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Decolonizing Knowledge:
Plural Visions of Water Conservation in the Ecuadorian Highlands

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Abstract

In Ecuador, the Andean highlands ecosystems, also known as *páramos*, are essential for producing water for human consumption and irrigation. Some *páramos* in the country are managed by indigenous communities that have contributed to their conservation through principles of reciprocity, territory and culture. However, these community-led initiatives are often marginalized by techno-scientific discourses and visions of water as promoted by public authorities as well as international experts working on these issues. Faced with these limitations, local water justice movements advocate for a more politicized approach that aims to shed light on the unequal distribution of benefits, access and control over water, as well as the tensions surrounding water rights, knowledge and cultural practices. This article draws on a case study in the communities of Cangahua, located in the northern highlands of Ecuador, where the Ñukanchik Urku *páramo* committee is contributing to watershed conservation based on community management principles. This study aims to examine the processes of decolonizing knowledge around water conservation practices in the community *páramo* of Ñukanchik Urku. Using participatory and transdisciplinary research methods from a decolonial perspective, this article questions the boundaries between techno-scientific and local and indigenous knowledge regarding water conservation.

Keywords: Water conservation, Community-based management, Local environmental knowledge, Decolonization, Ecuador

Descolonizando el conocimiento: Visiones plurales de la conservación del agua en la sierra ecuatoriana

Resumen

En Ecuador, los ecosistemas de las tierras altas andinas, también conocidos como páramos, son esenciales para producir agua para consumo humano y riego. Algunos páramos del país son manejados por comunidades indígenas que han contribuido a su conservación a través de principios de reciprocidad, territorio y cultura. Sin embargo, estas iniciativas comunitarias a menudo quedan marginadas por los discursos y visiones tecnocientíficas del agua promovidos tanto por las autoridades públicas como por los expertos internacionales que trabajan en estos temas. Frente a estas limitaciones, los movimientos locales por la justicia del agua a escala local defienden un enfoque más politizado que busca arrojar luz sobre la distribución desigual de los beneficios, el acceso y el control sobre el agua, así como sobre las tensiones en torno a los derechos, el conocimiento y las prácticas culturales sobre el agua. Este artículo se basa en un estudio de caso en las comunidades de Cangahua, ubicadas en la sierra norte de Ecuador, donde el comité del páramo Ñukanchik Urku está contribuyendo a la conservación de cuencas basándose en principios de manejo comunitario. Este estudio tiene como objetivo examinar los procesos de descolonización de conocimientos en torno a las prácticas de conservación del agua en el páramo comunitario de Ñukanchik Urku. A través del uso de métodos de investigación participativos y transdisciplinarios desde una perspectiva descolonial, este artículo cuestiona los límites entre el conocimiento tecnocientífico y el conocimiento local e indígena sobre la conservación del agua.

Palabras clave: Conservación del agua, Administración comunitaria, Conocimiento ambiental local, Decolonización, Ecuador

Introduction

Every morning, an *Urku kama*—guardian of the hills in Kichwa—walks extensive kilometers of community lands that are found in the upper parts of the Cangahua parish. Their responsibility is to ensure that those who live nearby, as well as potential visitors, do not bring in livestock, cause fires, or damage the landscape. Their objective is to safeguard the multiple benefits offered by the *Urku*—the segment of the hills where the mist hits—also known by its European, "*páramo*", which means arid and cold land (Llambi *et al.*, 2012). Among the main benefits provided by the *Urku* are water storage, habitat for endemic species, spaces of cultural importance, among others (Hofstede *et al.*, 2023). The lands that the *Urku kama* oversee are collectively owned and are under the active management of the Ñukanchik Urku Committee, which means "Our Mountain" in Kichwa. The Ñukuanchik Urku *páramo* extends over an area of 4300 hectares and has a water retention function used for human consumption and irrigation (López-Sandoval & Maldonado, 2019). The *páramo* supplies water for more than 700 families, including areas within the Metropolitan District of Quito (DMQ).

The Committee began in 1995 as a community organization made up of indigenous communities that own the *páramo*, beneficiary communities of the *páramo*, water boards, and second-level organizations (López-Sandoval & Maldonado, 2019). Indigenous communities of the area belong to the Kayambi People, organized through a second level organization named the Kayambi People Confederation. Within the Committee, the communities designate nine *Urku kamas* who have the role of watching over the *páramo* through voluntary and supportive work for the benefit of the communities that live in the area. Reciprocity, territory and culture are fundamental principles that guide the protection of water by communities. By ensuring socio-productive development in the surrounding areas, the effective conservation of this vital ecosystem is ensured. The experience of the Ñukanchik Urku Committee is a unique example, adapted to the local context of its peoples, their history and their culture.

Despite its historical contribution to the conservation of the *páramos*, the efforts of the Ñukanchik Urku Committee remain invisible or little recognized by the populations of urban areas, such as Quito and Cayambe, who benefit from the high-quality and abundant water preserved in the watersheds of the *páramos*. Additionally, public authorities in those cities tend to grant more credibility to techno-scientific information produced by technical experts over the historical and local knowledge held by the communities living close to the *páramo* territory. This dynamic can be observed, for example, in the production of maps and statistical data on water quality and conservation. During these processes, technicians from

the Cayambe municipality clearly value data produced by public or independent experts over the knowledge held by indigenous communities, which is framed as empirical. This separation reveals the existence of competing forms of knowledge and practices in relation to water resources, ranging from productive and economic values to socio-organizational, cultural, politico-legal, and techno-scientific values (Dupuits *et al.*, 2023).

Therefore, this article seeks to examine the processes of decolonizing knowledge around water conservation practices in the community *páramo* of Ñukanchik Urku. Through this article, we aim to bring into dialogue the various voices and knowledge around water and the *páramo*, particularly those of traditionally marginalized actors or approaches. This is a call for a knowledge dialogue that questions decontextualized global approaches to the study of water and requires continuous repositioning and relearning based on concepts and values produced by grassroots movements and organizations.

The analysis is based on two interconnected field experiences in the *páramo* of Ñukanchik Urku in Ecuador. On the one hand, it draws from a social engagement project implemented between January and March 2023, titled "Knowing the community *páramos* of Ecuador. Environmental and territorial education in Cayambe, Ecuador". The project consisted of bringing young people (high school and university level) from the city of Quito to discover community *páramos* in the Cayambe area through exchanges with young people who live in communities that care for water and the *páramo*. The broader objective was to promote environmental education among 60 young people across urban-rural areas, to foster exchanges of knowledge and practices. On the other hand, water quality analyses—including chemical, microbiological, and aquatic macroinvertebrates analyses—were conducted in the territory with community participation from the Ñukanchik Urku *Páramo* Committee. The objective of these analyses was to counter-map the reality of water conservation for human consumption and irrigation from the grassroots and the territory. Both activities were conducted with a decolonial lens, using participatory and transdisciplinary research methods, as further explained.

More broadly, the objective of this article is to empirically illustrate what forms of knowledge are valued by the different actors involved in water conservation practices, their cross-fertilization dynamics, and possible tensions. It draws attention to the diverse voices and knowledge on water that emerge from the Global South, including traditionally marginalized actors and approaches.

1. Decolonizing Knowledge Around Water Conservation Practices

The theoretical approach used to guide the project as a framework of reference is political ecology. Political ecology focuses on how natural resources are managed and controlled within power relations (Sutton & Anderson, 2004, p. 311). Therefore, the field of study of political ecology addresses topics such as degradation and marginalization, environmental conflicts, conservation and control, and environmental identities and social movements (Peet & Watts, 1996, p. 6; Robbins, 2004, p. 14). It focuses on "the study of everyday conflicts, alliances, and negotiations that ultimately result in some type of definitive behavior; how policy affects or structures the use of resources" (Sutton & Anderson, 2004, p. 311).

From a political ecology perspective, there is a growing interest in the co-creation, co-production, and knowledge dialogues around water resources. One key concept that has been used to study those interactions among various forms of knowledge is environmental knowledge politics (Horowitz, 2015; Foyer & Dumoulin, 2017; Ulloa, 2019; Boelens *et al.*, 2019; Ulloa *et al.*, 2020). Within this framework, authors have analyzed the co-production of knowledge in community water management (Goodwin, 2019; Dupuits, 2021), multi-stakeholder negotiation dynamics during water conflicts (Dupuits *et al.*, 2020), and the encounters and tensions between different types of knowledge surrounding water resources (Boelens *et al.*, 2019; Ulloa *et al.*, 2020), among other topics.

Another approach to understanding knowledge co-creation is through knowledge ecology and the coloniality of knowledge (Quijano, 2008), which examine the capitalist and colonial dynamics of knowledge imposition and the need for more knowledge dialogues. This approach also includes "the demand for new production processes and assessment of valid knowledge, scientific and non-scientific, and new relationships between different types of knowledge, based on the practices of classes and social groups who have systematically suffered unfair inequalities and discrimination caused by capitalism and colonialism" (De Sousa Santos, 2011, p. 35).

As previously mentioned, water resources are subject to various and potentially conflictive interpretations and values depending on the actors, revealing the multiple ontologies of water (Bonelli *et al.*, 2016; Blaser & De la Cadena, 2018). Two main values that emerge in the study of water knowledge politics are local and traditional knowledge, on the one hand, and techno-scientific knowledge, on the other (Dupuits & Mancilla Garcia, 2022).

On the one hand, local environmental knowledge—or, alternatively, indigenous knowledge or traditional ecological knowledge—refers to a "cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings

(including humans) with one another and with their environment" (Berkes, 2012, p. 7). In his analysis of the epistemologies of the South, De Sousa Santos (2011, p. 27) explains how "the movements of the Latin American continent, beyond contexts, build their struggles based on ancestral, popular, spiritual knowledge that they were always alien to the scientism typical of Eurocentric critical theory". At the local level, actors such as environmental and grassroots movements and organizations are reframing sustainability and conservation schemes from a water justice approach. This politicized perspective draws attention to the existing inequalities around water access and control, as well as the distribution of benefits associated with its use. Studies on water justice consider debates over the rights of nature and the use of local/traditional knowledge and cultural practices. Water justice movements also tend to interpret the Sustainable Development Goals (SDG) global agenda through a more cross-sectoral and integrated perspective, compared to the deterritorialized and functional frameworks of ecosystem services (Boelens *et al.*, 2016; Boelens *et al.*, 2018).

On the other hand, for public authorities and the private sector, water is often framed as a natural resource of vital importance for the industrial and energy production processes necessary for the reproduction of the neoliberal model (Swyngedouw, 2015; Jasanoff & Kim, 2015). This productive and economic understanding of water is often related to techno-scientific and socio-technical knowledge. One particular characteristic of modern Western society is the historical and colonial imposition of scientific knowledge and the claim of its superior credibility over other forms of knowledge (De Sousa Santos, 2011; Leff, 2015). On a global scale, the production of expert knowledge about water is most often related to techno-scientific and market-based approaches to water resources (Jasanoff, 2004). These approaches can be found in global discourses and norms on integrated water resources management (IWRM), ecosystem services and other types of market-based mechanisms that reveal economic and technical valuations of water. Consequently, global and regional ecosystem services conservation initiatives tend to produce a 'commodification' of water territories and clashes with local water rights, as well as a 'depoliticization' process (Boelens *et al.,* 2014; Dupuits *et al.*, 2020).

However, various authors point out the need to break with dichotomous approaches that oppose scientific and local knowledge and, instead, highlight their strategic encounters, political use, and dynamic interweaving in contexts of unequal power structures (Robbins, 2003; Li, 2013). These authors question the borders between techno-scientific and local/traditional knowledge, focusing on the situated practices of different actors in the co-production and co-creation of knowledge around water conservation. On the one hand, grassroots and indigenous movements may strategically use expert and scientific knowledge to gain credibility and support—for example, by producing community-led environmental monitoring

or co-management of protected natural areas (Bäckstrand, 2004; Sánchez-Vasquez, 2019). On the other hand, scientists and technical experts should also consider indigenous knowledge when producing information and knowledge, for example, in relation to climate science (Hernandez *et al.*, 2022).

As another example of knowledge co-creation, international actors have tried to integrate indigenous and local knowledge into the production of scientific expertise on a global scale. For example, according to the recent global discourse promoting Nature-Based Solutions (NbS)[4], solutions to the environmental and climate crisis should combine various values of nature and knowledges, community engagement processes, and ecosystem management practices (Palomo *et al.*, 2021). The authors found that over 80 % of NbS combined various forms of knowledge, highlighting the usefulness of knowledge combination for transformative change, from scientific knowledge to indigenous and local knowledge. However, NbS still tend to reproduce a dominance of techno-scientific knowledge and marginalize traditional and local knowledge.

Addressing connections or tensions existing between urban and rural spaces regarding water conservation is another key challenge in studying knowledge co-creation and dialogue (Hommes & Boelens, 2017; Hommes *et al.*, 2022). Many conflicts arise from the appropriation of watersheds in rural areas to respond to water needs in urban areas. Therefore, the objective of water security for urban areas often produces water insecurity for rural areas (Duarte-Abadía *et al.*, 2023). These conflicts illustrate the absence or limitation of knowledge co-creation and dialogue between spaces, as well as the power dynamics at stake between local and indigenous communities, public authorities and private actors. For example, Duarte-Abadía *et al.* (2023) study how various water funding schemes have emerged in the recent years in Latin America to improve water conservation in rural areas, ensure water availability amid increasing urbanization, and foster dialogue among the different actors involved. However, many experiences with water funds are failing to address equity and development issues for the most marginalized people and tend to prioritize technical conservation issues. Water funds have the potential to be spaces of dialogue, participation and knowledge co-creation among a diversity of actors. However, local peasant communities often accept 'sacrificing' and abandoning their ancestral knowledge to the benefit of water conservation for urban areas. This shows the remaining power inequalities and asymmetries that reduce the possibility of knowledge co-creation and negotiation among actors.

[4] NbS are defined as "actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" (p. 2).

2. Participatory and Transdisciplinary Research Methods from a Decolonial Perspective

We used a participatory and transdisciplinary research methodology based on a decolonial perspective to collect data and conduct our analysis (De la Cadena, 2015; Lang, 2022). Transdisciplinarity involved a dialogue among diverse scientific disciplines from political ecology to natural sciences—and between academia and local stakeholders, represented by indigenous communities and young students, respectively. Adopting a decolonial perspective when conducting research projects with the community makes it possible to reassess and make visible the diversity of knowledges from local and indigenous communities, avoiding the imposition of a superior Western techno-scientific knowledge (Dussel, 2019; Oslender, 2021).

2.1. Participatory Research Methods

There is an increasing body of literature on participatory action research that highlights the need for cross-fertilization between academic and activist forms of knowledge and methodologies (Fals-Borda, 2006). Donna Haraway (1995) developed the concept of 'situated knowledge', understood as the valorization of localized knowledge and the understanding of science and technology from their places of enunciation and production. This invites us to go beyond the dichotomy engendered by rational modernity to study the interactions between subjects and objects.

The participation of practitioners and grassroots organizations and the inclusion of their expertise in transdisciplinary research processes have the potential to co-produce societally relevant knowledge and leverage research's ability to empower marginalized actors and foster societal learning, especially in the Global Souths (Muñoz-García *et al.,* 2022). Recognizing participation and co-production of knowledge in transdisciplinary research as relational and social processes requires the disclosure of the power dynamics that shape them (Fritz & Meinherz, 2020). Participatory research occurs when researchers work cooperatively or collaboratively with community members, and sometimes other external actors, involved in a problem (Trimble *et al.* 2014). The different actors participate in each of the stages as co-researchers, from choosing the research question to the dissemination of the results. In addition to coproducing the knowledge, this strategy allows for addressing or solving local problems, articulating academic and local knowledges.

We applied this method during the implementation of a social engagement project that took place between January and March 2023, in collaboration with the Ñukanchik Urku *páramo* community in Cangahua. The objective of this project was to foster environmental education through participatory workshops in the *páramo* involving two educational institutions: one from Quito and the other from

Cangahua (Figure 1). During the participatory workshops, 30 young people from La Condamine School in Quito (a private school) and 30 young people from the Dolores Cacuango school in Cangahua (a public school) exchanged their experiences and perceptions around reciprocity, water, and the *páramo,* drawing from their respective living environments in the city or in the community. These two schools were selected to foster a dialogue between students living in medium and high-class conditions in the city of Quito and students living in a lower-class conditions in the community of Cangahua. This social gap was important to raise awareness in the city about the importance of water and *páramo* conservation by the community.

Figure 1. *Environmental Education Field Trip in the Páramo of Ñukanchik Urku.*

Note. Fotograph by C. Dupuit, 2023.

In the first phase, we organized two preparatory workshops in Quito and Cangahua to initiate a reflection with the students around their perceptions and knowledge on the *páramos* and their role in water provision, environmental conservation and reciprocity between the city and the community. In the second phase, the 60 students met in the community *páramo* to exchange their knowledge and feelings during various activities aimed to foster a reflection on reciprocity values, the future of the *páramo*, and an analysis of biodiversity and soil characteristics in the *páramo* ecosystem.

Through this social engagement project, we sought to contribute to the following SDGs and their corresponding goals:

- SDG 4: Quality Education. Target 4.7 By 2030, ensure that all students acquire the theoretical and practical knowledge necessary to promote sustainable development (...).
- SDG 6: Clean Water and Sanitation. Goals 6.1, 6.5 and 6.b.
- SDG 11: Sustainable Cities and Communities. Goals 11.5, 11.a and 11.b.
- SDG 12: Responsible Production and Consumption. Goals 12.2 and 12.8.
- SDG 15: Life on Land Ecosystems. Target 15.4.
- SDG 16. Peace, Justice and Strong Institutions. Goal 16.7.

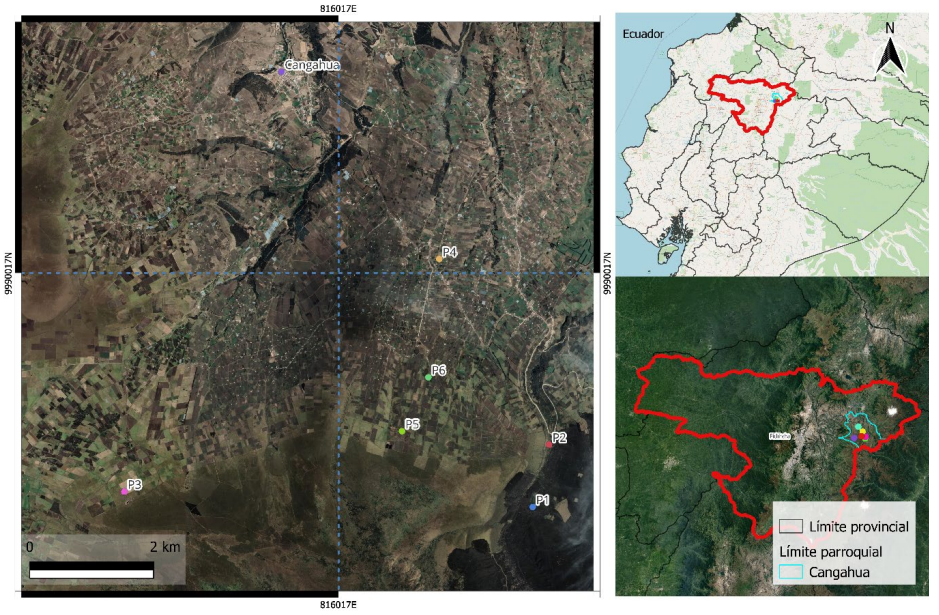
2.2. Counter-Mapping Water and the Territory

In parallel with the participatory workshops led with young people from the city and the community, and following the transdisciplinary approach applied in this study, various water quality analyses were conducted in the *páramo* in collaboration with the communities. To identify the sample points, we used a counter-mapping methodology from a decolonial perspective, which aims to "challenge dominant cartographic representations and empowering local communities vis-à-vis the State" (Oslender, 2021, p. 1).

Counter-mapping was used as a response to previous water quality analyses conducted in collaboration with the municipality of Cayambe in the same region at the beginning of the same research project. During this first research period, we selected the majority of sample points in the lower parts of the basins close to the city of Cayambe. This addressed the needs expressed by technicians from the municipal authority.

In the second phase of the research, we adopted a different position. Communities were consulted to evaluate the conservation needs and water uses in the territory. The community authorities of the *páramo* committee defined the sampling points in the Cangahua area—Porotoc River, Arcachaca Regional Water Board, Moyabamba Sector, and Izacata Community—where they considered it necessary to conduct water quality analysis (Figure 2). Several members of the *páramo* committee joined the field trips to participate in the collection of water samples for quality analysis, allowing the community to take ownership of the process (Figure 3).

Figure 2. *Water Quality Evaluation Points Selected by the Community, Cangahua, Ecuador.*



Nota. Fotograph by C. Égas, 2023.

Figure 3. *Sampling Water Quality in the Community.*

Note. Photograph by C. Puertas, 2023.

Community leaders highlighted the importance of conducting water quality analysis not only in the lower basin or close to the city of Cayambe, as requested by government authorities, but also in the highlands close to the community *páramo*. This alternative territorial focus is key to making visible the challenges faced by the communities that live in the upper basin, such as monitoring the impacts of agricultural practices, caring for watersheds, or preventing fires that affect water quality. Additionally, using counter-mapping from the grassroots while conducting water quality analysis helps highlight the efforts of indigenous communities in conserving watersheds.

2.3. Water Quality Sampling Methods

The water samplings were carried out between March and May 2023 in the Cangahua Parish sector, Pichincha Province. Six points were established (Figure 2, Table 1) to conduct chemical analysis (copper, BOD5, COD, iron, mercury, nitrites, nitrates, lead, selenium, phosphate), analysis of basic physico-chemical parameters (pH, oxygen, dissolved oxygen, temperature) and microbiological analysis (total coliforms and fecal coliforms). The chemical concentration and coliform analyses were carried out the LASA laboratory in Quito. Data on basic physico-chemical parameters were collected *in situ* using a HANNA HI 98194 multiparameter device from the International University of Ecuador (UIDE). The physico-chemical parameters were collected in all the six sampling points, as along with samples for the chemical and microbiological analyses. Three points were suitable for aquatic macroinvertebrates sampling (Table 1).

The results of the analyses were compared with the maximum permissible limits stablished in Ministerial Agreement 097A (AM 097A) and the Ecuadorian Technical Standard 1108 issued by the Ecuadorian Institute for Standardization (INEN 1108). For the macroinvertebrates, a D net was used to sample the microhabitats within the water bodies. Two indices were applied to analyze water quality based on macroinvertebrates: the BMWP/Col (Biological Monitoring Working Party/ Colombia) and the EPT index. The estimation of the alpha diversity in the study area and at each sampling point was calculated using the Shannon-Wiener H´ diversity index. This index was computed using the PAST3 program.

Additionally, following a demand from the community, a specialist carried out an assessment of the drinking water system and the irrigation system in the Izacata community. The study covered the evaluation of the current supply sources, pipeline, chlorination process, reserve and the service area of the drinking water system, as well as the supply sources, sedimentation and distribution tank, conduction line, reserves, and the current service area of the irrigation system.

Table 1. *Sampling Points for the Evaluation of Water Quality.*

Code	Name	Sampled component	Coordinates UTM		Altitude masl	Date	Description
			East	North			
P1	Quirochimbana	Water and macroinvertebrates	17819152	9986236	3747	March 11, 2023	Spring water for human consumption. Arcachaca Regional Water Board. Quirochimbana Sector. *Páramos* of Ñucanchiurcu
P2	Porotoc	Water and macroinvertebrates	17819416	9987245	3636	March 17, 2023	Porotoc River comes from the Minas River. Hirbabuena Sector, *Páramos* de Ñucanchiurcu. Irrigation water
P3	Moyabamba	Water	17812557	9986485	3914	April 8, 2023	Water treatment plant for human consumption. Moyabamba Sector. Serves seven communities
P4	Community Center	Water	17817643	9990242	3480	April 22, 2023	Tap water for human consumption. Izacata Community
P5	Water spring Izacata	Water	17817041	9987461	3846	April 22, 2023	Spring water for human consumption. Izacata Community
P6	Cubero	Water and macroinvertebrates	17817467	9988332	3634	May 6, 2023	Water for irrigation and human consumption. Izacata Community.
Reference point	Cangahua town		17815093	9993267	3190		

Note. Prepared by C. Puertas, 2023.

3. Studying Water Conservation Knowledges From the Grassroots and the Marginalized

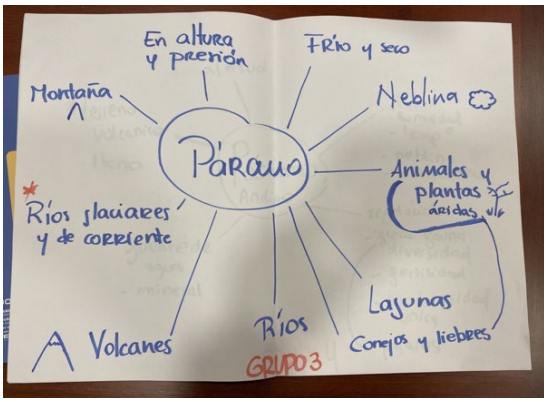
3.1. Reciprocity and Knowledge Dialogue in the *Páramo*

A key result that emerged from the preparatory workshops held in Quito and Cangahua was the existent diversity of perceptions and visions about what the '*páramo*' means among the youth in the city and the community. On the one hand, the young people of Quito who participated in the project tend to conceive the *páramo* as an ecosystem where animals and plants important for biodiversity live (Figure 4). On the other hand, most of the young people of Cangahua have a more comprehensive vision of the *páramo*, which they consider a territory for food production and access to medicinal plants (Figure 5). During these preparatory workshops, we observed that there were various perceptions of the *páramo* among the youth of the city and the community, which guided our subsequent experiences of knowledge dialogues in the *páramo*. These results apply to the social engagement project we conducted and are not intended as a generalization of the research.

During our fieldtrips to the *páramo*, we learned that the youth of Quito conceive of reciprocity as giving and receiving: giving to the *páramo* and to the environment, or maintaining it so that it provides essential resources and services for human life, such as clean water (Figure 6). This relationship with the *páramo* is more transitory than reciprocal. On the contrary, the youth of the community understand reciprocity as the Kichwa concept of *randi randi*, which means giving and giving. It is conceived as a mutually beneficial, equitable, respectful, and non-transitory exchange. During the knowledge dialogue in the Ñukanchik Urku *páramo*Ñukanchik, various indigenous leaders explained that the essence of *randi randi* is found in the millennial relationship that communities maintain with their environment. This relationship provides essential empirical knowledge for the maintenance and survival of ecosystems and the benefits they provide (Manosalvas *et al.*, 2021).

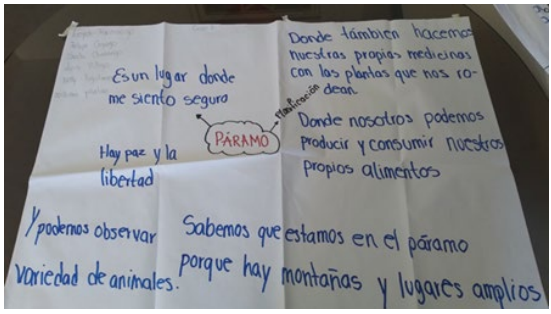
However, it is necessary to maintain a critical stance on the processes of reciprocity in rural communities and in the relationship with the city, in order to highlight possible tensions and contradictions. For example, in the study area of this article, flower plantations in the hands of indigenous populations have increased, which represents a possible threat to the conservation of water resources in the highlands (Mena-Vásconez, 2020, p. 20).

Figure 4 . *Results of the Work on Perceptions of the Páramo in Quito.*



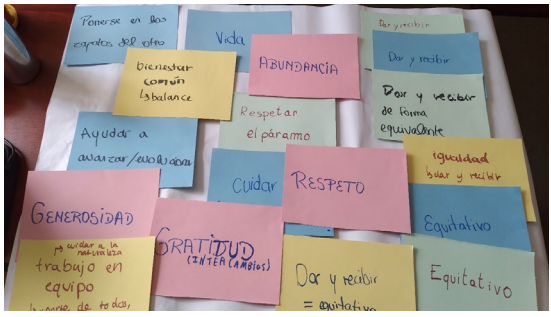
Note. Photograph by E. Dupuits, 2023.

Figure 5. *Results of the Work on Perceptions of the Páramo in Cangahua.*



Note. Photograph by E. Dupuits, 2023.

Figure 6. *Results of the Knowledge Dialogue on Reciprocity in the Páramo.*



Note. Photograph by *E.* Dupuits, 2023.

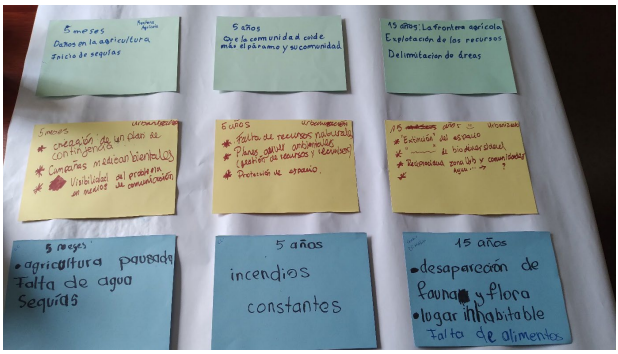
The concepts that most caught our attention during the knowledge dialogue workshop on reciprocity in conversations among young people were the need to take care of the ecosystem, avoid hunting animals, refrain from throwing garbage or glass that increases the risk of fires and participate in *mingas*, which are collaborative and voluntary community work to preserve the *páramos*. The young people insisted on the need to raise awareness about caring for the environment and the ecosystem of the *páramo* to make use of its natural resources. During the workshop, students characterized reciprocity with words such as "care, protect, exchange, union, solidarity and correspondence". There is an awareness that the *páramo* provides water; however, little is actually given to the *páramo* from urban areas. It is important to maintain a knowledge dialogue to increase understanding of the *páramo*, exchange opinions and broaden horizons.

Community members know each other, and there is a relationship of trust that unites them in facing any problems that may arise. Likewise, we consider that this experience helped us to know the importance that communities place on youth; young people are preparing to take over from their elders and face the challenges of the present and the future. The communities assume responsibility for the maintenance of the *páramo* and the water services without government intervention. This work is done through *mingas,* in which all members of the community participate in turns. The responsibility of managing the *páramo* is instilled from an early age and the youth of the indigenous communities understand that if they do not participate in *mingas*, their family will not have access to water. The relationship with the environment is more symbiotic: the community gives to the *páramo* and the *páramo* gives to the community.

Additionally, young people from the city and the community reflected on the possible future consequences of certain practices on the Ñukanchik Urku *páramo* for the populations in both communities and the cities (Figure 7). We noted that there is a lack of direct relationship between the city's inhabitants and the *páramo* and its water supply, despite Quito's dependence on remote watersheds.

There are different imaginaries about water and the *páramo* that directly affect the way ecosystem resources are managed. On the one hand, from an urban imaginary, young people from Quito tend to conceive of water management as something that must be carried out from a technical perspective. There is a strong feeling of superiority of the engineering vision that comes from the city, compared to the management experience of the communities. However, this imaginary is disconnected from the reality of the *páramos* and imposes development without considering the already existing dynamics in the communities.

Figure 7. *Results of the Activity on Future Utopias in the Páramo.*



Note. Photograph by E. Dupuits, 2023.

On the other hand, a different imaginary emerges from the *páramo* committee. Following this imaginary, indigenous leaders mentioned during the activities in the *páramo* that the community's indigenous worldview significantly influences the management and administration of the *páramo*, based on the principle of reciprocity as a philosophy of life. In this sense, the community's imaginary about water and the páramo for the community relates to water as a common good. This works under the principle of *randi randi*, or 'giving-giving', a proposal that implies a shared responsibility, unlike the urban imaginary, which only delegates responsibility for the conservation of the *páramo* to the community, without allowing them to participate in decision-making. For adolescents living in the hydrosocial territory of the Ñukanchik Urku *páramo*, their lives are mostly affected by water management. Their daily activities and those of their families are focused on the labor of conserving and distributing water in their territory. They have stopped engaging in potentially more profitable activities to dedicate themselves to conserving the *páramo* and water, which benefits not only them but also the rest of the city of Quito.

Observing the interactions between young people from the city and the community, we found that they do not share the same relationship with or knowledge of the *páramo*. City youth imagine that because Cangahua youth are local and part of *mingas*, they are experts in all aspects of the *páramo*. While it is true that their experience provides them with strong empirical knowledge that deserves recognition, it does not mean that these young people are or should be experts in all aspects of *páramo* management, nor should they be forced to focus solely on it without exploring other interests.

During the workshops, we hoped that the Cangahua students would be the ones to take the initiative and share their experiences on the *páramos*, due to the notion that they are the 'guardians of the *páramo*', akin to a modern version of the 'noble savage'. In a way, this is why we give them specific responsibilities. On the contrary, when sharing ideas with the whole group, there was a certain verticality of knowledge from the Quito students, who were not afraid to speak or present their ideas. However, the activity facilitated an interaction between different forms of knowledge, giving way to dialogue and the co-creation of knowledge.

The responsibility for caring for the *páramo* that falls on indigenous communities can be seen as unfair. By emphasizing indigenous knowledge about the *páramo* and other natural spaces, the ability of urban societies to participate in the care of this ecosystem and learn these conservation practices is minimized. The indigenous people are named protectors of nature, although they are only taking care of the land that sustains them. This results in an unfair exchange, as the living standards of those outside the communities directly influence the preservation of the *páramos* and make this conservation even more complex.

From a water justice perspective, redistributing responsibility for ecosystem care is essential to prevent the indigenous community from having to face environmental injustices alone. Thus, to contribute to a more equitable management, strategic alliances must be built between community, public and private actors across the rural and urban world. Additionally, it is essential to create spaces for knowledge co-production between academics and activists, as well as indigenous and local communities, to reinforce the principles of environmental and water justice.

From the *randi randi* philosophy, indigenous leaders of Cangahua mention that rural-urban relations should be reciprocal. However, without the Cangahua community, it would be difficult for another group to take charge of reciprocal and sustainable territorial management. This demonstrates the need to preserve this cosmology from generation to generation, as a form of territorial resistance against unsustainable production models. In the same way, the Cangahua community maintains a socially and environmentally responsible model through participatory processes. However, this model should be transmitted to the entire population, beyond the efforts of indigenous communities. For this reason, advancing water justice globally must be a top priority on the environmental agenda.

3.2. Counter-Mapping and Water Quality Analyses Led by the Community

Counter-mapping and water quality analysis led by the community underscores the importance of local perceptions, which are often invisible in institutionalized government representations that tend to value techno-scientific knowledge over local and indigenous knowledge. Including local knowledge in territorial processes fosters

more independence and autonomy in the production of information about the water situation in a specific area. This information can then be used to take appropriate actions in partnership with the municipality regarding water conservation programs.

The results of the water analysis show, in general, good water quality. The sampled points have a large amount of dissolved oxygen. Points P3, P4, P5 and P6 indicate pH values in compliance with the norm, while Points P1 and P2 indicate values that are slightly off, so it would be recommended to control these points and observe if they continue to present pH values of less than 6. As for the biochemical oxygen demand (BOD5) and the chemical oxygen demand (COD), points P5 and P6 do not comply with regulations for human and domestic water consumption. Although they present values very close to compliance with regulations, it is important that the water undergoes prior treatment before consumption.

In relation to metals (lead, selenium, copper, and mercury), the analyses show low values, fall within the parameters established by regulations. As for iron, P5 slightly exceeds the limits for human consumption and preservation of aquatic life, but complies with regulations for use in irrigation in agriculture.

The values of nitrites, nitrates and phosphate, as well as the microbiological analysis of all the sampled points, are low and in comply with regulations.

The BMWP/Col and EPT indices indicate that water quality in the study area is regular (moderately polluted). The Shannon-Wiener (H') diversity index results indicate that the study area and all sampling points exhibit low diversity.

In the study area, a total of 114 individuals of aquatic macroinvertebrates were recorded, distributed across 12 families belonging to ten orders. The characterization of macroinvertebrates showed that the study area has low abundance compared to similar studies conducted in rivers of the Ecuadorian Andes. For example, Jiménez *et al*. (2021), recorded 1685 individuals across 35 families at 12 sampling stations in the Macizo del Cajas, province of Azuay. Likewise, Buenaño *et al*. (2018) recorded 3023 macroinvertebrate specimens belonging to eight orders and ten families at five points in a high Andean river (micro-basin of the Pachanlica) in the Tungurahua province. In terms of orders and families, the present study is comparable to the study of Buenaño *et al*. (2018).

In terms of composition and abundance, the dominance of Ephemeroptera as the most representative order and Baetidae as the most abundant family identified in this study does not align with the findings of Jiménez *et al*. (2021), where the most abundant family was Chironomidae (Diptera). Similarly, in Buenaño *et al*. (2018), the most abundant group was Hyalellidae (Crustacea). Ephemeroptera is considered one of the orders most sensitive to water pollution, along with Plecoptera and Trichoptera, as no Ephemeroptera species can survive high levels of contamination (Flowers & de la Rosa, 2010).

The diversity patterns of biological populations are not static but vary spatio-temporally due to both natural and anthropic factors. The spatial variability of macroinvertebrates is related to site heterogeneity, which depends on geography, water quality and plant communities. Th differences found among the different sampled bodies of water are due to geographical separation, which prevents the movement of macroinvertebrates between water bodies, even within the same hydrographic basin, and even more so if they are found in different basins (Córdoba-Ariza *et al.*, 2020).

In the study area, there is a large presence of agriculture, livestock, and flower industry activity that could be negatively impacting the bodies of water. In addition, the bodies of water receive sewage and solid waste as a result of urban and industrial activities in the area, which would be contributing to the deterioration of water quality (Buenaño *et al.*, 2018).

The results of the assessments of the drinking water and irrigation systems in the Izacata community reveal system shortcomings and provide recommendations for their improvement. Some of the components and units require immediate maintenance, while others need to be replaced. This document contains very useful information that will help the community request support from the local government.

The results of all the analyses were presented at a community assembly, and the documents were delivered to the community leaders in June 2023. There, attendees expressed the importance of carrying out studies that co-produce scientific and local knowledge, and stressed the importance of community access to information. They highlighted the importance of ensuring water conservation through the inclusion of various actors and forms of knowledge, and expressed their willingness to continue with this type of research-action project, where they have the opportunity to be highly involved.

One of the issues raised by the attendees was the lack of techno-scientific information about watersheds, as well as the lack of attention from local and national authorities. On the few occasions when these authorities visit communities near the *páramo*, there is little to no interaction or involvement with local people. They also expressed their awareness of the importance of preserving water resources and the fundamental role that the *páramos* play in this regard. The attendees stated, too, that they are protecting water for cities where people do not even know where this vital resource comes from or who is working to protect it.

4. Discussion and Conclusions

This study examined the processes of decolonizing knowledge around water conservation practices in the community *páramo* of Ñukanchik Urku, in the Ecuadorian

Andes. Using research methods grounded in a decolonial perspective, we were able to counter-map the territory, incorporating indigenous perspectives on water conservation dynamics in the *páramo*. The objective was to focus on the needs and voices of indigenous communities living close to the *páramo* rather than prioritizing those of people living in cities and public authorities.

The different participatory workshops held as part of the environmental education project in Cangahua helped to understand the relationship that each group of young people maintains with the *páramo* ecosystem. It became clear that there is insufficient reciprocity between the city and the *páramo*. There must be balance and mutual support between both spaces, along with reciprocity as a correspondence of benefits. The workshops prompted a reflection on what the city can do to reciprocate the community's efforts to protect the *páramo*. For instance, when creating water funds to incentivize watershed conservation, the needs of communities surrounding the *páramos* should take priority over those of urban populations.

We observed that the young people of Cangahua had greater knowledge about the *páramo*; however, they should not be solely responsible for the care of this ecosystem. By applying the Kichwa concept of *randi randi*, or "giving and giving", and not simply the idea of giving and receiving, young people from the city could become more involved in this care by understanding the importance and significance of the *páramo* in the region's water supply. This would allow greater appreciation of communal water management and support alternatives to private water management.

It is critical that conservation and sustainability awareness projects focus especially on youth. Young people are the new generation of environmental defenders and activists who can promote values of conservation and protection of the *páramo*, as well as demand changes in the models of production and ecosystem management from power groups. This contributes to the promotion of an eco-centrist approach, in which all living beings hold equal value. It is essential to stop viewing the *páramo* solely for its utilitarian value and to understand it as an ancestral territory where identities have been formed, recognizing that its conservation is essential for future generations.

Beyond the particular case study of the community *páramo* of Ñukanchik Urku in Cangahua, our research opens broader reflections for community-based water conservation and the production of knowledge. Other studies have shown similar dynamics of conflict and power in knowledge production related to addressing water conservation issues in Mexico. In the case of the Valle de Aguascalientes aquifer, authors have analyzed how techno-scientific solutions, implemented through investment in irrigation technologies, were not really efficient in reducing the aquifer overdraft, despite being promoted by public authorities as potential

realistic solutions to water availability problems (Sainz-Santamaria & Martinez-Cruz, 2019). The authors conclude that in this context, public actors and experts should engage with traditional knowledge to find more sustainable and participatory solutions. Other study carried out in Mejia, in the Ecuadorian Andes, with dairy farmers, also reveals that the low rate of water conservation practices adoption in the area is more related to local governance and conflict resolution issues than to the need for irrigation technologies (Ortiz *et al.*, 2023). This study, too, echoes our findings on the need to open a dialogue between classical techno-scientific knowledge and practices on water conservation to other forms of knowledge and solutions based on traditional and indigenous worldviews.

Through this study, we found that there are various forms of interaction and co-production processes between actors, values, scales, spaces and epistemologies. These processes echo the need for more creative encounters between scientific and non-scientific knowledge that do not lead to mutual destruction (De Sousa Santos, 2011). This co-creation entails discussing new creative categories of 'scientific science' or 'people's science' (Leff, 2015), as demonstrated in the interaction between indigenous leaders and scientists in this study.

However, the spaces and institutions designed for water knowledge co-creation are failing at a certain point to facilitate genuine dialogue between actors, enhance the effective participation of the most marginalized actors, and recognize the legitimacy of *other* values and ontologies of water. This indicates a missed opportunity to take advantage of existing water conservation institutions to facilitate knowledge dialogue. More broadly, these limited co-creation dynamics also reveal the need for decolonizing knowledge production and dissemination, aiming to "liberate them from cultural as well as political-economic exploitation, inequality and subjugation that hinders the realization of alternative life-worlds" (Leff, 2015, p. 48). This is a determinant precondition for stablishing an effective knowledge dialogue among the diversity of actors. As Leff states (2015, p. 49), "decolonizing knowledge is therefore an epistemological condition for deconstructing the exploitative trends of the global economy and reviving the ecological potentials and cultural meanings of local people, thereby giving life to alternative modes of production, thinking and being".

Finally, we reaffirm how challenges in water conservation and environmental degradation interact with historical social inequalities and power asymmetries. This study invites us to reflect on the mechanisms needed to ensure water knowledge co-creation processes that would benefit water conservation for all, instead of designing and implementing partial solutions and spaces that reproduce power inequalities among actors.

References

Bäckstrand, K. (2004). Scientisation vs. Civic Expertise in Environmental Governance: Eco-feminist, Eco-modern and Post-modern Responses. *Environmental Politics* 13(4), 695-714. https://doi.org/10.1080/0964401042000274322

Berkes, F. (2012). *Sacred ecology* (3rd ed.). Routledge.

Blaser, M., & de la Cadena, M. (2018). Introduction: Pluriverse Proposals for a world of Many Worlds. In M. de la Cadena & M. Blaser (Eds.), *A world of many worlds* (pp. 1-22). Duke University Press.

Boelens, R. (2009). Aguas diversas. Derechos de agua y pluralidad legal en las comunidades andinas. *Anuario de Estudios Americanos*, *66*(2), 23-55. https://doi.org/10.3989/aeamer.2009.v66.i2.316

Boelens, R., Hoogesteger, J., & Rodriguez de Francisco, J.C. (2014). Commoditizing Water Territories: The clash between Andean water rights cultures and payment for Environmental Services Policies. *Capitalism Nature Socialism*, *25*(3), 84-102. https://doi.org/10.1080/10455752.2013.876867

Boelens, R., Hoogesteger, J., Swyngedouw, E., Vos, J., & Wester, P. (2016). Hydrosocial Territories: A Political Ecology Perspective. *Water International*, *41*(1), 1-14. https://doi.org/10.1080/02508060.2016.1134898

Boelens, R., Perreault, T., & Vos, J. (2018). *Water Justice*. Cambridge University Press.

Boelens, R., Shah, E., & Bruins, R. (2019). Contested knowledges: Large Dams And Mega-Hydraulic Development. *Water, 11*(3), 416. https://doi.org/10.3390/w11030416

Bonelli, C., Roca-Servat, D., & Bueno de Mesquita, M. (2016). The Many Natures of Water in Latin-American Neo-extractivist Conflicts. *Alternautas*, *3*(2), 81-92. https://journals.warwick.ac.uk/index.php/alternautas/article/view/1047

Buenaño, M., Vásquez, C., Zurita-Vásquez, H., Parra, J., & Pérez, R. (2018). Macroinvertebrados bentónicos como indicadores de calidad de agua en la cuenca del Pachanlica, provincia de Tungurahua, Ecuador. *Intropica*, *13*(1), 41-49. https://doi.org/10.21676/23897864.2405

Córdoba-Ariza, G., Rincón-Palau, K., Donato, R., Jhon, C., & González-Trujillo, J.D. (2020). Variación espacio-temporal de macroinvertebrados acuáticos en la Lindosa, Guayana colombiana. *Revista de Biología Tropical*, *68*(2), 452-465. https://dx.doi.org/10.15517/rbt.v68i2.39331

De la Cadena, M. (2015). *Earth Beings: Ecologies of Practice Across Andean worlds*. Duke University Press.

Duarte-Abadía, B., Galarza Suárez, L., & Hidalgo-Bastidas, J.P. (2023). ¿Seguridad hídrica urbano-rural en los fondos de agua? Un análisis desde las relaciones de poder, la participación y la co-creación de conocimientos. *Journal of Political Ecology*, 30(1), 391-400. https://doi.org/10.2458/jpe.5295

Dupuits, E., Baud, M., Boelens, R., de Castro, F., & Hogenboom, B. (2020). Scaling Up but Losing Out? Water commons' dilemmas between transnational movements and

Grassroots Struggles in Latin America. *Ecological Economics*, *172*, 106625. https://doi.org/10.1016/j.ecolecon.2020.106625

Dupuits, E. (2021). Coproducción de imaginarios de justicia hídrica y desarrollo verde en Ecuador. *European Review of Latin American and Caribbean Studies*, *111*, 19-37. https://erlacs.org/articles/10.32992/erlacs.10713

Dupuits, E., & Mancilla Garcia, M. (2022). Knowledge Politics Around Water, Development and Ecosystem Services in Ecuador: Creative Encounters and Resistances. *Alternautas*, *9*(2), 175-200. https://doi.org/10.31273/an.v9i2.1149

Dupuits, E., Puertas, C., & Guadamud, J. A. (2023). Resistencia, negociación y cocreación de saberes para la construcción del Fondo Plurinacional del Agua en el territorio Kayambi, Ecuador. *Allpanchis*, *50*(91), 45-79. https://doi.org/10.36901/allpanchis.v50i91.1536

Fals-Borda, O. (2006). Participatory action research in social theory: Origins and challenges. In P. Reason & H. Bradbury (Eds.), *Handbook of action research: Participatory inquiry and practice* (pp. 27-37). Sage.

Flowers, R.W., & de la Rosa, C. (2010). Ephemeroptera. *Revista de Biología Tropical*, *58*(S4), 63-93. https://doi.org/10.15517/rbt.v58i4.20083

Foyer, J., & Dumoulin, D. (2017). Objectifying Traditional Knowledge, Re-enchanting the Struggle Against Climate Change. In S. Aykut, J. Foyer, & E. Morena (Eds.), *Globalising the Climate: COP21 and the Climatization of Global Debates* (pp. 153-172). Routledge.

Fritz, L., & Meinherz, F. (2020). Tracing Power in Transdisciplinary Sustainability Research: An Exploration. *GAIA*, *29*(1), 41-51. https://doi.org/10.14512/gaia.29.1.9

Goodwin, G. (2019). The Problem and Promise of Coproduction: Politics, History, and Autonomy. *World Development*, *122*, 501-513. https://doi.org/10.1016/j.worlddev.2019.06.007

Haraway, D. (1995). *Ciencia, cyborgs y mujeres. La reinvención de la naturaleza*. Cátedra.

Hernandez, J., Meisner, J., Jacobs, L., & Rabinowitz, P.M. (2022). Re-centering Indigenous Knowledge in climate change discourse. *PLOS Climate*, *1*(5), e0000032. https://doi.org/10.1371/journal.pclm.0000032

Hofstede, R., Mena-Vásconez, P., & Suárez Robalino, E. (2023). *Los páramos del Ecuador: Pasado, presente y futuro*. USFQ Press.

Hommes, L., & Boelens, R. (2017). Urbanizing Rural Waters: Rural-urban Water Transfers and the Reconfiguration of Hydrosocial Territories in Lima. *Political Geography*, *57*, 71-80. https://doi.org/10.1016/j.polgeo.2016.12.002

Hommes, L., Hoogesteger, J., & Boelens, R. (2022). (Re)making Hydrosocial Territories: Materializing and Contesting Imaginaries and Subjectivities Through Hydraulic Infrastructure. *Political Geography*, *97,* 102698. https://doi.org/10.1016/j.polgeo.2022.102698

Horowitz, L. (2015). Local Environmental Knowledge. In T. Perreault, G. Bridge, & J. McCarthy (Eds.), *Routledge Handbook of Political Ecology* (pp. 235-248). Routledge.

Jasanoff, S. (2004). *States of Knowledge: The Co-production of Science and Social Order*. Routledge.

Jasanoff, S., & Kim, S.H. (2015). *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*. University of Chicago Press.

Jiménez, R., Barnuevo, E., Timbe, B., & Astudillo, P. X. (2021). El uso de gremios tróficos en macroinvertebrados acuáticos como herramienta de monitoreo en los Altos Andes del Sur de Ecuador. *Neotropical Biodiversity*, *7*(1), 310-317. https://doi.org/10.1080/23766808.2021.1953891

Leff, E. (2015). Encountering Political Ecology: Epistemology and Emancipation. In R. L. Bryant (Ed.), *The International Handbook of Political Ecology* (pp. 61-73). Edward Elgar Publishing.

Li, F. (2013). Relating Divergent Worlds: Mines, Aquifers and Sacred Mountains in Peru. *Anthropologica*, *55*(2), 399-411. https://cas-sca.journals.uvic.ca/index.php/anthropologica/article/download/715/1105/2067

Llambi, L. D., Soto Werschitz, A., Célleri, R., De Bievre, B., Ochoa-Tocachi, B., & Borja, P. (2012). *Ecología, hidrología y suelos de páramos*. Proyecto Páramo Andino.

Mena-Vásconez, P. (2020). Flowers, Powers, and Water Flows: Conflicts over Irrigation Water and Rose Farming in the Ecuadorian Andes [Doctoral thesis, Wageningen University and Research]. Wageningen University. https://doi.org/10.18174/510268

Muñoz-García, A.L., Lira, A., & Loncón, E. (2022). Knowledges from the South: Reflections on Writing Academically. *Educational Studies*, *58*(5-6), 641-656. https://doi.org/10.1080/00131946.2022.2132394

Ortiz, C. A., Avila-Santamaría, J. J., & Martinez-Cruz, A. L. (2023). Dairy Farmers' Willingness to Adopt Cleaner Production Practices for Water Conservation: A Discrete Choice Experiment in Mejia, Ecuador. *Agricultural Water Management*, *278*, 108168.

Oslender, U. (2021). Decolonizing cartography and ontological conflict: Counter-mapping in Colombia and "cartographies otherwise". *Political Geography*, *89*, 102444. https://doi.org/10.1016/j.polgeo.2021.102444

Palomo, I., Locatelli, B., Otero, I., Fischborn, M., Metz, R., & Lavorel, S. (2021). Assessing Nature-based Solutions for Transformative Change. *One Earth*, *4*, 1-12. https://doi.org/10.1016/j.oneear.2021.04.013

Peet, R., & Watts, M. J. (Eds.). (1996). *Liberation Ecologies: Environment, Development, Social Movements*. Routledge.

Robbins, P. (2003). Beyond Ground Truth: GIS and the Environmental Knowledge of Herders, Professional Foresters, and other Traditional Communities. *Human Ecology*, *31*(2), 233-253. https://doi.org/10.1023/A:1023932829887

Robbins, P. (2004). *Political Ecology: A Critical Introduction*. Blackwell Publishing.

Sainz-Santamaria, J., & Martinez-Cruz, A. L. (2019). How Far can Investment in Efficient Irrigation Technologies Reduce Aquifer Overdraft? Insights From an Expert Elicitation in Aguascalientes, Mexico. *Water Resources and Economics*, *25*, 42-55. https://doi.org/10.1016/j.wre.2017.10.003

Sánchez-Vázquez, L. (2019). ¿Ciencia de resistencia? Monitoreos ambientales participativos en contextos de conflicto ambiental. Reflexiones desde una mirada decolonial. *Revista de Paz y Conflictos*, *12*(2), 57-79. https://doi.org/10.30827/revpaz.v12i2.10399

de Sousa Santos, B. (2011). Epistemologías del sur. *Utopía y praxis latinoamericana*, *16*(54), 17-39. https://produccioncientificaluz.org/index.php/utopia/article/view/3429

Sutton, M. Q., & Anderson, E. N. (2004). *Introduction to Cultural Ecology.* Altamira Press.

Swyngedouw, E. (2015). *Liquid Power. Contested Hydro-modernities in Twentieth-century Spain*. MIT Press.

Trimble, M., Iribarne, P., & Marila, L. (2014). Una investigación participativa en la costa uruguaya: características, desafíos y oportunidades para la enseñanza universitaria, *Desenvolvimiento e Meio Ambiente*, 32, 101-117. https://doi.org/10.5380/dma.v32i0.35603

Ulloa, A. (2019). Indigenous Knowledge Regarding Climate in Colombia: Articulations and Complementarities Among Different Knowledges. In G. Feola, H. Geoghegan, & A. Arnall (Eds.), *Climate and Culture: Multidisciplinary Perspectives on a Warming World* (pp. 68-92). Cambridge University Press.

Ulloa, A., Damonte, G., Quiroga, C., & Navarro, D. (2020). *Gobernanzas plurales del agua: formas diversas de concepción, relación, accesos, manejos y derechos del agua en contextos de gran minería en Colombia y el Perú*. Documento de investigación No. 103. GRADE-UNAL