, particularly in the Andean region where the population is concentrated and water is withdrawn for human activities such as agriculture. Water sources are limited not only in their availability but also in quality, which can restrict consumptive use.

Colombia has undertaken an initiative of rural regional centers of higher education, where participatory action research in water resources is being incorporated as a pilot project. Following the steps outlined above, student researchers and local partners formulated research questions relevant to the municipality of Génova (Figure 3). The specific goals were to investigate the impact of agriculture and livestock activities on water quality, hygiene practices related to water handling in homes, the effectiveness of the local water treatment plant, and local water use practices.

Water quality parameters were measured by youth, generating knowledge on the conditions upstream and downstream of the local treatment plant, the impact of water released from coffee processing, and the impact of wastewater release. The results demonstrated that the source water complied with most standards for human consumption, with the exception of bacterial (coliform) contamination. The treatment plant was effective in reducing turbidity and eliminating bacterial contamination related to cattle ranching in the headwaters. However, downstream sewage discharge from the urban zone of Génova results in significant increases in bacterial contamination.

When the youth presented their results to the community, confidence in the water purveyor was increased, and practices that people have maintained over the years such as boiling and storing water for domestic consumption are now being questioned, as the quality of water provided does not require further treatment at home, and energy use and risk of storage contamination are also reduced.



FIGURE 3 Research theme diagnostic, Génova, Colombia. (Photo by Cristina Harris)

Leadership skills and integration

In parallel with the research process, workshops for the development of leadership skills were conducted. They focused on self-awareness, group affiliation, self-

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confidence, goal setting, and teamwork. Exercises reinforced public speaking skills, leadership roles and responsibilities, group participation, and the process of designing and conducting research projects. Workshops aided the development of individual skills, the generation and expression of new ideas, and integrating youth from different areas. The workshops were conducted for students and their mentors—teachers in Colombia and community organizations in Bolivia.

Once the research projects were well advanced, an international exchange workshop was arranged. A group of 10 young researchers from Bolivia traveled to Colombia and exchanged results with young researchers from Génova. The contrasting results on water use gave the participants a sense of the value of their work. Domestic water use in Génova averaged 104 L/person/day in the urban area and 245 L/person/day in the rural upper watershed, compared to 66 L/person/day in rural Tiquipaya and only 11 L/person/day in the upper Cordillera of Cochabamba (Figure 4). Households in the upper Cordillera of Cochabamba do not have flush toilets or showers and use 6 times less water than the lower Tiquipaya watershed, despite being the source water region. By contrast, in Génova the upper watershed is "unregulated" and uses >2 times the water that the urban center uses. The Bolivian group presented a theater play to illustrate how water rights are assigned in their area; this had a major impact on the Colombian youth, who understood the benefits of collaboration in sharing a scarce resource.

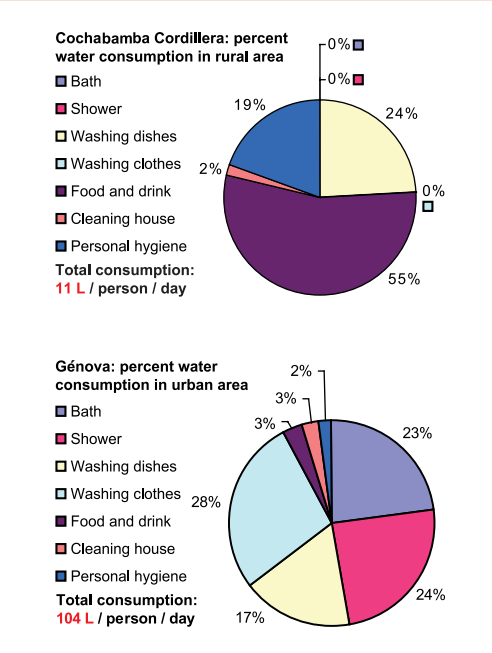


FIGURE 4 Domestic water use in Tiquipaya (Bolivia) and Génova (Colombia).

Similarities and differences between the 2 countries

In Colombia some students participated in the project work for the municipality or the local aqueduct. Their research was directly relevant to their work activities and facilitated the involvement of decision makers. In some cases the employer provided the time and resources required by the project, and adopted the recommendations of the research. In Bolivia the students were chosen by their communities based on the perception of how individual youth will be involved in water management in the future.

During the 3 years of the project, the student drop-out rate was a significant challenge. In Colombia, 31% of initial participants left the project, mainly due to economic reasons or pregnancy. In Bolivia, gender imbalance within the groups was a challenge, and youth drop-out was largely related to the need to work in family-run businesses or farms. The young participants from both countries expressed how their involvement with real problems changed their perspectives. In Bolivia, the youth of 2 distinct but neighboring communities had an opportunity to work together on the solution of common problems. Water served as the means through which the youth from the valley understood the challenges of life in the high mountains, and 2 of the youth were hired to maintain the water quality monitoring program. Participants in Colombia expressed the sense of responsibility they acquired through direct contact with farmers and the understanding of the issues that challenge them as a community.

Lessons learned

Research tools and leadership skills for rural youth were successfully combined in

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FIGURE 5 Participatory water source mapping, Cordillera of Cochabamba, Bolivia. (Photo by Sandra Brown)



this project to generate and disseminate knowledge about the state of local natural resources and about water as a critical resource for improving livelihoods. Through the generation of local knowledge and acquired communication skills, projects were formulated to improve resource management in the micro-catchments. Issues related to water availability, water pollution, and water use were quantified by local youth, and mitigation options were investigated with local water users (Figure 5). Young researchers gained valuable analytical skills and an understanding of pollution issues in their communities, which they were able to communicate and use to initiate behavioral change.

The systematic application of participatory research and leadership tools is a way to target education in rural areas while boosting development processes that involve the use and management of natural resources. The application of these tools and the implementation of the project in other areas should take account of the uniqueness of each mountain community. Not only are issues different: so are paces, priorities, and perspectives.

ACKNOWLEDGMENTS

The authors wish to thank the International Center for Tropical Agriculture for institutional and logistical support; the Colombian National Ministry of Education for their interest in incorporating the results of this project within the national rural education system; Maria Cristina Harris for her work in Génova; and our donors, the W.F. Kellogg Foundation and the Canadian International Development Agency.

FURTHER READING

Brown S, Roa C, Yepes LD, Ceballos JL. 2007. Protocol for the characterization of water and carbon cycles in high-mountain ecosystems. *Mountain Research and Development* 27(4):372–375.

Goedkoop J, Roa MC, Barahona JM, Menéndez JL. 2004. Youth and research: Experiences from Honduras and Colombia. *LEISA Magazine* 20(2):12–13.

Roa MC, Brown S, editors. 2005. *Jóvenes Investigadores: Educación, Recursos naturales y Seguridad Alimentaria* [in Spanish]. CD-ROM. Vancouver, BC: W.F. Kellogg Foundation. CD-ROM available from Sandra Brown.

Roa MC, Brown S, Roa CE, Diaz E, Hernández AM. 2008. *The Role of Youth in Natural Resource Management and Food Security: Improving Education for Rural Development.* Final report for W.F. Kellogg Foundation. Cali, Colombia: CIAT [International Center for Tropical Agriculture] and Ministry of Education of Colombia.

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