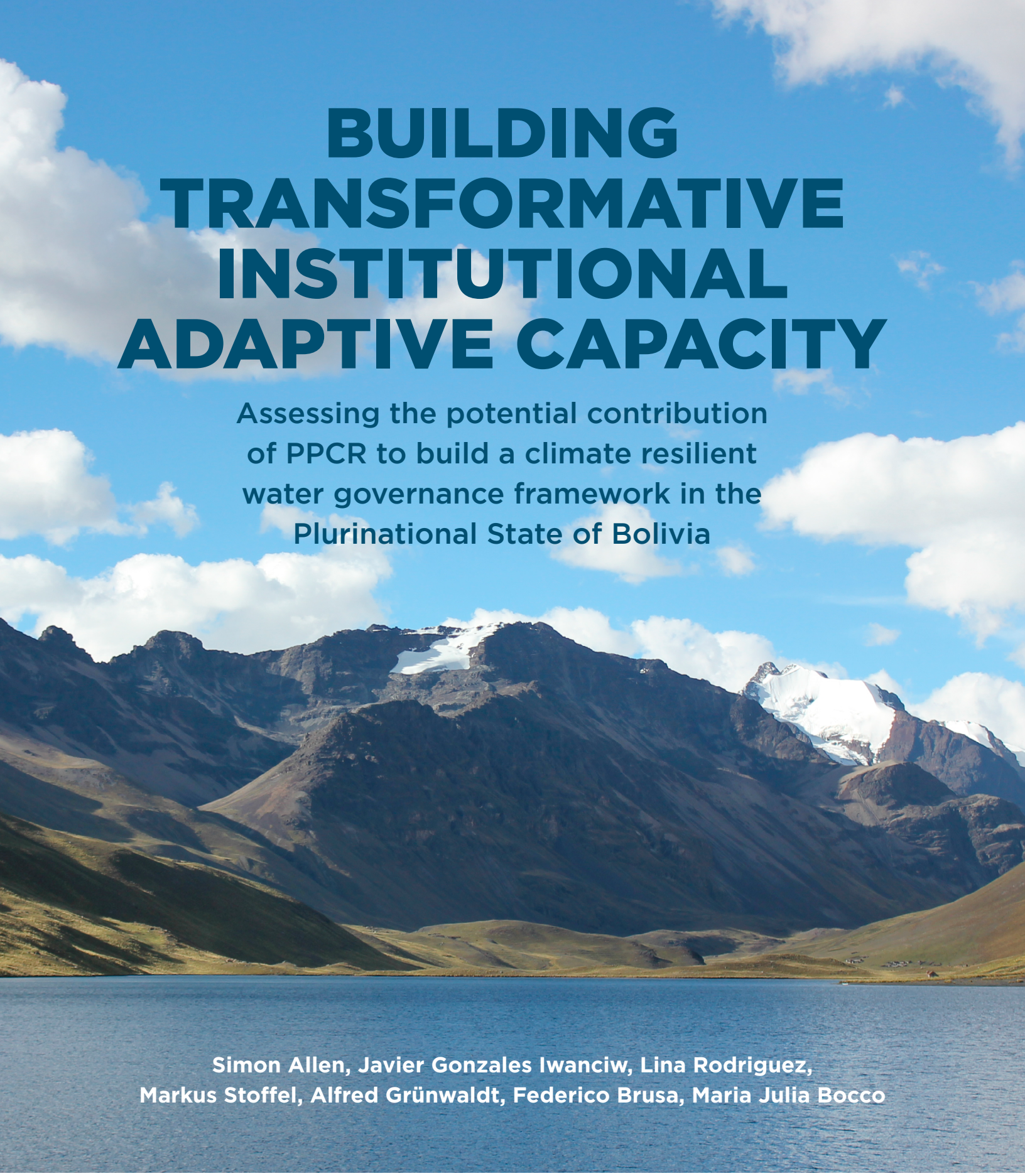

BUILDING TRANSFORMATIVE INSTITUTIONAL ADAPTIVE CAPACITY

Assessing the potential contribution of PPCR to build a climate resilient water governance framework in the Plurinational State of Bolivia

Simon Allen, Javier Gonzales Iwanciw, Lina Rodriguez, Markus Stoffel, Alfred Grünwaldt, Federico Brusa, Maria Julia Bocco

IDB Inter-American Development Bank

CIF CLIMATE INVESTMENT FUNDS

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Prologue

Since 2008 the Climate Investment Funds (CIF) have been providing scaled-up climate finance to support transformational change for low carbon and climate-resilient development. The Inter-American Development Bank is one of the five multilateral development (MDBs) implementing entities. The Pilot Program for Climate Resilience (PPCR) is one of the key programs under the CIFs. The PPCR involves a two-phase programmatic approach with grant funding to assist national governments in developing Strategic National Programs for Climate Resilience which integrate climate resilience into development planning across sectors and stakeholder groups. In addition, the program provides highly concessional funding to implement these Strategic Programs through innovative public and private sector solutions to address climate-related risks and build resilience.

To date, the PPCR has approved US$939 million for 58 projects around the globe. These funds have leveraged around US$2.0 billion in co-financing from other sources. There are 11 PPCR pilot countries— which includes Bolivia, Dominica, Grenada, Haiti, Honduras, Jamaica, Saint Lucia and St. Vincent & Grenadines from Latin America and the Caribbean. There is also a Caribbean pilot regional approach.

In the case of the Plurinational State of Bolivia, the PPCR supports an integrated plan to improve water resource management in three prioritized sub-basins and planning capacity at the national level. The program is designed to support full implementation of the country's National Mechanism for Adaptation to Climate Change, a strategy that aims to lay the groundwork to address climate change. Bolivia's PPCR Strategic Program was designed under the leadership of the government (Ministry of Environment and Water and Ministry of Planning) in coordination with the Inter-American Development Bank (IDB), members of the World Bank Group (IBRD, IDA, IFC) and widely consulted involving more than 50 national NGOs, 40 civil society organizations, 15 donors and 35 academic institutions including also 9 country's departments and several municipalities.

Given the uncertainties associated with climate change impacts and the importance of "learning by doing" in adaptation processes, the experience of the PPCR provides valuable lessons for how a country can effectively build adaptive capacity and what type of enabling environments can foster transformational change. In light of CIF's mandate to serve as a learning laboratory for scaled-up climate finance, in 2015 the Evaluation and Learning (E&L) Initiative was launched to document these processes and construct a body of relevant knowledge that can be used by countries and/or international development agencies. The E&L Initiative focuses on four priority learning themes: transformational change, private sector investment, local stakeholder engagement and benefits, and CIF design and approach.

This study draws on the experience of Bolivian PPCR Strategic Program for Climate Resilience to identify what is needed to achieve a **national transformational change for resilience within the water sector.** A robust methodological framework was used to assess adaptive capacity in the country's water governance system, and the analysis focused on CIF's defined "arenas

of intervention". An arena of intervention is an entry point to take action to alter the course of events and enable or catalyze transformational change. The arenas considered relate to financing, governance and engagement, institutions, knowledge and information, policies, practices and mindsets, technologies and infrastructure, markets, and natural capital.

Study results will feed into the overall programs' portfolio evaluation process, which is being carried out by the CIF. The expectation is that the innovative approach of this study will become a reference for future design of projects to deliver transformational impact for adaptive capacity in the water sector.

Funds to conduct this study were provided by both the IDB and the CIF.

Dr. Amal-Lee Amin

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The authors would like to thank all the people and institutions that have contributed to the development of this study, including the national authorities, non-governmental organizations, and research centers, as well as the PPCR Program management team at the national level; without their participation and technical input, this report would not have been possible. Likewise, we would like to highlight and recognize the contribution of the IDB's water specialist in Bolivia, Cristina Mecereyes, who, with her knowledge of the sector contributed significantly in the execution of the study. Likewise, we would like to recognize the CIF for its financial contribution, which made this study possible. Last but not least, we would like to thank and highlight the support of the IDB management, which allowed us to successfully accomplish the objectives proposed in the study, especially the head of the Climate Change Division, Dr. Amal-Lee Amin, the chief of the Water and Sanitation Division, Sergio Campos, the country representative, Alejandro Melandri and the manager of the Department of Climate Change and Sustainability, Juan Pablo Bonilla.

Abbreviations

AAPS	Autoridad de Fiscalización y Control Social de Agua Potable y Saneamiento Básico (Authority for Oversight and Social Control of Drinking Water and Basic Sanitation)
CIF	Climate Investment Funds
CONARADE	Consejo Nacional para la Reducción de Riesgos y Atención de Desastres y/o Emergencias (National Council for Risk Reduction and Response to Emergencies and/or Disasters)
ENDE	Empresa Nacional de Electricidad (National Electricity Company)
EPSAS	Empresa Pública Social de Agua y Saneamiento (Public Social Enterprise for Water and Sanitation)
IPCC	Intergovernmental Panel on Climate Change
MMAyA	Ministerio de Medio Ambiente y Agua (Ministry of Environment and Water)
PPCR	Pilot Program for Climate Resilience
SDC	Swiss Agency for Development and Cooperation
SENAMHI	Servicio Nacional de Meteorología e Hidrología (National Meteorology and Hydrology Service)
SENASBA	Servicio Nacional para la Sostenibilidad de Servicios en Saneamiento Básico (National Service for the Sustainability of Services in Basic Sanitation)
SNICA	Sistema Nacional de Información Climática y del Agua (National Climate and Water Information System)
SPIE	Sistema de Planificación Integral del Estado (Integral State Planning System)

Executive Summary

Water governance has attracted increased attention as a policy concern in recent years because climate change is expected to increase the variability between wet and dry regions, and wet and dry seasons, leading to challenges associated with water security and sustainable development. This raises questions about the adaptive capacity of water governance systems and their ability to respond to the threat of climate change. While the lack of adaptive capacity could serve as a barrier to adaptation, exploring where strengths and weaknesses exist allows stakeholders and decision-makers to tailor adaptation programs to bridge gaps and strengthen capacities.

In view of recent and projected climate change and the related challenges that Bolivia is facing in the water sector, this study has refined a robust methodological framework to assess adaptive capacity in the Bolivian water governance system. Under the framework of this study, an exploration of how governance systems have managed and responded to past extreme events, and what manifestations of adaptive capacity have arisen, has allowed us to examine whether governance practices have hindered or enabled adaptive capacity, emphasizing transformative processes. This assessment thereby provides the foundation to explore the potential of the Pilot Program for Climate Resilience (PPCR) under the Climate Investment Funds (CIF) to address gaps, build adaptive capacity, and achieve transformative change in the Bolivian water sector.

The major drought in 2016/17 (emphasizing the La Paz/El Alto metropolitan area) and the flood in late 2017/early 2018 (emphasizing affected areas in Cochabamba) served as case studies. They represent the type of extreme climate events that are expected to become more severe in the future. Thirty semi-structured interviews were undertaken with key stakeholders active in the water sector, focusing on their experiences and perceptions of adaptive mechanisms operating before, during, and after these recent events. Stakeholders were selected from across government departments, the public service, the water operator in the metropolitan region of La Paz-El Alto, academia, international cooperation agencies, and social stakeholder groups. Questions focused on three key determinants of adaptive capacity—Regime, Knowledge, and Networks—for which the assessment framework establishes several indicators that can be measured in accordance with operational criteria. Evidence extracted from the interviews was complemented with a comprehensive desk-based review of literature and policy documents, and further stakeholder discussions during a series of three workshops.

The assessment revealed a positively evolving water governance system in Bolivia, starting with the mainstreaming of climate change adaptation into planning instruments in 2011. Particularly over the past five years (2014–2019), with the support of programs such as the PPCR, the state has put additional emphasis on the role of information systems, monitoring and early warning, technical and institutional capacities, and engagement with key stakeholders, in part responding to some of the weaknesses exposed during the recent drought and flood crises. However, despite this progress, there remain core barriers to building adaptive capacity, and the evidence is predominantly mixed as to whether or not transformative processes are currently being facilitated.

Hence, significant opportunities have been identified for programs such as the PPCR to fill gaps and build on existing enabling mechanisms to further strengthen adaptive capacities and, ultimately, facilitate transformative change in the Bolivian water sector.

Key recommendations emerging from this study include interventions that focus on the following:

I. Addressing challenges in preparatory and contingency planning for extreme events

Establishing clear operational protocols and strengthening the limited regulatory framework to enhance preparatory and contingency planning for extreme events. Interventions in this area would be in line with current efforts of the Authority for Oversight and Social Control of Drinking Water and Basic Sanitation (AAPS) and the Vice Ministry of Drinking Water and Basic Sanitation to better prepare for droughts in La Paz/El Alto. Protocols should guide water companies, authorities, and ministries on how to respond to various scenarios of water stress and how to communicate with civil society in those situations. Protocols should also aim to streamline the process of decision-making, issuing alerts, and other response actions.

Enhancing efforts to establish flexibility and a clear hierarchical prioritization in distributing water during emergency situations as fundamental components of a universal regulatory framework to define water rights in Bolivia. While there has been difficulties in making progress toward a universal regulatory framework that integrates across sectors, flexibility and prioritization should be highlighted as key components that will enable the governance system to better respond to climate change and related climate threats. The PPCR could support the ongoing efforts to consolidate a regulatory framework by drawing on experiences from other countries and regions to provide technical input and support mechanisms for the drafting process.

II. Addressing challenges in long-term planning and climate change integration

Integrating future climate scenarios and future-oriented risk mapping to enhance forward-looking, flexible climate adaptation planning and ensure that financial and technical resources are in place to guarantee the sustainability of these plans. This means adequately accounting for the full range of future scenarios in the design of physical response strategies (e.g., multi-year reservoirs, expansion of irrigation systems, and flood protection measures) to be sure that infrastructure can sufficiently cope with the type of drought and flood events that could occur 30 or 50 years from now. Basin and territorial planning needs to consider how flood and drought risk will change in the future as a result of not only increasing frequency and magnitude of extreme events, but also changes in demographics and water demand.

Improving decision-making in the face of deep uncertainties, recognizing the importance of flexibility in systems and structures, and exploring potential low-regret adaptation options that can potentially bring immediate benefits to a community irrespective of how the climate may evolve in the future. Examples of low-regret adaptation include creating green spaces in high-risk land areas or building community awareness and raising the response capacities of those living in high-risk areas. Current regulatory efforts to maintain the security of Tiquipaya's river zone goes in the desired direction; however, additional efforts should be put into raising awareness in neighboring areas so that people can see the benefits of adaptation measures and adopt them. Expanding such measures increases the depth of change, which is one of the core dimensions of transformation.

III. Addressing challenges in governance across sectors

Establishing projects that are framed by broad intersectoral development objectives that aim to improve livelihoods, ecosystem productivity, and health, supported by the necessary planning tools to improve coordination in governance across sectors. This would be ambitious, moving away from typical sector-specific objectives, such as increasing the area under irrigation or increasing households with access to drinking water, to a series of bigger picture objectives focusing on improved livelihoods, ecosystem productivity, and health. Such projects would provide a practical, pilot demonstration of how adaptation investments can be framed in the context of sustainable development, leading to transformation. In parallel, tools or platforms to assist adaptation planning are needed to integrate information on socioeconomic dimensions, environmental degradation, and the vulnerability of ecosystems.

IV. Addressing challenges in hydrometeorological and climate services

Ensuring data and associated data platforms like the National Climate and Water Information System (SNICA1) of the Ministry of Environment and Water (MMAyA2) are tailored to sectoral needs and support the establishment of a national research agenda that formalizes exchange between academia and the state. Increasing the volume and reliability of data is one aspect, but less can be more, and in the case of drought or flood early warning systems, stakeholders have identified the need for a clear set of simple indicators that can be used as a basis for issuing alerts. Interventions that strengthen national research capacities can be seen as long-term, transformative investments, as universities are responsible for developing the next wave of young professionals who will establish careers in water and related sectors.

Integrating traditional knowledge to enhance hydrometeorological and climate services, such that local communities are seen as active participants in adaptation projects, rather than solely as benefactors. This requires that existing positive experiences be scaled up with joint-knowledge production in the region (examples were identified in the academic sector and under the MMAyA) and directing efforts toward training and developing the capacities of community leaders and local or municipal technicians in hydrometeorological monitoring.

V. Addressing challenges in learning and innovation

Establishing a platform to ensure that learning becomes institutionalized, upscaling positive experiences and mechanisms linked with integrated planning and community-based adaptation at the micro-basin level, and investing in research and development for irrigation efficiency to address challenges in learning and to strengthen innovation. Any lessons from recent water crises have largely been assimilated and exchanged informally, and stakeholders have called for such learning to be formalized. This could be in the form of a web platform, where data and information on best practices could be compiled and exchanged. In terms of integrated basin management, stakeholders recognize that communities within micro-basins have historically demonstrated ownership and sensibility in caring for their environment and water, and the strong network mechanisms that exist at this level could be replicated on larger scales. When adaptation actions emerge from the ground level, rather than from the top down, civil society will more likely take ownership, leading to deep transformative change in societal behavior.

1 From Spanish Sistema Nacional de Información Climática y del Agua.

2 From Spanish Ministerio de Medio Ambiente y Agua.

VI. Addressing challenges in building knowledge, awareness, and engagement on the ground

Building awareness of the value of water as a resource, mainstreaming climate change and environmental education, changing perceptions and mindsets about risk, and recognizing that traditional knowledge can be central to adaptation planning will all contribute to improved cooperation between civil society and the state. The PPCR in Bolivia already includes outcomes related to educating women, children, and youth in selected rural communities. However, the national level requires a coordinated program that transfers climate and environmental knowledge to the broader public through mass media, education in schools, and other mechanisms. Knowledge generation at the ground level should be seen as a two-way process within the PPCR, not only building new capacities with local communities, but providing a space where knowledge and traditional practices can be integrated into climate change policies and actions.

The set of recommendations summarized above are supported by several innovative examples and cases of best practices that may help guide further development of the PPCR in Bolivia. Furthermore, recommendations are aligned with the nine Arenas of Intervention for transformative change defined by the CIF,[3] thereby increasing the potential of the PPCR to generate relevant, deep, far-reaching, and sustainable manifestations of adaptive capacity in the Bolivian water sector. The CIF could use the lessons and experiences from this study as a reference for assessment practices and to design adaptation projects in other countries where climate change and water security threaten sustainable development.

3 The nine arenas are Financing, Governance and Engagement, Institutions, Knowledge and Information, Markets, Natural Capital, Policies, Practices/Mindsets, and Technologies and Infrastructure. See Annex 4 for definitions.

Motivation

Recent assessment reports of the Intergovernmental Panel on Climate Change (IPCC) paint a clear picture of continued changes in the global water cycle over the 21st century, including a projected increase globally in the overall population exposed to challenges of both water scarcity and flooding (IPCC, 2014). This is particularly concerning for mountainous countries, where melting snow and ice is leading to changes in seasonal water supply and where steep topography can enhance risks associated with heavy rainfall, flooding, and landslides. The Plurinational State of Bolivia is one such country. Its geographic location straddling distinct climatic zones, coupled with the demands of economic development and poverty reduction, are leading to significant climate-related challenges in the water sector. This vulnerability was evidenced as recently as 2016/17, when a major drought crippled the La Paz/El Alto metropolitan area, and in late 2017/early 2018, when unusually heavy rainfall caused flooding and related landslides across several departments. While future climate projections are uncertain, the frequency and/or intensity of climate extremes are expected to increase.

Given that every degree of global warming is likely to amplify risks (IPCC, 2018), a fundamental question arising both academically and politically is to what extent countries like Bolivia have the mechanisms and processes in place to build adaptive capacity and to facilitate adaptation. In fact, the importance of building adaptive capacity, strengthening resilience, and reducing vulnerability to climate change, particularly within developing countries, has been explicitly recognized in Article 7 of the Paris Agreement (21st Conference of Parties of the United Nations Framework Convention on Climate Change). In practice, although institutional and governance factors have been shown to be key to building adaptive capacity at the local, regional, and national levels, there remain few examples of how to characterize adaptive capacity in operational terms and, more importantly, how to measure it under different sectoral and national contexts.

This study contributes to reducing this knowledge gap by assessing how the water governance system in Bolivia has been able to manage and respond to recent drought and flood crises, the type of which could occur with greater frequency and/or magnitude in the future. Following a participatory stakeholder process, this study identifies key challenges and opportunities in the process of building adaptive capacity in the Bolivian water sector and further refines an assessment framework (after Hill, 2013) that could be replicated in other regions. Such an assessment will enable programs and projects to be developed to address core gaps in the process of building adaptive capacity in Bolivia. In particular, the study focuses on mechanisms and interventions that could lead to transformative change, recognizing that adapting to climate-related challenges in the water sector is fundamental for sustainable development (as highlighted across several sustainable development goals of the United Nations 2030 agenda).

PART A

Establishing the Context

PART A: Establishing the Context

1. Introduction

The Organisation for Economic Co-operation and Development (OECD) has defined water governance as "the range of political, institutional, and administrative rules, practices, and processes (formal and informal) through which decisions are taken and implemented, stakeholders can articulate their interests and have their concerns considered, and decision-makers are held accountable for water management" (OECD, 2015). In recent years, water and its governance have attracted increased attention as a policy concern because climate change may reduce the availability of water resources in already dry regions, affecting regional water, energy, and food security, and because changes in rainfall variability could lead to increased flood risks (Woodhouse and Muller, 2017). Hence, questions arise as to how water governance systems can facilitate or hinder adaptation to climate-related challenges.

Bolivia is one of the 20 countries on the planet with the most renewable water resources. However, almost half of Bolivia's territory is in arid and semi-arid areas that exhibit high levels of water deficit and frequent severe droughts. In fact, two-thirds of the population is concentrated in the dry regions of the country. Hence, Bolivia is a nation vulnerable to the impacts of hydrometeorological extremes, and drought and floods have been classified as the most costly natural disasters to have affected the country over the past century.

In view of recent and projected future climate change (see Section 3) and the related challenges that Bolivia is facing, this study focuses on the major drought of 2016/17 (emphasizing the La Paz/El Alto metropolitan area) and the flood of late 2017/early 2018 (emphasizing affected areas in Cochabamba) to assess adaptive capacity in the Bolivian water governance system. In this way, past extreme events are considered a proxy for the type of events that might become more frequent and/or intense in the future. Adaptive capacity is a central concept when developing and implementing effective strategies to reduce the likelihood and magnitude of harmful outcomes resulting from climate change. While the lack of adaptive capacity could serve as a barrier to adaptation, exploring where strengths and weaknesses exist allows stakeholders and decision-makers to tailor programs to bridge gaps and effectively strengthen capacities. Under the framework of this study, an exploration of how governance systems have managed and responded to past extreme events, and what manifestations of adaptive capacity have arisen, has allowed us to examine whether governance practices have hindered or enabled the building of adaptive capacity in the water sector, emphasizing transformative processes.[4] This analysis will provide the foundation to explore the potential of the PPCR (see Box 1) to address gaps, build adaptive capacity, and achieve transformative change in the Bolivian water sector.

4 Transformative processes enable the transition of a system to a fundamentally different, potentially more desirable state, along a path toward sustainable development (i.e., transformative change).

Box 1. Pilot Program for Climate Resilience

In 2008, the Climate Investment Funds (CIF) were established to provide scaled-up climate financing to support transformational change toward low carbon, climate resilient development. Channeled through multilateral development banks, the CIF encompasses two funds: the Clean Technology Fund and the Strategic Climate Fund, which includes three targeted programs, the Forest Investment Program, the ***Pilot Program for Climate Resilience (PPCR)***, and the Program for Scaling-Up Renewable Energy in Low Income Countries (SREP). The US$1.2 billion PPCR uses a two-phase programmatic approach to assist national governments in integrating climate resilience into development planning across sectors and stakeholder groups. The program provides additional funding to put country plans into action and pilot innovative public and private-sector solutions to pressing climate-related risks. In Bolivia, the PPCR is supporting an integrated plan to improve water resource management in prioritized sub-basins and planning capacity at the national level. More specifically, the three main areas of interventions are as follows:

- **Component 1:** Strengthening the national capacity to manage climate change. The overall objective of this component is to strengthen the national capacity to integrate climate change resilience within public planning, management, and investment, and to mainstream the pilot experiences with the integrated river basin management approach.

- **Component 2:** Multipurpose drinking water and irrigation program for the Batallas, Pucarani, and El Alto municipalities. The overall objective of this component is to improve drinking water service delivery, taking into account climate change resilience.

- **Component 3:** Integrated Basin Management (Rio Grande). The overall objective of this component is to support the implementation of Bolivia's strategy for climate resilience by strengthening institutional capacity to define the new integrated river basin management approach to climate change adaptation, supporting its implementation in three pilot sub-basins in the Rio Grande river basin.

The PPCR in Bolivia is designed to support the full implementation of the country's National Mechanism for Adaptation to Climate Change.

This study aims to **assess the potential role of the PPCR in building robust institutional adaptive capacity in the Bolivian water sector using a previously tested evaluation framework developed by the University of Geneva** (Hill, 2013). Within the broader context of the CIF, this study directly aligns with the goals of the Transformational Change Learning Partnership, which seeks to increase the transformative impact of investments made under climate funding schemes. Specifically, the study is guided by a series of research questions, including the following:

- How do existing governance regimes and their associated mechanisms promote adaptive capacity in the water sector in Bolivia? (enabling environment for adaptive capacity)

- What is the potential of the current PPCR-funded National Investment Plan to influence these water governance regimes and achieve transformational change?

- What type of adjustments to the PPCR in Bolivia would be needed to assure existing water management regimes contribute more effectively to a robust adaptive capacity framework in the water sector?

- What are the main challenges across different sectors and governance levels in building adaptive capacity in Bolivia and how could these be addressed?

Two particular groups of stakeholders were engaged in the research process and were to benefit from the results:

1 **Primary users,** including national and subnational institutions, policymakers, and water managers responsible for designing and implementing adaptation programs, and the CIF managers and committees.

2 **Secondary users,** consisting of other funds and implementing agencies for programs seeking to deliver transformational change through their organizations.

Both primary and secondary users were engaged in workshops and the participatory research activities. It was, however, considered beyond the scope of this study to evaluate issues of water insecurity among the most vulnerable populations.

The study focuses on two different geographical contexts where the PPCR national program is investing resources: the La Paz/El Alto watershed (Katari) and the Rio Grande watershed in the south (department of Cochabamba). These selected areas were heavily affected by the recent drought (La Paz/El Alto) and flood (Cochabamba).

2. Determinants of Adaptive Capacity

Adaptive capacity is defined succinctly by the IPCC (IPCC, 2014) as "the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences." It can be characterized as the preconditions needed to enable adaptation, including social and physical elements, and the ability to mobilize these elements (Nelson, Adger, and Brown, 2007). Adaptive capacity is closely related to (and sometimes confused with) concepts of robustness, adaptability, flexibility, resilience, and coping ability (see Lavell, Oppenheimer, Diop, et al., 2012, for a full nuanced discussion). Adaptive capacity should be seen as contributing to these aspects of a system. In other words, the presence of adaptive capacity increases the ability to cope with climate risks. Building and mobilizing adaptive capacity requires actors to be able to adapt reactively to and cope with extreme hydrometeorological events, such as floods and droughts, but also plan for longer-term gradual impacts and uncertainties of climate change (Matthews, Wickel, and Freeman, 2011; Tompkins and Adger, 2005).

Adaptive capacity is considered a function of a number of determinants, namely a group of factors that, when present in a community (or system), strengthen adaptive capacity. In particular, institutional and governance factors (e.g., legislative and regulatory frameworks, policies, rights, and formal and informal institutions) have all been shown to be key to building

adaptive capacity at local, regional, and national levels. For example, a recent study focusing on the Bolivian department of Cochabamba found that governance-related factors such as lack of understanding of issues (i.e., confusion), unwillingness to act, unclear division of responsibilities, lack of coordination, not using available knowledge (including local knowledge), and contested issues were all limiting factors for interventions that would build adaptive capacity (Wilk, Jonsson, Rydhagen, et al., 2018). While adaptation and vulnerability literature highlights factors such as economic and physical resources; access to technology, information, and skills; infrastructure; and institutions (Smit, Burton, Klein, et al., 2000; Yohe and Tol, 2002), actors in the field of resilience have additionally highlighted the importance of flexibility in the process of building institutional adaptive capacities, including elements of experimentation and learning (Brooks, Adger, and Kelly, 2005; Kerner and Thomas, 2014; Panpakdee and Limnirankul, 2017).

Building on the theoretical context established from an extensive review of the international literature (see overview in Table 1), Hill (2013) operationalized a set of governance-related determinants of adaptive capacity to assess adaptive behavior in the water sector during recent extreme events in both Chile and Switzerland. The process of operationalization evolved gradually during a three-year project, with the initial literature-based listing of determinants and indicators refined following a series of in-country workshops and stakeholder interviews. By exploring the governance mechanisms associated with more transformative adaptation and identifying favorable conditions that fostered adaptive capacity on different levels, Hill (2013) arrived at a final consolidated grouping of three core determinants—Regime, Knowledge, and Networks—and associated nuanced indicators and their criteria (see Section 5. *Assessment Framework*). Given the contextual similarities between Bolivia and Chile (both countries face hydrological challenges related to accelerated tropical glacier retreat, changes in precipitation patterns, and conflicting uses of water between rural and growing urban areas and among different sectors), the assessment framework developed by Hill (2013) was considered a suitable starting point for the current study.

Table 1. Overview of the initial identification of governance and institutional determinants of adaptive capacity that provided the basis for the adaptive capacity indicators and assessment framework being used in this study. (Source: Hill and Allan, 2014)

Determinants	Related Criteria
Knowledge	Right to information; communication and public perception; access to scientific and environmental information; exchange of data and information; integration of scientific expertise; quality of scientific information; use of traditional and local knowledge (Olsson, Folke, and Hahn, 2004; Folke, Hahn, Olsson, et al., 2005; Ostrom, 2007)
Networks	Access to participation; selection of non-state actors; level of influence; type of participation and stage in the political process; social networks and professional networks; willingness to cooperate (Berkes and Folke, 2001; Folke et al., 2005)
Levels of Decision-Making	Ecologically based units of decision-making; institutional arrangements (Berkes and Folke, 2001; Pahl-Wostl et al., 2007; Huitema, Mostert, Egas, et al., 2009)
Integration	Geographical integration; sectoral integration; governance scale integration (Pahl-Wostl et al., 2007; Engle, Johns, Lemos, et al., 2011)

Flexibility and Predictability	Consistency in rule of the law; predictability of legal provisions; interactivity in laws, plans, and institutions to deal with uncertainty (Keeney and McDaniels, 2001; Pahl-Wostl et al., 2007; Iza and Stein, 2009; Herrfahrdt-Pähle, 2010)
Resources	Financial resources; quantity and quality of human resources; organization of resources; independence and impartiality of experts (Smit and Wandel, 2006; Engle and Lemos, 2010)
Experience	Training and development; years of experience (Yohe and Tol, 2002; Engle and Lemos, 2010)
Leadership	Political commitment; initiation of partnerships; support for mobilization of resources; linking of actors; building trust among stakeholders (Tompkins and Adger, 2005; Olsson, Gunderson, Carpenter, et al., 2006)

3. Recent and Future Extreme Events in Bolivia

Bolivia is vulnerable to the impacts of hydrometeorological extremes and, according to the Emergency Events Database (www.emdat.be), droughts (US$1.5 billion in damages) and floods (US$1.7 billion in damages) are the most costly natural disasters to have affected the country over the past 100 years. To explore how water governance systems have managed and responded to past hydrometeorological extreme events, in this study we focus on two recent crises: the major drought of 2016/17 and the flood of late 2017/early 2018. To provide the necessary context for this study, we provide a brief overview of these events, focusing on the physical dimensions and impacts, and look at how the frequency and/or magnitude of such events might evolve in the future under a changing climate.

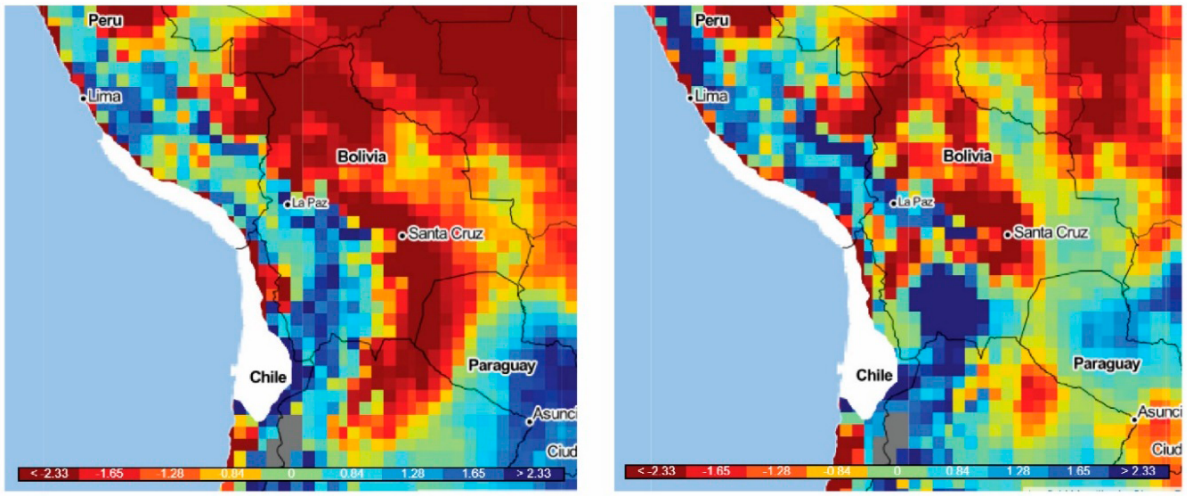
3.1. Drought of 2016/17

In the final quarter of 2015, observations were already indicating the onset of a strong El Niño event, with sea surface temperature anomalies in the tropical Pacific Ocean higher than seen in the previous 30 years (Jiménez-Muñoz, Mattar, Barichivich, et al., 2016). As a consequence of projected further strengthening of the El Niño, in October 2015, the World Health Organization released a status report outlining expected impacts over the subsequent months, including the moderate to high likelihood of drought in Bolivia.[5] At that time, drought indices for Bolivia were already strongly negative (Figure 1) and seasonal climate forecasts published by the National Meteorology and Hydrology Service (SENAMHI from Spanish Servicio Nacional de Meteorología e Hidrología) were showing a higher probability of drought for some regions and flooding for others. Throughout 2016, the drought further intensified, such that by November 21, 2016, a State of National Emergency was declared. By this time, 173 of the country's 339 municipalities within eight of the nine departments were affected by the drought, with severe impacts in the La Paz/El Alto metropolitan area and in other major cities such as Cochabamba, Oruro, Potosí, and Sucre. The drought continued into early 2017 before moderate rainfall alleviated the situation. Some 130,000 families are estimated to have been affected by the drought and associated water rationing, with severe impacts on agricultural land, crops, and livestock.[6]

5 http://www.who.int/hac/techguidance/preparedness/el_nino_2015_2016/en/

6 https://reliefweb.int/disaster/dr-2016-000002-col

Figure 1. Standardized Precipitation-Evapotranspiration Index for Bolivia showing the extent of the drought conditions (orange–dark red) that prevailed over much of Bolivia before and during the 2016/17 water scarcity crisis.



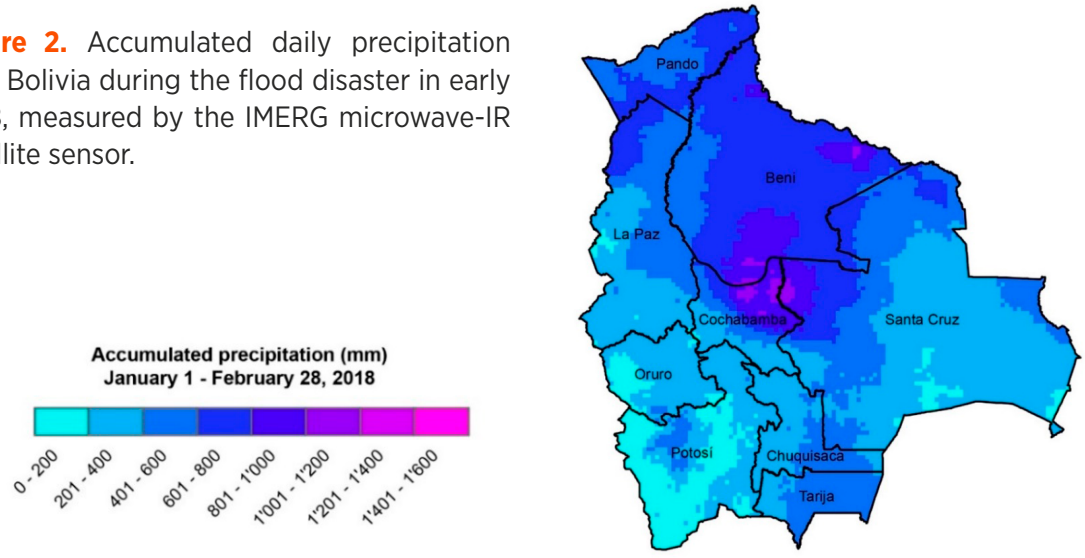
a) December 2015 a) July 2016

Source: http://spei.csic.es

3.2. Flooding of 2017/18

Moderate to strong intensity rainfall in late 2017 and into January and February of 2018 caused significant flooding across several departments of Bolivia. Analyses of accumulated precipitation data over these months show that rainfall was heaviest over Cochabamba, Beni, and eastern areas of Santa Cruz, consistent with where flooding proved most severe (Figure 2). In Cochabamba, the first week of February saw major devastation in the municipality of Tiquipaya, where the Taquiña River burst its banks, flooding streets with mud, rocks, and debris. Flooding also occurred in the department of La Paz, within the municipality of Pucarani. As of February 23, 2018, official figures from the government of Bolivia indicated that 17,000 families were affected and 337 homes destroyed as a result of the flooding across the country, although these figures likely further increased.[7]

Figure 2. Accumulated daily precipitation over Bolivia during the flood disaster in early 2018, measured by the IMERG microwave-IR satellite sensor.



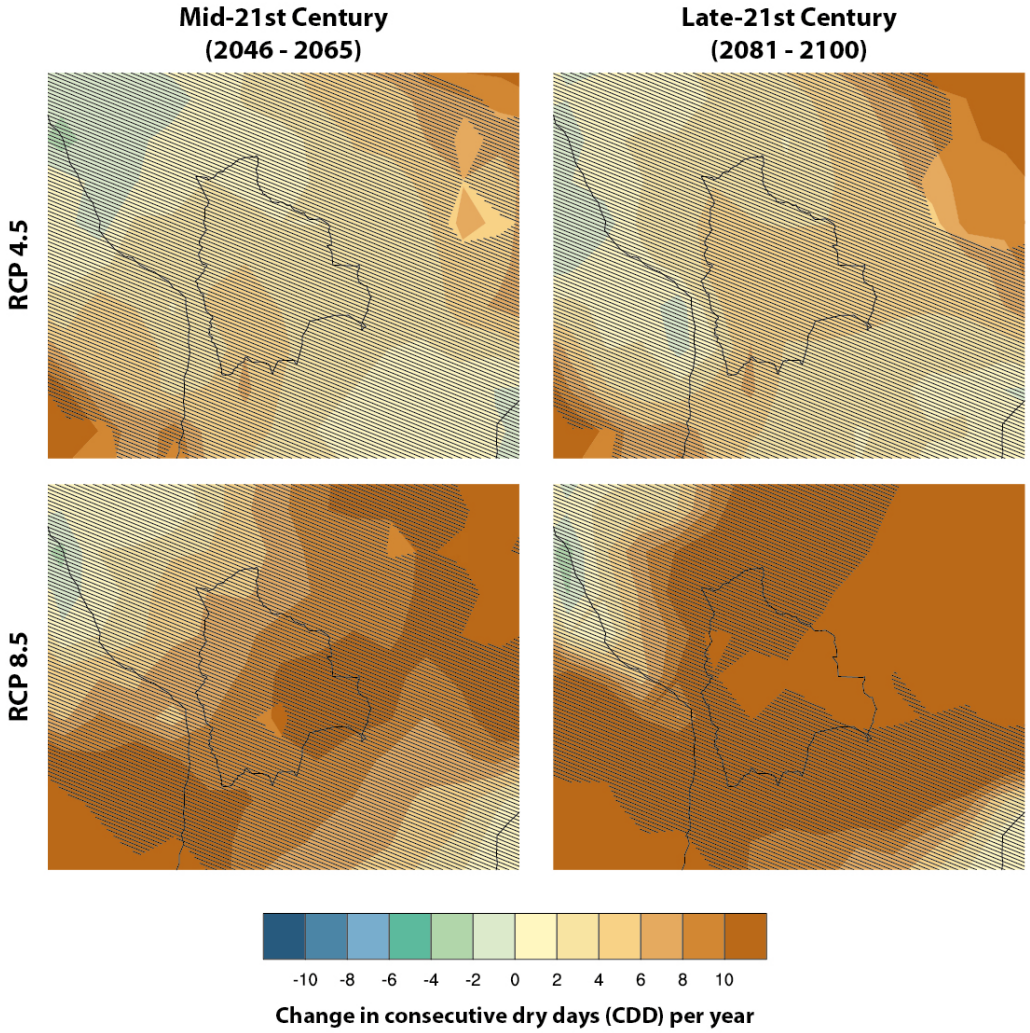
Source: NASA Giovanni tool at https://giovanni.gsfc.nasa.gov/giovanni/

7 https://reliefweb.int/disaster/fl-2018-000015-bol

3.3. Expected Future Changes in Extreme Events

From a global perspective, flood and drought events are generally expected to become more frequent and intense as a result of continued atmospheric warming into the mid- and late-21st century, with increased contrasts emerging between wet and dry regions, and wet and dry seasons (IPCC, 2012). This is seen for Bolivia, where the suite of CMIP5 global climate models show both an increase in consecutive dry days (a commonly used drought proxy) and an increase in the amount of extremely heavy rainfall under both moderate RCP 4.5 and worst-case RCP 8.5 emission scenarios (Figures 3 and 4).[8]

Figure 3. Change in consecutive dry days over Bolivia, as simulated from the CMIP5 suite of global climate models for mid- and late-21st century.

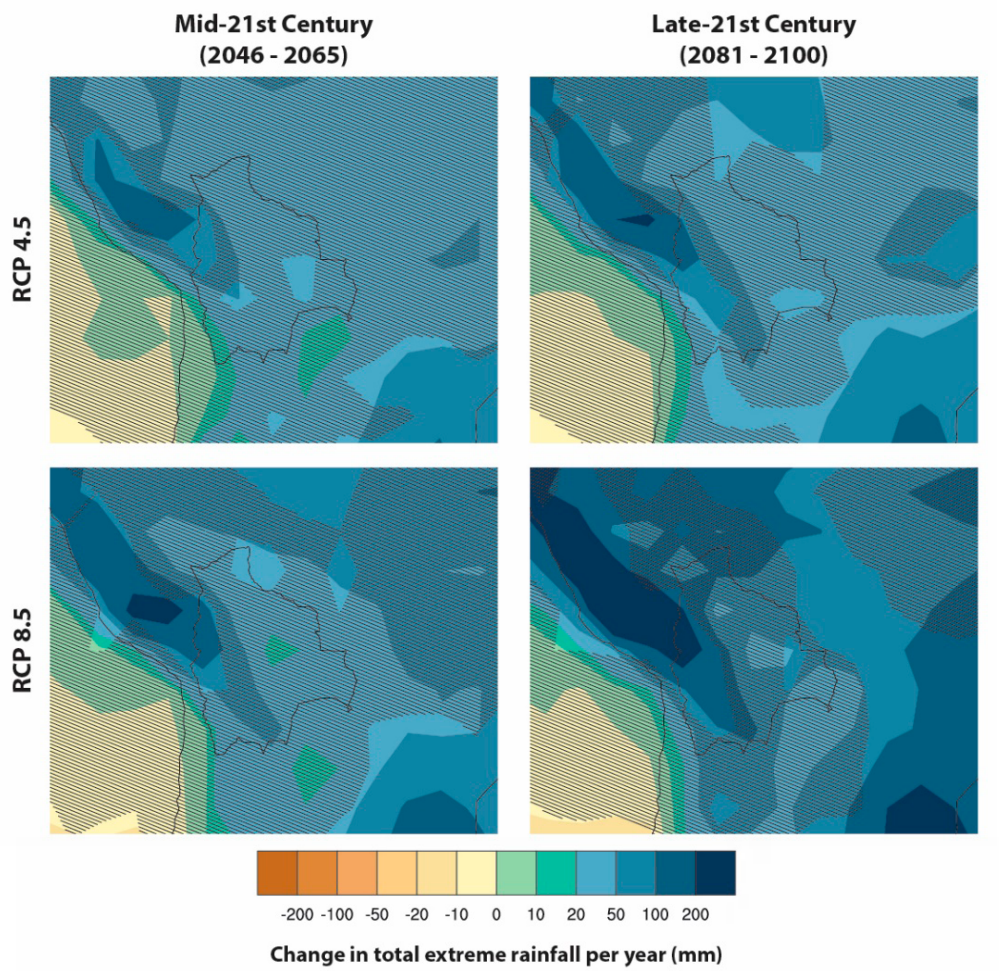


Source: KNMI climate explorer at https://climexp.knmi.nl. Changes are relative to the present-day baseline (1986–2005). Hatching indicates where the magnitude of the change is less than 1 standard deviation of model estimated present-day natural variability.

8 Representative Concentration Pathways (RCPs): Scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases, aerosols, and chemically active gases, as well as land use/land cover (https://www.ipcc-data.org/guidelines/pages/glossary/glossary_r.html).

The hatching in the model projection figures can be interpreted as an indication of the strength of the future anomalies relative to present-day climate compared to the strength of present-day internal variability. In other words, hatching either means that the future change is relatively small or that there is little agreement between models about the sign of the change. Over complex mountainous countries like Bolivia, and where long-term observations (needed to calibrate models) are scarce, future climate projections are very uncertain. Nonetheless, a clear increase in flood-causing heavy rainfall events is seen over western Bolivia, and the signal strengthens by the late 21st century and under RCP 8.5. There is less certainty in drought projections, but a clear signal of increasing dry spell length is seen across the departments of Santa Cruz and Cochabamba and into La Paz under RCP 8.5 by the end of the 21st century. Other drought indices, such as the Standardized Precipitation-Evapotranspiration Index, also show increased drying over Bolivia. To date, there is no consensus among climate scientists as to how El Niño-Southern Oscillation will change and influence regional climate into the mid- to late-21st century, but it is expected to remain the dominant driver of inter-annual variability in the tropical Pacific, with continued wide-reaching impacts across the surrounding region (IPCC, 2013). **The continued influence of El Niño and other modes of climate variability, coupled with an expected increase in hydrological extremes under a changing climate, will bring additional challenges for long-term sustainable water governance in Bolivia and gives urgency to the need to strengthen adaptive capacities in the water sector.**

Figure 4. Change in the annual sum of precipitation over Bolivia in days where daily precipitation exceeds the 95th percentile relative to the base period, 1986–2005, as simulated using the CMIP5 suite of global climate models for mid- and late-21st century.



Source: KNMI climate explorer at https://climexp.knmi.nl. Hatching indicates where the magnitude of the change is less than 1 standard deviation of model estimated present-day natural variability.

4. Institutional and Governance Context in Bolivia

In past years, Bolivia has faced conflicts and challenges due to the lack of appropriate water regulation (Baer, 2015; Marston, 2015). The existing water law is from 1906 and efforts to update this regulatory framework have not been successful. In the absence of a strong legal framework, the country has primarily based the governance of its water resources on watershed management programs and local agreements. Since 2010, Bolivia has taken important steps to build a society resilient to climate change, developing and structuring a conceptual, institutional, legal, and regulatory framework that relates its economic development to the environment, understood as living well and in harmony with Mother Earth.

Various documents have shaped the development and implementation of the water policy across the country (Annex 1). The new National Constitution, adopted in 2009, recognizes water as a fundamental right and attributes its care and management to the state (Art. 373 and 374). In 2010, the United Nations General Assembly approved the Bolivian-led 64/292 Resolution, which recognizes drinking water and basic sanitation as essential human rights. Later, in the same year, Law 071 on the *Rights of Mother Earth was enacted and included water as a right of Mother Earth* (Art. 7). Likewise, the Framework Law of Mother Earth and Integral Development to Live Well (Law 300) included guidance on governing, managing, and using water (Art. 27). More recently, in 2014, the 13 pillars of the 2025 Patriotic Agenda incorporated water and sanitation services as part of the basic services with sovereignty to live well. The Ministry of Environment and Water (MMAyA from Spanish Ministerio de Medio Ambiente y Agua) prepared the Sectoral Plan for Integral Development 2016–2020, which determines the necessary elements for a comprehensive management of "life systems" and places water management at the core. Under this framework, important sectoral plans and normative instruments have been integrated. Some of the most important are (i) the National Watershed Plan, (ii) the Sectoral Plan for the Development of Basic Sanitation 2016–2020, and (iii) Law 755, Integral Management of Waste, among others.

The two versions of the National Watershed Plan—2013–2017 and 2017–2020—include strategic guidance to govern and manage water resources and explicitly state that climate change adaptation needs to be considered and disaster risk reduced. The plan established the operationalization of integrated water management through dialog and intersectoral coordination between water user sectors and those sectors that can contribute to water conservation. Such processes are articulated through watershed management plans in the case of strategic basins and through watershed management bodies at the level of micro-watersheds. Moreover, public investments to protect and restore watersheds have become available within the framework of integrated watershed management projects. Finally, four of the strategic river basins defined by the plan will be the focus of implementation under the PPCR: Katari, Rocha, Mizque, and Arque-Tapacarí.

Climate change considerations have been included at different governance levels, encompassing the science and planning instruments of water management, including integrating climate scenarios in preparing water balance studies in key watersheds, applying water planning tools (e.g., WEAP, which incorporates the science of climate change adaptation and resilience in basin management plans), and applying climate proofing tools and specific project guidelines in water infrastructure planning and budgeting (i.e., water reservoirs, dams, and irrigation projects). In addition, in response to the drought of 2016/17, the MMAyA enhanced collaboration with the SENAMHI and research centers to put in place an Early Warning and Drought Forecasting System under the National Climate and Water Information System (SNICA from Spanish Sistema Nacional de Información Climática y del Agua) with support of the PPCR.

PART B

Methodological Development

PART B: Methodological Development

In Part B, we introduce the assessment framework that guided this study and describe the process that was undertaken to identify and select stakeholders who were engaged in workshops and the field survey. We then outline how core components of the assessment framework, including the design of the questionnaire, were tailored for the Bolivian context based on the initial contextual understanding (Part A) and results emerging from the first stakeholder workshop.

5. Assessment Framework

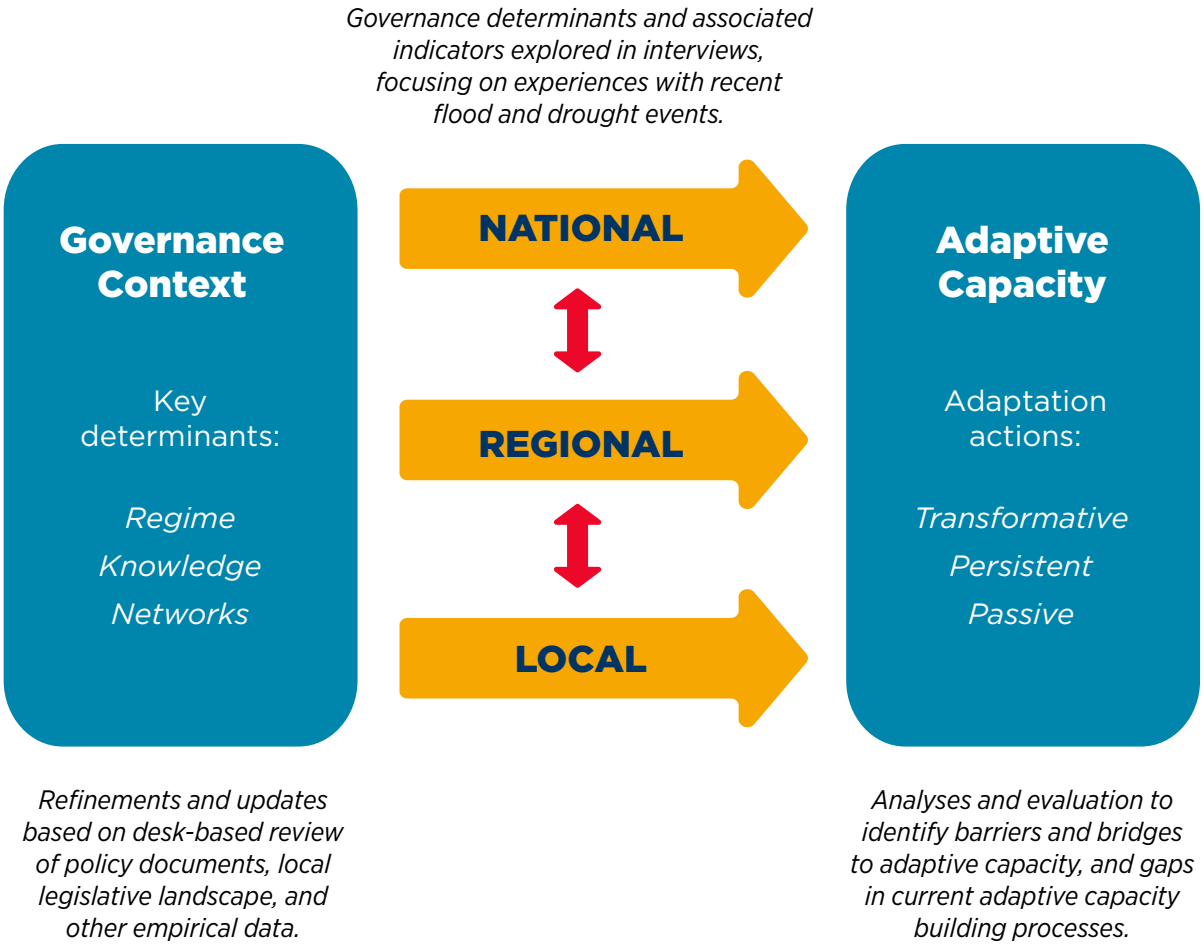
The framework for assessing adaptive capacity in the water sector was developed by the University of Geneva within the context of the large EU-funded project ACQWA (Assessing Climate Impacts on the Quantity and Quality of Water) and has been implemented previously in Chile and Switzerland (Hill, 2013). Under the framework, governance (national, regional, and local) is seen as the key driver of adaptive capacity and the type of adaptation actions occurring in the water sector (Figure 5). By exploring how governance systems have managed and responded to past extreme events, actual manifestations of adaptive capacity can be identified and we can examine how governance practices hindered or enabled building adaptive capacity, emphasizing transformative adaptation.

The assessment framework recognizes three key determinants of adaptive capacity. For each determinant, there are several indicators that can be measured (in accordance with a given criteria) using quantitative or qualitative data to assess the level to which governance systems are enabling adaptive capacity.

- ***Regime*** refers to the sets of rules; policies; and legislative, regulatory, and property rights that determine what water stakeholders can and cannot do. It also comprises the dynamics and power relations between different political and administrative levels.
- ***Knowledge*** refers to the informational inputs into a governance system. It includes the timeframe in which plans and management techniques are evaluated and implemented, and the integration of uncertainty into evaluation and planning.
- ***Networks*** refers to the way in which actors interact and cooperate. It encapsulates the connectivity between groups and stakeholders and the mode of coordination and delegation across different political and administrative layers.

As introduced earlier, this study focuses particularly on identifying how governance systems and associated adaptation mechanisms are or could enable transformative change. Under the assessment framework, **transformative change** is defined *as the transition of a system to a fundamentally different, potentially more desirable state, onto a trajectory that sustains and enhances ecosystem services, societal development, and human well-being.* **Persistent change** *refers to adjustments in response to actual or expected climate impacts, allowing the system to persist within the current state. Finally, at the other end of the spec*trum, passive change refers to the degradation of a system to a less favorable state resulting from failure to adapt or transform.

Figure 5. Conceptual framework to assess the relationship between governance and adaptive capacity in the water sector.



Source: Authors' elaboration.

6. Tailoring the Assessment Framework

The assessment framework of Hill (2013) was initially developed to guide studies in Chile and Switzerland. The three determinants (Regime, Knowledge, and Networks) are well established in the international literature and are considered to be broadly applicable across a range of sectors and governance levels (see Section 2 and literature cited therein for a theoretical basis). However, it is worth bearing in mind that Hill's (2013) framework was developed in an iterative manner during a three- to four-year project, with the indicators of adaptive capacity and the associated criteria emerging out of a multi-pronged assessment approach based on interview responses and other data. Such an iterative process was not possible within the current study given the timeframe available, thus the indicators and criteria were tailored to the local context was based on:

- Critical lessons and experiences gained during previous implementation of the framework in Chile and Switzerland.

- A desk-based review of the latest international literature, as well as policy documentation and technical reports relating to water governance in Bolivia.

- Consideration of key discussion points and issues raised in the April 2018 first stakeholder workshop.

Following consultation with Margot Clarvis Hill (author of the initial framework), a guiding principle for the revisions was to reduce and/or streamline the indicators and criteria to the extent possible (without losing coverage of key issues), aiming to reduce redundancy and ensure a clearer alignment of data coming out of the interviews with a given criteria (reducing the need for subjectivity in the assessment process). A key step in the revision process was an initial coding (classification) of the various discussion points and issues raised during the first stakeholder workshop to see how well the range of views were being captured by the existing framework indicators and criteria. This process helped identify gaps in the classification scheme and several redundancies where statements could be assigned to multiple indicators.

Published studies considering the assessment of adaptive capacity in the water sector remain rare. One notable study comes from the work of Koop, Koetsier, Doornhof, et al. (2017), who developed a water governance capacity framework for Amsterdam, Netherlands. An important aspect of this framework is the inclusion of an indicator and clear criteria for uncertainty around regulatory responsibilities for decision-making and the division of these responsibilities. In this case, division of responsibilities refers to the accurate and clear division of tasks and roles for which stakeholders can be held accountable (Mees, Kijk, van Soest, et al., 2014). In our view, the original framework was weaker on this, focusing more on responsibilities relating to monitoring and enforcement than responsibilities for decision-making in the face of water crises. Given that issues related to the division of responsibilities have been highlighted in the Bolivian context (Zurita, Thomsen, Holbrook, et al., 2018) and that bottlenecks in decision-making emerged as key issues from the first stakeholder workshop (Box 2), we favored the inclusion of clear indicators and criteria.

A further issue highlighted at the first workshop included the importance of integrating a risk management perspective into adaptation planning (added under the *Integration* indicator), a topic that has also emerged strongly over recent years in the international literature (e.g., IPCC SREX, 2012). Also there was much discussion about knowledge, how it was distributed and the importance of building knowledge at the ground level with civil society. Hence, we decided to strengthen these aspects of the framework with a new set of criteria under the *Experience* and *Expertise* indicator and specific reference to civil society under the *Perceptions* indicator (Table 2a).

Following the revision process, the total number of indicators declined from 16 (41 criteria) to 13 (33 criteria). It is important to note that three indicators from the original framework (accountability, institutional integration, and levels of decision-making) were not removed, but rather the same information is now being captured under the Responsibility and Accountability and *Cooperation* indicators.

Box 2. Brief Summary of the First Workshop

The event was held at the Inter-American Development Bank facilities in La Paz on April 17 and 18, 2018. The two-day workshop brought together 30 people, including national actors of the PPCR, to discuss the approach and scope of the study. The discussions explored the progress of the PPCR as well as gaps and difficulties in building adaptive capacity within the water sector to cope with climate change and variability, including extreme climate events. The workshop featured presentations, as well as questions and comments from the participants.

The following key messages were compiled based on presentations and discussions over the two-day workshop and helped to tailor the assessment framework and design the field questionnaire:

- Lack of social communication, which is required in non-technical language, is seen as a weakness of the PPCR in Bolivia. Communication requires a strong link between the state and civil society to empower civil society to become co-responsible in solving problems.

- Clarification of roles and responsibilities. Lack of binding rules and agreements (laws and protocols) give rise to conflicts and delayed responses. Requires one clear authority with clear rules.

- Strengthening of capacities and technical know-how is needed to ensure plans can be implemented on the ground. Can be facilitated through better links to local education providers (universities). Improvement in the analysis of the available data is crucial in order to incorporate it into emergency response measures.

- It is important that institutions absorb lessons learned from the PPCR, ensuring plans can be implemented for the long term and that knowledge platforms remain active after the program is completed. The challenge of buy-in is common to all programs.
- Short-term thinking and lack of institutional memory is a limitation.
- There is a need for a transformative shift in focus from disaster/emergency response to risk management, preparation, prevention, and awareness.
- There is a shortage of financial resources linked to weak institutions and there are large variations in institutional capacities across municipalities.
- Knowledge is not evenly distributed across different institutions and levels of government.
- A true intersectoral approach to water governance is lacking, although there is progress in this direction. Intersectoral coordination is needed (e.g., between agriculture and energy).
- Systematic and integrated approaches to water governance and risk management are needed in a changing climate.
- The media and schools need to be involved, using simple clear messaging, in order to raise awareness about extreme climate events.
- Changes in water demand need to be monitored and included in national planning in order to avoid supply–demand conflicts.

A full listing of the indicators and operationalized criteria used in the Bolivian study is provided in Table 2. Revising and tailoring the framework represent a trade-off. On one hand, we aim to undertake the most comprehensive and tailored assessment possible for the Bolivian water sector. On the other hand, within the bigger scope of the CIF and the PPCR, eventually we aim for an approach that can be upscaled to other countries. Hence, the framework needs to be replicable and subjectivity in the assessment process needs to be limited to the extent possible. In general, however, we anticipate that the revisions undertaken for Bolivia—reducing the number of operationalized indicators and criteria—will have enhanced the potential to replicate and upscale the methodological approach.

Table 2. Final listing of the indicators and their operationalized criteria used to assess adaptive capacity in the Bolivian water sector. Pertinent questions for each indicator are included (see Annex 2 for full questionnaire).

(a) Knowledge Indicators	Operationalized Criteria
Evaluation and planning	**Reactivity and longevity** Development of both short-term coping plans and longer-term adaptation plans.
	Socio-environmental integration Integration of climate change and environmental and societal impacts into planning process.
	Data and analyses Appropriateness and application of the data and analytical contribution to the decision-making process.
Pertinent questions: • Regarding the most recent events, what type of data or information did your organization/group/community generate to help manage the drought/flood event? • Before the event, did coping and/or response plans exist? Have these plans been adjusted or new plans put into operation as a result of new knowledge from the event?	
Monitoring and assessment	**Consistency** Consistency across data sets, coordination in collation.
	Diversity Diversity of inputs into the decision-making system.
	Coverage Spatial and temporal extensiveness and accuracy of the monitoring network.
Pertinent questions: • What kind of technical or scientific information is used to manage water supply and/or flooding in your region? (Examples) • Can you give examples of how technology/information/data was used to manage the extreme situation and how the information was integrated into planning and decision-making?	
Transparency	**Availability** Availability, relevance of, and access to information about water resources.
	Communication Communicating relevant information and building capacity to prepare for periods of extreme weather.
	Simplicity Non-technical language used in communications with civil society.
Pertinent questions: • Was the information clear, applicable, and in a format you could use? • Who or what institution should be responsible for sharing information? • What improvements in technical and scientific information are required to better prepare, manage, and respond to these types of events?	
Perceptions	**Awareness** Awareness of climate change impacts among stakeholders (including civil society).
	Openness Openness to learning and willingness to adopt new solutions or paradigms.
Pertinent questions: • After such events, are institutions and civil society aware of what the impacts of climate change represent in Bolivia? If so, how? For example, what are the perceived impacts? • How did civil society respond during the disaster? And, what civil-led adaptation actions resulted from these experiences?	

Experience and expertise	**Knowledge distribution** Even distribution of knowledge across institutions and stakeholder groups at various levels (national, subnational, and local).
	Preparedness and response Technical competence, range of expertise, and training needed to prepare and respond to hydrometeorological extremes.
	Traditional knowledge Social memory and traditional knowledge feeds into adaptation planning and environmental monitoring.
Pertinent questions: • How was information/data relevant to managing and decision-making around extreme hydrometeorological events shared across different groups? • Was there any training or preparation for such events? (Workshops/information locally/regionally/nationally).	

(b) Regime Indicators	Operationalized Criteria
Ownership	**Consistency and certainty** Legal certainty about ownership and use rights, at multiple levels (national, subnational, and local).
	Coverage Coverage of all water rights and uses.
Pertinent questions: • Do legal provisions/guidelines exist to manage the water supply during periods of high demand? Or to manage flooding events? • How were response actions (e.g., water allocation and disaster response) prioritized during the extreme events? What was the basis for these decisions?	
Responsibility and accountability	**Consistency and certainty** Clear legal authority and regulations (embedded in law or policy) to enable decision-making to address water-related challenges.
	Division of responsibilities Clear division of tasks and responsibilities against which stakeholders can be held accountable.
	Enforcement Clear responsibilities and capacities for monitoring and enforcement.
Pertinent questions: • Who was involved in decision-making about water supply and/or flood management response during the event? • When it comes to response actions in case of extreme events, is there a clear division of responsibilities and tasks among the institutions/individuals? Did they act according to such division during the past extreme events? • Do legal provisions/guidelines exist to manage the water supply during periods of high demand? Or to manage flooding events?	
Preparedness	**Pre-emptive planning** Emergency provisions and preparedness for hydrological extremes.
	Prioritization Proportional reduction or prioritization of water rights/uses and other resources (personal/financial) to deal with hydrological extremes.w
Pertinent questions: • Do legal provisions/guidelines exist to manage the water supply during periods of high demand? Or to manage flooding events? • How were response actions (e.g., water allocation and disaster response) prioritized during the extreme events? What was the basis for these decisions?	

Integration	**Risk management** A cross-sectoral risk management perspective is integrated into adaptation planning.
	Systemic integration Sustainability of socio-ecological systems is a recognized goal.
Pertinent questions: • Were any concerns for the environment and ecosystems taken into account in managing the event(s)? • Is climate change and/or risk management integrated into the planning process within your sector or within any committees you are involved in at the local/regional level?	
Effectiveness	**Holistic** Incentives to use water efficiently and effectively across multiple uses (including conservation).
	Capacity Matching resources (financial, human, and technical) at the level of enforcement.
Pertinent questions: • How well was the event managed? • Were the financial capacity and human resources sufficient? • Were preparation and relief adequate?	

(c) Network Indicators	Operationalized Criteria
Cooperation (collaboration)	**Negotiation** Ability to negotiate and resolve conflicts, and reach agreements on water distribution, security, and pollution.
	Modes of organization Institutional platforms for actors to collaborate and cooperate across different sectors, uses, and levels (national, subnational, and local).
	Incentivization Mechanisms to incentivize cooperation among water stakeholders within a basin.
	Collaboration Trust, power balances, mixed nature of support structures.
Pertinent questions: • Within your role, did you have regular involvement with other water managers, water stakeholders, or disaster management authorities? If so, can you give examples of how you interacted with them? • Did any of these groups/individuals particularly block or drive progress? • How are/were conflicts negotiated and resolved?	
Participation	**Inclusiveness** Providing a voice in decision-making across water stakeholders, including civil society.
Pertinent questions: • How do you transfer/share information across different stakeholder groups, including to civil society?	
Knowledge partnerships	**Integration and dissemination** Partnerships and clear processes to integrate scientific information into decision-making.
	Exchange and support Informal or formal networks to share and exchange best practices, lessons learned, and technical solutions.
	Societal outreach Strong linkages between the state and civil society.
Pertinent questions: • How could the transfer of knowledge (including scientific and traditional knowledge) be improved across stakeholder groups?	

7. Stakeholder Mapping and Interviews

The main source of data feeding into the assessment framework comes from interviews conducted by a local consultant with 30 key stakeholders from the water sector (Figure 6 and Annex 3). The interviews focused on the experiences of respondents during recent flood and drought events. Due to their involvement with preparing for, responding to, and recovering from recent water-related crises in La Paz/El Alto and the River Rocha (sub-basin of Rio Grande) watersheds, all interviewed stakeholders brought knowledge and information that is highly relevant in the context of the PPCR. Special attention was given to ensuring broad representation in the assessment process (both in workshops and in interviews) across government departments, public services, water operators, academics, cooperation agencies, and social stakeholder groups. The selection of stakeholders was guided by three core principles:

1. The relevance of potential respondents, not the organization. For example, the executive director of the organization might in some cases be the interviewee, but in other cases the interviewee might be a delegate who had more active involvement with adaptation in the water sector.

2. A balance of representation from different governance levels, including national, subnational (departmental), and local stakeholders.

3. Different perspectives and views, including gender perspectives, selecting different types of stakeholders within a certain group. For example, interviewees from local governments included a mayor, the president of the local association, and a member of the municipal council, while maintaining a gender balance.

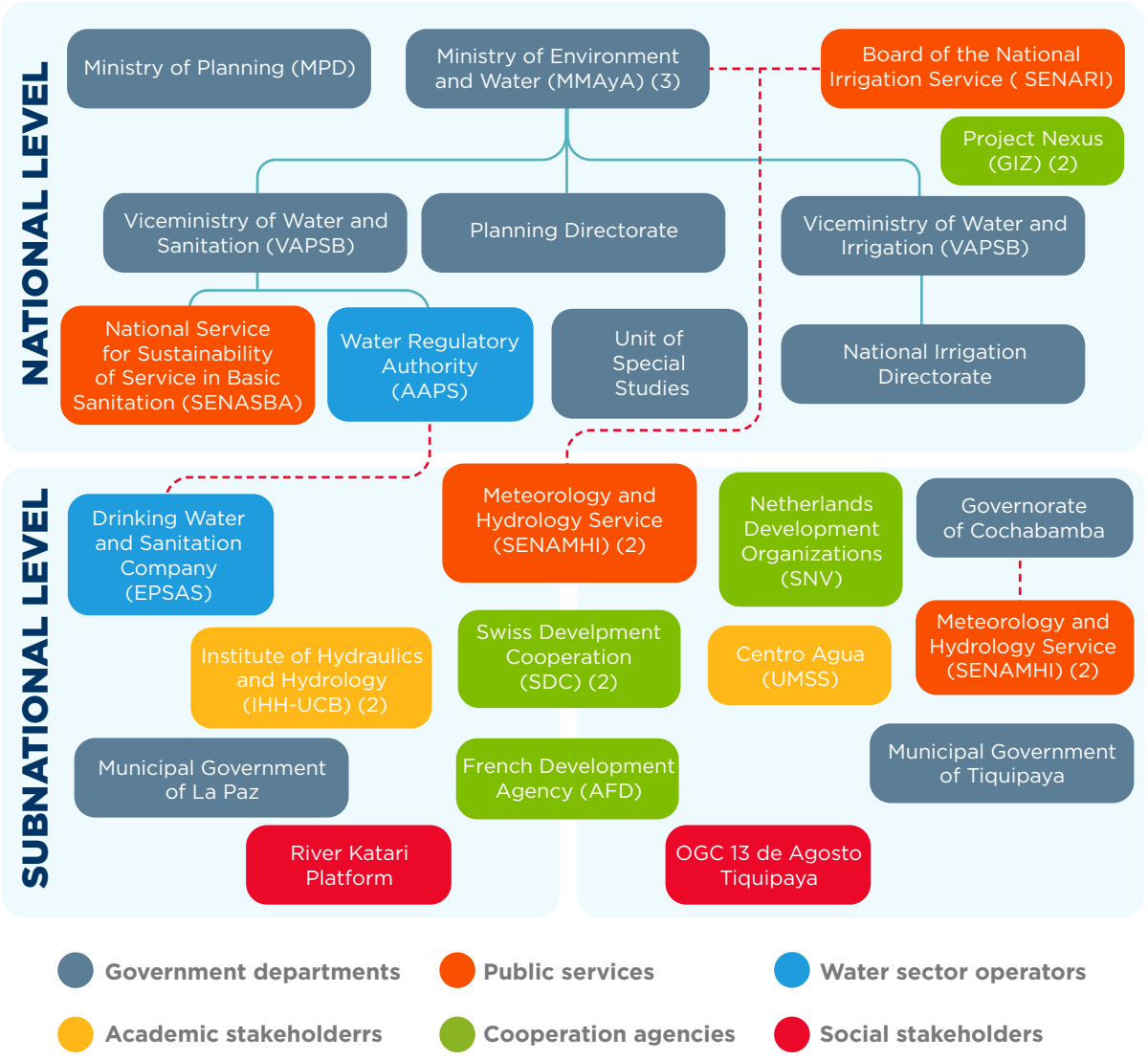
We acknowledge that the interests of the local community are under-represented among the interviewed stakeholders, as it was outside the scope of this study to directly engage with the most vulnerable populations. However, cooperation agencies and non-governmental organizations were engaged in the study and could reflect on their experiences working at the ground level on issues of adaptation in the water sector. Furthermore, representatives from the key water-use sectors, such as mining, hydropower, and other industries, were not engaged in the study. While it would have been desirable to include such perspectives, it is considered extremely unlikely that these sectors would have been willing to participate in interviews.

We used a semi-structured interview technique built around a series of questions relating to the different indicators of adaptive capacity (Table 2 and Annex 2). The questionnaire was intended to guide interviews and ensure that information relating to all core determinants and indicators of adaptive capacity were captured. The original questionnaire developed by Hill (2013) focused primarily on the lessons and experiences relating to water supply during drought events. For Bolivia, in many instances the questions were modified to better capture adaptation experiences during recent high (flood) and low (drought) water extremes. Questions were also added to better align with the revised indicators. For example, questions addressing regulatory responsibilities and clear division of these responsibilities were added. We recognize the challenge in designing a single questionnaire that remains relevant across the range of stakeholders engaged in this study, from social groups to operators, planners, and high ranked government officials. Hence, the broad questions provide a general structure and some tailoring of the questions by the interviewer is inevitable. Most importantly, the interviewer refrained from inserting their views to maintain a neutral and objective basis for the assessment.

The responses from the interviews provide qualitative data on experiences with planning and preparation for floods and droughts, and other adaptation actions before, during, and after these events. Interviews on average lasted about one hour. All interviews were recorded and transcribed. Importantly, data from the interviews was treated confidentially, meaning, within the results, no individuals or institutions are directly associated with their responses. This is important to ensure trust and a spirit of openness in the interviews.

Following a round of review and feedback with the Inter-American Development Bank, the questionnaire (Annex 2) was translated into Spanish for use in the field. In total, the structured questionnaire comprised 32 questions (compared to 26 used by Hill, 2013).

Figure 6. Subset of the broader stakeholder mapping exercise from which interviewees were selected, showing the key institutions at national and subnational levels and their linkages. One person from each institution was interviewed, unless indicated otherwise in parentheses.



Source: Authors' elaboration.

8. Analytical Approach

The transcribed interview data were analyzed to identify relationships between input conditions (governance determinants and indicators) and output conditions (types and scale of adaptation), looking for evidence of how governance systems are or could enable adaptive capacity to be built and what difficulties or challenges are evident. To help the analytical process, computer software for qualitative data analyses was used to organize, group, and categorize (code) the segments of text transcribed from the interviews. The main analytical steps can be summarized as follows:

1. Characterize existing adaptive mechanisms in the water sector by the governance level (national, subnational, or local) on which they are used.

2. Identify bridges and barriers to mobilizing adaptive capacity in each case area and with regards to governance determinants across different levels of governance.

3. Categorize the inputs (governance indicators) and outputs (adaptation mechanisms: transformative, persistent, and passive) according to fulfillment of the assessment criteria.

4. Evaluate how the PPCR design features can be modified or improved to address these challenges and facilitate transformative processes in Bolivia based on the gaps and challenges in the current adaptation building processes identified above.

The process of coding (or categorizing) the information contained in the interview transcripts under Step 3 was undertaken by two researchers in parallel, ensuring subjectivity was minimized. Several waves of coding were undertaken, first assigning all transcribed interview segments to one or more indicators and then, within those segments, extracting all case evidence relating to each of the assessment criteria (Table 2). Case evidence consistently pointing to positive fulfillment of the assessment criterion was considered to be indicative of *transformative* processes. Conversely, no evidence that the criteria were being fulfilled and/or evidence of negative fulfillment was considered to be indicative of *passive* processes. Finally, mixed evidence (e.g., because different stakeholders presented contrasting experiences or because the criterion was only partially fulfilled) was considered to be indicative of *persistent* processes. In other words, some adjustments could be evident in response to climate change but fall short of what would be considered transformation. In all cases, the final categorization presented in Section 11 (*Persistent, Passive, and Transformative Responses*) is based primarily on the case evidence from the interviews, but also reflects broader understanding coming out of the stakeholder workshops and desk-based review. Furthermore, all primary analyses undertaken by the University of Geneva were reviewed by and discussed with an independent Bolivian consultant who has extensive local experience working on issues of water governance in the region.

Under Step 4, final recommendations from this study have been aligned to the Dimensions of Transformation and *Arenas of Intervention*, defined under the Transformational Change Learning Partnership. A CIF Arena of Intervention is an entry point to take action to alter the course of events and enable or catalyze transformational change. The arenas are Financing, Governance and Engagement, Institutions, Knowledge and Information, Markets, Natural Capital, Policies, Practices/Mindsets, and Technologies and Infrastructure (Annex 4). The four key *Dimensions for Transformation are relevance, depth, scale, and sustainability* of change (after World Bank, 2016).

PART C

Results and Recommendations

PART C: Results and Recommendations

In this part of the report we present the core findings extracted from an analyses of the field survey. Sections 9 through 11 sequentially follow the analytical steps that were undertaken in this study. Section 9 provides a comprehensive overview of key institutions, their governance mechanisms, and existing adaptation actions that are evident in the Bolivian water sector at the national, regional (basin), and local levels of governance. The intention here is to highlight that many institutions, programs, and projects are already operational and have been contributing to strengthening adaptive capacities in the Bolivian water sector over several years or decades.

To evaluate how these mechanisms have performed in the context of recent water crises, Section 10 dives deeper into the interview responses to explore what aspects of the existing governance system have impeded (barriers) or aided (bridges) adaptive responses and the building of adaptive capacity. This analysis begins to paint a picture of where the key challenges in the systems are and, equally, what elements are working well.

This emerging picture is then substantiated in Section 11, which reviews and summarizes all the case evidence from the interviews, in accordance with the indicators of adaptive capacity, to identify where the assessment criteria is (or is not) fulfilled. Results from Section 11 identify where more transformative, persistent, or passive actions are evident, helping to elucidate potential Arenas of Intervention that could strengthen transformative actions.

Finally, in Section 12, the lessons and results from Sections 9 through 11 are integrated to establish core gaps in the process of building adaptive capacity in the Bolivian water sector, with recommendations given as to how the design of the PPCR could be tailored to address these gaps and, in particular, support the journey toward transformation.

9. Adaptive Mechanisms across Governance Levels

Bolivia started mainstreaming climate change adaptation into planning instruments in 2011, with strong support from the PPCR. However, broader climate change concerns in the water sector were evidenced over the previous two decades, most notably with research and monitoring studies on the glaciers. The adaptation project on the Impact of the Accelerated Retreat of Glaciers in the Tropical Andes was the first attempt to link ongoing climate change research with policy measures and concrete adaptation in the water provision system of La Paz.

The main sector policy, the National Watershed Plan, includes a chapter on climate change and disaster risk reduction and has provided the orientation from which to use PPCR resources to better integrate climate change adaptation and disaster risk reduction within different planning instruments:

- The guidelines to prepare watershed master plans point out the need to base the analysis on a robust set of climate data and scenarios. With the support of the PPCR, 3 out of 14 watershed master plans will be prepared based on those guidelines. Based on these experiences and the acquired lessons, guidelines will be adjusted to serve the other 11 watershed master plans, covering almost half of the Bolivian territory.

- The guidelines to prepare irrigation projects include a set of recommendations to better integrate climate resilience considerations. This experience will serve to integrate climate resilience methods in the project guidelines of different sectors, including watershed management, irrigation, water, and sanitation.

In the past five years, the government of Bolivia has put additional emphasis on the role of information systems, monitoring, and early warning to enhance the capacities of the water sector to respond to drought events. Further, it has involved key stakeholders, including water sector operators and the AAPS, the authority for water and sanitation. Within this context, we draw on information from the transcribed interview data and a review of key documentation to provide a tabulated summary of the adaptive mechanisms identified in the Bolivian water sector and relevant to the recent flood and drought events (Table 3). As per the assessment framework, adaptive mechanisms are defined as an institutional or governance response (e.g., a law, regulation, policy, or institutional action) undertaken at the national or subnational level that provides guidance or assistance in preparing for or responding to environmental stresses.

Table 3. Overview of key institutions, their governance mechanisms, and adaptation actions that are or have been active in the Bolivian water sector. The role of these institutions, mechanisms, and actions in the context of recent drought and flood events affecting La Paz/El Alto and the Rocha River is described where relevant (italics).

Institution/Governance Mechanism/Adaptation Action	Explanation and relevance in the context of flood and drought events
	National Governance
Coordination Mechanisms	
CONARADE (National Council for Risk Reduction and Response to Emergencies and/or Disasters)	This council (created under Law 2140) is activated in cases of emergency. It comprises the Ministry of Defense, Ministry of Finance, Ministry of the Presidency, Ministry of Development Planning, and Ministry of Government. CONARADE defines strategies, policies, and standards for disaster risk reduction.
Ministerial Water Cabinet	*Established during the 2016/17 drought crisis.* Comprises representatives of all the main ministries (Ministry of Economy, Ministry of Government, Ministry for Civil Defense, MMAyA, and others). Responsible for coordinating emergency and response actions at the national level.
Government Departments and their Core Programs	
Ministry of Development and Planning – Sectoral plans – Emergency plans	In 2016, coordinated with the MMAyA to develop the sectoral plan, which included components of climate change adaptation and risk prevention. *Worked with the MMAyA to develop an emergency plan during the 2016/17 drought crisis in La Paz/ El Alto and managed financial execution of the plan (e.g., dam construction).* Emergency plans have a maximum duration of one year and are multi-sectoral. The plans include budgets, identification and prioritization of projects, and schedules, among other elements. For example, credits to support small producers who lost their harvests due to floods or droughts and drilling of wells.

Ministry of Planning – Territorial Plans for Integral Development – INFO-SPIE	Law 777 of January 21, 2016, incorporates managing life systems and risk, as well as climate change, in the planning processes of all sectoral plans. When preparing Territorial Plans for Integral Development, it is mandatory that all territorial, municipal, and departmental plans include identification of ecosystems and environmental functions. This represents operationalization of Law 300 (*Framework Law of Mother Earth and Integral Development to Live Well*). INFO-SPIE, a multi-sectoral planning tool, enables users to identify where environmental functions are deteriorating for a given system and use this information in development planning. INFO-SPIE informs authorities where certain areas are vulnerable due to drought or flooding, providing a basis to prevent adverse impacts. Unfortunately, this tool is not systematically updated and maintained, and consequently is currently underutilized.
Ministry of Environment and Water (MMAyA) – Sectoral plans – Various projects and programs	The MMAyA is directly responsible for implementing water and environmental policies, programs, and projects related to risk prevention. The ministry has included climate change and disaster risk reduction considerations in different planning instruments as well as projects with a focus on adapting to climate change. Its 2016 sectoral plan includes components of climate change adaptation and risk prevention. Engineered defenses are being built on Rio Grande to protect crops.
Vice Ministry of Water Resources and Irrigation – National Watershed Plan – Support of the PPCR – Irrigation efficiency	The National Watershed Plan includes a chapter on climate change and risk reduction and guides the development of instruments for these purposes. A basket fund from international donors supports the implementation of this plan. Climate change and risk reduction are included with support of the PPCR at the level of three strategic watersheds (Mizque, Rocha, and Arque-Tapacarí). The vice ministry undertakes studies to build more resilient systems. For example, it has studied how to determine the degree of efficiency across irrigation systems and developed guidelines to mainstream climate change and risk reduction in irrigation projects.
Vice Ministry of Water and Sanitation – Water infrastructure – Engineering protection	Several projects that focus on activities before or during an extreme event. For example, in relation to droughts, drilling wells or improving small water sources in advance of the event. As a result of the 2016/17 drought, major investments have been made to improve drinking water infrastructure in major cities. In relation to floods, engineering protection is being built on Rio Grande to protect crops.
Special Studies Unit of the MMAyA – Analysis of water supply and demand – National Climate and Water Information System (SNICA)	Responsible for establishing and analyzing information about water availability in basins to support decision-making, planning, and conflict resolution. A water resource management model (developed under the PPCR) was used to generate scenarios of water supply/demand during the 2016/17 event in coordination with EPSAS (Public Social Enterprise for Water and Sanitation) and the SENAMHI. The SNICA is a collaboration of the SENAMHI and the Vice Ministry of Water Resources, within the framework of the PPCR. Planning is underway to establish the system, strengthening Bolivia's capacity to use hydrometeorological and climatic data. In response to the 2016/17 drought, the World Bank managed to redirect further funding to establish a drought component within the SNICA.

Public Services and Programs	
SENAMHI (National Meteorology and Hydrology Service)	The lead institution for collecting hydrometeorological data. The MMAyA is making considerable efforts to strengthen SENAMHI's technical capacities and its institutional linkages, with support from the World Bank. *The SEHAMHI provided several seasonal forecasts of the drought risk before and during the 2016/17 event.*
EMAGUA (Executing Entity for the Environment and Water)	Responsible for investments in the water sector. In this capacity, it executes the PPCR multipurpose project.
AAPS (Authority for the Control and Social Control of Drinking Water and Basic Sanitation)	The regulatory body that ensures continuous provision of drinking water services. It regulates 70 drinking water companies and reports to the MMAyA. *During the 2016/17 drought, the AAPS was asked to present contingency plans.*
SENASBA (National Service for the Sustainability of Services in Basic Sanitation)	Provides technical assistance and institutional development. For example, the Mi Agua program provided a component of community development and institutional strengthening for EPSAS.
More Investment for Water – My Water and My Irrigation Program (Más Inversión para Agua – Mi Agua and Mi Riego)	Financed by the Development Bank of Latin America, the program (Mi Agua I, Mi Agua II, and Mi Agua III) seeks to facilitate adequate and timely construction of minor works of water provision and irrigation systems to increase agricultural production and generate employment, and to strengthen the organizational and management capacity of users to operate and maintain irrigation systems.
Sowing Light and Harvesting Water Program	Under the MMAyA and the Ministry of Energy, this program facilitates access to safe water for human consumption and sanitation and access to alternative and renewable sources of energy to improve living conditions in rural communities that are dispersed and vulnerable to the effects of climate change. Contributes to the larger economic and social development plan.
Support Programs (International Cooperation)	
Nexus Project, undertaken with GIZ (a German development agency)	Development of sustainable, long-term multipurpose project plans (e.g., drinking water, hydropower, and irrigation) together with ENDE (the national electricity company) and in coordination with the Vice Ministry of Drinking Water and Basic Sanitation and the Ministry of Rural Development and Land.
Disaster Risk Reduction Program	One of eight programs of the Swiss Agency for Development and Cooperation in Bolivia. Launched in 2005, with its third phase covering 2010 to 2014. Responsible for supporting and strengthening local and political capacities to cope with disaster risk reduction and encouraging local communities and rural municipalities to be more resilient to climate change.
Integral Water Management Project	One of eight programs of the Swiss Agency for Development and Cooperation in Bolivia. Covers 40 municipalities in Cochabamba, La Paz, Oruro, Chuquisaca, Tarija, and Potosí. Works with the national, subnational, and local governments on issues related to water, watersheds, and climate change. At the national level, it is aligned with the National Watershed Plan of the MMAyA. At the subnational level, it interacts with the Autonomous Governorate of Cochabamba through the PPCR. At the local level, it strengthens watershed management organizations, municipal autonomous governments, associations, and public and private entities, promoting integral water management processes in micro-watersheds, including two micro-basins with mining activity.

Research Programs	
Adaptation to the Impact of Rapid Glacier Retreat in the Tropical Andes Project	Aims to implement pilot adaptation projects that can be replicated in other high Andean communities. In Bolivia, the project has promoted the creation of tools that involve deglaciation scenarios in order to provide decision-makers with factual information.
GRANDE project	International knowledge transfer, research, and capacity building project undertaken with Japanese Cooperation (2010–2015) that focused on glacial water resources. Provided technical training to, for example, technicians from EPSAS.
Universities, academic research, and knowledge generation	Various studies in collaboration with international partners to assess current and future impacts of climate change, including hydrological impacts. Studies are typically undertaken on the scale of basins.
Subnational and Local Governance	
Coordination Mechanisms, Platforms, and Agendas	
Structure to share information **and knowledge between various stakeholders and levels of government**	Alliances between municipal authorities and local producers and communities to promote competitiveness and manage natural resources. The purpose is to reduce conflict and build trust, allowing coordination and joint action to achieve objectives that none of the members could achieve on their own.
Inter-institutional Platform for the Katari Basin Master Plan	Aims to develop and execute plans, programs, and projects to effectively address the water and environmental problems of the Katari Basin and the Bolivian sector of Titicaca Lake by involving governmental and civil society institutions in coordination with the population. Coordinated according to four key areas of intervention: (i) water, sanitation, and solid waste; (ii) recovery and management of affected zones and life systems; (iii) management, environmental control, and biodiversity monitoring; (iv) productive development in balance with the environment.
Regulations for Operators	
Contingency plans prepared by EPSAS and approved by the AAPS	EPSAS is responsible for supplying drinking water and for the sanitary sewer network within eight municipalities and their metropolitan areas. As a rule, EPSAS is obliged to submit to the AAPS contingency plans that are based on information about water storage in the dams during the rainy season. *During the 2016/17 drought, contingency plans were developed and presented, but implementation was slow.*
Adaptation and Risk Reduction Mechanisms at the Basin or Household Level	
Constructing and enhancing dams and water storage	Prominent examples include the Hampaturi dam and the pumping system in the Pongo River basin (an emergency measure to bring water to the Milluni Dam). Three prominent dams on the Choqueyapu river are also in initial stages of development as part of a strategy for sustainable development and urban growth. The MMAyA undertakes risk analyses to determine how dams will operate under, for example, a 2° warmer climate.

Integrated Watershed Management	Includes consideration of actions to restore basins. Closely linked with irrigation projects, in that there can be no irrigation project without integrated watershed management.
Improving irrigation practices, under the Vice Ministry of Water Resources and Irrigation of the MMAyA	Programs aim to reduce the use of water while maintaining the same overall area under irrigation. For example, transitioning away from traditional irrigation practices to technology supported irrigation either by drip or sprinkler.
Flood protection works	For example, important works carried out on the Rio Grande at a cost of up to US$100 million (funded by the Development Bank of Latin America) to prevent floods and protect crops.
Household water rationing	During the 2016/17 drought, the Vice Ministry of Drinking Water made an effort to communicate the need for families to ration water.
Emergency provision of water (supported by the armed forces)	Drinking water transported to large emergency tanks in various neighborhoods in La Paz (6.5 million liters distributed each week) during the emergency period of the 2016/17 drought, and channels constructed to temporarily supply water to affected areas.

Source: Authors' elaboration.

10. Bridges and Barriers to Building Adaptive Capacity

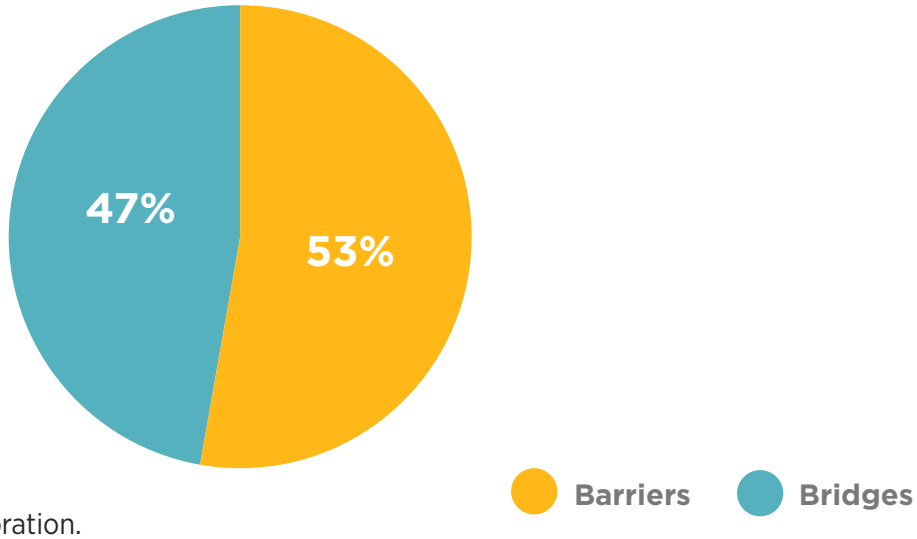
10.1. Overview of Assessment

In this section, we examine how existing governance regimes and their associated mechanisms have promoted (bridges) or inhibited (barriers) adaptive capacity in the water sector in the context of recent extreme events. The assessment serves as a broad indicator of the system's adaptive capacity. As such, maintaining or enhancing specific bridges, while reducing or eliminating barriers, could improve adaptive capacity and ultimately enable transformative change (Engle, 2012). In this way, bridges can be viewed as *opportunities*—favorable conditions that can be built on or enhanced to further strengthen adaptive capacities. Conversely, barriers can be viewed as *challenges*—weaknesses or gaps in the system that need to be addressed. We note that, in some studies, bridges and barriers are used interchangeably with indicators of adaptive capacity in that an indicator can be either positive or negative (Moser and Ekstrom, 2010). In the context of this study, we see identifying bridges and barriers as a logical first step in understanding the potential role of the PPCR in supporting adaptation in the Bolivian water sector, identifying how key processes relating to the determinants of Regime, Knowledge, and Networks currently facilitate or inhibit building adaptive capacity.

The 30 interviewed stakeholders had a wide-range of experiences to share in relation to recent drought and flood crises in the La Paz/El Alto and Rocha River watersheds, highlighting successes and positive outcomes and challenges that emerged before, during, and after these crises. Figure 7 shows that, across the 30 transcribed stakeholder interviews, the amount of text (responses) that addressed challenges (barriers) is only marginally more than the amount of text that discussed opportunities (bridges). This finding generally concurs with the feedback during the first stakeholder workshop, where participants spoke enthusiastically about what had been or was being achieved under various projects and programs in the water sector, while acknowledging important weaknesses in the system. This balance of responses is important, as

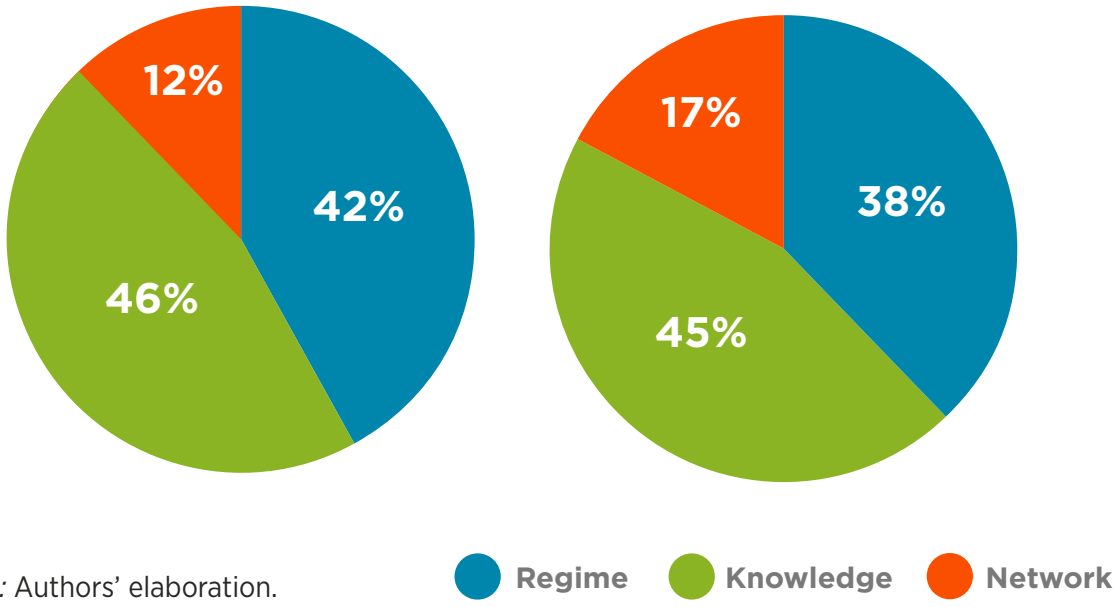
it provides a degree of confidence that the stakeholders who were interviewed were comfortable enough to reflect on both challenges and opportunities based on their experiences. In terms of the focus of the discussions, it is evident that, in relation to both bridges and barriers, aspects of knowledge were emphasized the most, followed by Regime, and to a much lesser extent, networks (Figure 8). To some extent, these results reflect the distribution of questions, which were not even across all determinants, with 40 percent of the questions focusing on knowledge. However, this focus is also consistent with the workshop discussions, which tended to focus most heavily on information and data inputs to adaptation decision-making and issues surrounding management, regulation, and legislation.

Figure 7. Summary of the coded interview segments (from 30 transcribed interviews), illustrating the proportion of responses that discussed barriers and bridges.



Source: Authors' elaboration.

Figure 8. Summary of the coded interview segments (from 30 transcribed interviews) addressing barriers (top) and bridges (bottom), categorized according to the three determinants of adaptive capacity.

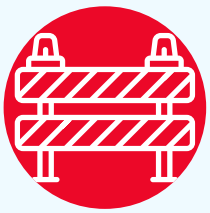


Source: Authors' elaboration.

Box 3. Brid ges and Barriers to Building Adaptive Capacity in the Bolivian Water Sector Overarching Themes

BRIDGES

- Improved awareness and priority setting around climate change issues
- Enhancements in meteorological and climate facilities
- Integration of climate change in planning efforts
- Progress in intersectoral planning
- Improved technical and institutional capacities
- Improved water saving efforts
- Greater participation of civil society



BARRIERS

- Constraints for capturing and assimilating lessons
- Technical capacities and staff limitations
- Weakness in meteorological and climate services
- Difficulties for long-term planning and climate change integration
- Limitations in intersectoral coordination
- Challenges in preparatory and contingency planning
- Lack of knowledge and information across broader segments of society
- Weaknesses in irrigation systems
- Difficulties for territorial planning

Table 4 provides a comprehensive overview of key bridges and barriers identified from interview transcripts, categorized according to the determinant of adaptive capacity to which they relate (Regime, Knowledge, or Networks) and the applicable governance scale (national, subnational, or local). The table is further grouped into general themes that emerged from the analyses of bridges and barriers (see Box 3). It should be noted that in some cases the bridges and barriers cut across different governance scales, such as when common issues are identified at multiple levels of government (state, department, and municipality). While the questioning and analyses focused primarily on experiences relating to the recent flood and drought events, some more general challenges and opportunities relating to adaptation to climate change in Bolivia were also raised.

Where possible, bridges have been aligned to closely related barriers to indicate where existing processes and adaptation mechanisms are or could contribute to addressing these challenges. This does not imply that the challenges are fully addressed, but rather provides some orientation for the recommendations that follow in Section 12, which aims to build on progress that is being made and fill major gaps. Such gaps become evident in Table 4a, where several barriers were not, based on the interviews, linked to any of corresponding bridges listed in Table 4b. These specific barriers include:

- High staff turnover and lack of institutional memory within key government offices.
- Deficiencies in long-term planning efforts and lack of integration of appropriate climate change scenarios into this planning.
- Lack of an intersectoral perspective within development planning.
- Lack of clarity around roles and responsibilities before and during extreme events.
- Lack of binding agreements and operational protocols for managing water crises.
- Insufficient coordination between levels of government.
- Lack of monitoring of changes in water usage and demand, including how demand might change in the future.
- Difficulties in encouraging or enforcing resettlement from at-risk areas.

Further synthesis of bridges and barriers in relation to the key determinants of adaptive capacity is provided below.

Table 4. Analyses of key barriers (a) and bridges (b) to building adaptive capacity in the Bolivian water sector, categorized according to the determinant of adaptive capacity (Regime, Knowledge, and Networks) and the applicable governance scale (national: Nat., regional: Reg, or local: Loc.).

(a) Major Barriers to Building Adaptive Capacity

	Determinant	Scale	Bridges*
Constraints to Capturing and Assimilating Lessons			
Potential for learning from past disasters and experiences is not being maximized. Tendency to focus on responding to immediate problems. In the following year, when normal conditions return, time is not being taken to systematically reflect on lessons learned, implications for planning, and transferring learnings to other regions. This is linked to the issue of institutional memory. Similar events have occurred in the past (e.g., comparable flood event 50 years ago or drought in 2009) but have not been well studied.	Knowledge	All	2, 24, 38 39
Technical Capacities and Staff Limitations			
High turnover of technicians leading to a lack of continuity and institutional memory within key government institutions. This means resources go toward training technicians, but then they leave, so process starts over again.	Knowledge	Nat.	-
Technical capacities need strengthening at the municipal and department levels, which are lacking ability to respond to recent disasters. This includes capacities to interpret risk information and the large volume of hydrometeorological data that is available. When information is not well understood and it is shared, it can be the cause of political decisions rather than technical decisions.	Knowledge	Reg.	4, 21
Financial, human, and physical resources have not been sufficient to respond to previous disasters, and major asymmetry in resource availability is seen between large and smaller cities. During the flooding in Tiquipaya, machinery was mobilized from different municipalities and from the government, but it was not enough. Support was only for a short time, and renting of machinery incurred significant costs to the municipality, leading to economic deficits.	Regime	Reg.	15, 16
Weakness in Meteorological and Climate Services			
National hydrometeorological monitoring service remains a weakness. Politically, the strategic importance of this component has not been recognized. The monitoring network itself is not sufficient (in terms of intensity and distribution), and issues of training, operation, and maintenance are not well addressed (long-term sustainability). There has been a lack of clarity as to how to structure the national information system for climate and water. Untimely or unreliable information causes sectors to move away from centralized information management to establish their own monitoring, and this data is not publicly available and does not feed into the SENAMHI network.	Knowledge	Nat.	5, 6, 8, 11, 12, 14

	Determinant	Scale	Bridges*
There is no national climate service that integrates information from various monitoring programs and warning systems to make this information available for decision-makers and other public and private users. This lack of information was one of the Achilles heels for authorities at the departmental and municipal levels during the drought. Reliable platforms to communicate and provide warnings are lacking during emergency situations. At the community level, in some of the most vulnerable regions, there is no electricity or access to modern social media platforms that can be used to share such information.	Networks	Nat.	8
There is a lack of connection and coordination between the institutions that have the mandate to collect data and those responsible for transmitting that data to public and private users.	Knowledge Networks	Nat.	8
Failures to effectively transfer scientific knowledge (and uncertainties) from the scientific/academic community to the stakeholders and civil society. There is no interface with the universities, except for some specific investigations. There are issues of credibility, in that the work of a researcher is only considered credible when projections are seen to regularly come true. For example, when an alert is not fulfilled, this is seen to harm credibility.	Knowledge	Nat.	9, 10, 13
Difficulties for Long-Term Planning and Climate Change Integration			
There is still a lot to do in order to move toward medium- to longer-term strategic preventive management and lower risk levels supported by strong sources of information and knowledge. Focus is often on responding and recovering from disasters; however, if the threat is known, preparation and prevention is possible.	Regime	Nat. Reg.	15
Deficiencies in mid- to long-term planning. Governments do not want to focus on policies and programs beyond the five years of their term in office. For example, inter-institutional platforms need to last beyond the duration of a municipal government or minister. Regular changes at the level of authorities makes long-term programs difficult, with new actors arriving with new demands that delay progress.	Regime Knowledge	Nat.	-
Models of long-term climate trends and impacts are not feeding into planning and decision-making. For example, there is not adequate consideration of climate change scenarios, in terms of changes in frequency and magnitude of hydrological extremes, when designing and constructing dams and other engineering structures. Large volumes of data have been generated (e.g., studies by the University of Nebraska), but there are issues around accessibility and usability of this information.	Knowledge	Nat.	-
There are no multi-year dams built; all dams rely on annual rains and seasonal recharge. In micro-basins, the options are limited because small catchment areas provide a physical limitation that prevents more water from being captured and stored. However, for larger basins, the lack of multi-year dams has been linked to inadequate preparation and long-term planning for climate change.	Regime	Nat.	32
Available tools (e.g., INFO-SPIE) and data (e.g., water quality) that would enable better integration of information on vulnerability of social-ecological systems are not being used in water resource and development planning.	Knowledge	Nat.	8

	Determinant	Scale	Bridges*
Integrated basin planning (and management) is not incorporated into the national planning system. For example, the human dynamics, regional productive dynamics and tendencies, and people's expectations are not reflected in territorial planning. The concept of life systems (soil, plants, water) is not connected with state actions. At the municipal level, issues of pollution are not being taken into account in planning in Pucarani.	Regime	Nat. Reg.	44
Insufficient participation of the departmental governments in planning water resources. This is important because basins generally cover more than one municipality. Departmental governments require more information about the effects and impacts, meaning which regions and which sectors would potentially be affected by hydro extremes.	Regime knowledge	Reg.	5,6,7
Managing the metropolitan water supply system (La Paz/El Alto), which is operating with margins of safety that are too narrow. For example, the 12 percent deficit in rainfall in 2016 is already leading to drought problems.	Regime	Reg.	32
Limitations in Intersectoral Coordination			
An intersectoral perspective is lacking from the economic and social development plans. Each sector has its own objectives, but there are no overarching development objectives. For example, ENDE (the national electricity company) aims for 4000 MW of exports by 2025 and irrigation authorities aim for 1 million hectares of irrigation, but what this means for sustainable development, food sovereignty, or improved quality of life is not formulated.	Regime	Nat.	-
Some sectors do not want to participate in coordinated processes and actions. For example, ENDE is reluctant to cooperate; it has agreed to participate in committees but only under the condition that its projects are not touched. Linked to lack of a legal framework that obliges actors to participate and that sets priorities. For example, water needed for irrigation (Culpina, 2000 hectares) could be taken from a hydropower dam, but the cost to the hydropower plan would be significant, leading to questions about compensation for that loss.	Networks Regime	Nat.	26, 27
Interconnections between different institutions is lacking and is complicated because often these institutions have different political visions. This is not only within a sector, but also affects intersectoral planning. This situation can prevent the exchange of information and lead to delays in planning processes.	Networks	Nat.	26
The country does not have a legal framework to support prioritization of water distribution. This becomes particularly evident during extreme events, when contingency plans require flexibility in the governance system to allow water to be redistributed from one user or sector to another. The constitution establishes that human consumption is a priority, but there is no prioritization for all other sectors. Furthermore, there are no specific protocols for sensitive users such as hospitals.	Regime	Nat.	17, 27

	Determinant	Scale	Bridges*
Challenges in Preparatory and Contingency Planning			
Lack of monitoring and enforcement by authorities to ensure contingency plans established by the water companies are being followed. Ministries have a management role and watch over the sector, but if information is concealed by the water companies, the authorities are limited in what actions they can take. From April to November 2016, the steps established in EPSAS' contingency plan that had been presented to the AAPS were not followed, such that water levels continued to drop and reached a crisis situation.	Regime	Nat. Reg.	35
Within reports, information and knowledge are not optimized for the needs of decision-makers across different sectors. For example, contingency plans are lengthy documents (100 pages or more), meaning ministers are not able to easily access the relevant information.	Knowledge	Nat.	8
Information bottlenecks and delays occurred in transferring information between EPSAS and the AAPS, and to the head of the MMAyA. EPSAS does not communicate directly with the ministry, but through the AAPS as an intermediate regulatory authority. There were suggestions that EPSAS was concealing information from the authorities. Also the Vice Ministry of Water and Sanitation did not receive information in a timely manner. When the recent crisis happened, the ministry learned practically at the same time as the community.	Knowledge Networks	Nat. Reg.	35
Coordination is insufficient at and between the levels of government (national, departmental, and municipal). Ministries often work directly with the municipalities, but watershed management requires all three levels of government. During the drought (La Paz 2016/17), there was conflict between the local and national governments.	Networks	All	-
There was a failure to foresee, take action, and issue warnings given that a deficit in the recharge of the reservoirs in March and April meant there was already a potentially complicated situation. The failure to foresee and act was linked to (i) inefficient monitoring of water reservoirs, as sectoral ministries need to both monitor the reservoirs and monitor projects/programs, and (ii) operational inefficiencies at EPSAS.	Regime	Nat.	11, 14, 35
There is a lack of clarity around who in the chain is ultimately responsible for decision-making and giving alerts before and during extreme events. Although the division of responsibilities is specified in the risk legislation, the committees that were created lacked legislative guidance and protocols on how to respond operationally. Response ended up being improvised reactively.	Regime	Nat.	-
There is a lack of binding agreements and operational protocols that consider scenarios of surplus water, normal conditions, and water scarcity. The MMAyA did not have a protocol to react to the water crisis that occurred in La Paz. This is linked to the need for more preparatory long-term planning, rather than responding with short-term, informal arrangements.	Regime	Nat.	-
Government decision-makers lack awareness of water issues and broader climate change issues. Opposition leaders who are not well aware of the issues tend to politicize them.	Knowledge	Nat.	1, 2, 9, 31

	Determinant	Scale	Bridges*
During the response to the drought, there was no consideration or prioritization given to environmental concerns. The priority has been to make water available and avoid water shortages irrespective of the environmental costs.	Regime	Nat.	-
Politicization of water companies, complex management structures, and serious levels of inefficiency was noted at EPSAS. This is seen as one of the factors leading to delays in the response to recent droughts. At EPSAS, decisional paralysis occurred as a result of inefficient management and inadequate understanding of roles.	Regime	Reg.	30
There were inadequate technical capacities and operational protocols at EPSAS, such that technicians did not know how to interpret information that was being provided to them, ultimately leading to slow response and recognition of the emerging drought conditions.	Knowledge	Reg.	4, 30, 36, 37
There is no clear division of responsibility for water supply and demand for various sectors. EPSAS acts in both roles. For example, it negotiates with communities to implement infrastructure, thereby also acting as a supply authority.	Regime	Reg.	-
Preparation, training, and planning process for extreme events is almost non-existent. For example, rationing water at the household level was noted as a rapid contingency response, rather than a well-planned process. Particularly in La Paz, stakeholders noted that the MMAyA did not have any planning or protocol for action in the face of the water crisis. In relation to the 2018 flooding (Tiquipaya), there was also a lack of contingency plans.	Regime	Reg.	-
Urban growth and expansion of population, including migration from rural to urban areas, are leading to rapid changes in water demand and consumption patterns and thus water stress. This becomes a barrier due to lack of open dialog and coordination between water companies and mayors' offices, and therefore, inadequate monitoring of changes in water demand. Projected scenarios are not considering changes in demand.	Knowledge Networks	Reg.	-
Lack of Knowledge and Information across Broader Segments of Society			
Environmental information and knowledge is not being shared with civil society groups (e.g., United Women's Organization in Defense of Water). Information goes directly to higher authorities but not to the local population. The example given relates to annual data on lake pollution and contamination levels. Addressing environmental issues requires a coordinated approach between civil society and municipal and departmental governments.	Networks	All	45, 46, 47
There is a crucial lack of laws and regulations relating to environmental issues affecting the large lakes. For example, pollution of a lake means that water cannot be used for drinking or sanitation, exacerbating problems during drought conditions.	Regime	Nat.	48, 49

	Determinant	Scale	Bridges*
At the community level, society is not aware of climate change and environmental issues, the causes, and possible responses. Lack of knowledge and guidance on how to take action against climate impacts is perceived to be leading to migration of young people out of rural areas. Lack of knowledge can also lead to misinformation and distrust among local actors.	Knowledge	Loc.	1,2, 38, 40, 43, 45, 46
In the past, the integration of ancestral knowledge has not been optimized to monitor and address water issues.	Knowledge	Loc.	10, 23
Weaknesses in Irrigation Systems			
Inefficient irrigation systems and low productivity. It is expensive to get information about irrigation systems — how many there are, how much water is collected, what area is irrigated, what is produced, how many families benefit, and other questions. Some areas move toward efficient sprinkle irrigation methods, but others still use inefficient old-fashioned methods.	Knowledge	Nat.	28
There is an imbalance between the allocation of financial resources given to roads and productive development projects (e.g., irrigation projects) compared to more technological development in the water sector. For example, technological development could lead to more efficient use of water or improved abilities to monitor and forecast hydrological extremes, thereby increasing adaptive capacities.	Regime	Nat.	15, 16
Difficulties for Territorial Planning			
There is mismanagement of river channels (torrents) at the municipal level, with reductions in stream-flows in the lower parts leading to a false sense of security and flooding in rainy season. Settlements and land degradation along flood plain areas. Regulations exist but have not been enforced.	Regime Knowledge	Nat.	44
Lack of regulation relating to well drilling, which is leading to overexploitation of the ground water.	Regime	Nat.	41
Difficulties in encouraging and enforcing permanent evacuation of communities from damaged or at-risk areas into safer locations, as people have strong cultural and social ties to their territories.	Regime	Loc.	-

(b) Major Bridges to Building Adaptive Capacity

		Determinant	Scale
	Improved Awareness and Priority Setting around Climate Change Issues		
1	There is a general perception of change in mindset at the state level after the crises, with the governance sphere now paying more attention to climate change issues and risks.	Regime	Nat.
2	Hydrological crises have alarmed and awakened the entire country about what can be done to improve water resource management. This is seen as an opportunity to improve the planning and management system and to implement integrated water resource management. Thus, water is starting to be considered not only as a resource but also as a common good.	Knowledge	Nat.
3	The memory of the recent disasters provides an ideal opportunity to move forward with emergency planning and preparation, as society is more sensitized to the needs and issues. Support and engagement of all stakeholders is easier to generate in the aftermath of a disaster, when awareness levels are highest. Stakeholders noted that in the immediate aftermath of the recent disasters, cooperation agencies, universities, and international experts showed significant openness and willingness to cooperate with the MMAyA on immediate response actions.	Network	Nat.
4	There are several examples of international technical cooperation regarding climate change and water management with support from agencies in Japan, France, Switzerland, Germany, and other countries. For example, agencies provided technical training and capacity building in ministries, water companies, and water authorities. However, stakeholders noted that the temporary nature of international cooperation and financing limits the long-term sustainability of such programs.	Knowledge	Nat.
	Enhancements in Meteorological and Climate Facilities		
5	The SENAMHI installed new facilities to provide hydrometeorological information in real time. For example, some reservoirs are now being monitored in coordination with EPSAS in order to provide specific forecasts and to foresee or prevent any future emergency. The SENAMHI implemented local observation of hydrometeorological changes using local observers.	Knowledge	Nat.
6	The SENAMHI implemented drought monitoring and a drought plan by using statistical tools that will allow for better hydrometeorological predictions (e.g., use of the Standardized Precipitation Index (SPI)).	Knowledge	Nat.
7	Decision-makers, risk management units, governorates, and municipalities are periodically informed of all the hydrometeorological events through the SENAMHI website. Within the SENAMHI website, the most visited page is the forecast, which means that civil society has greater confidence in this meteorological service.	Knowledge	Nat.
8	Components of climate and water monitoring are to be structured and developed through the SNICA. A water balance platform is foreseen as a component of the SNICA, bringing together different institutions and academics, and establishing an institutional context of users of climate and water information. This is considered a positive step in the direction of centralized management of water information, where information is shared and processed in a way that it can best be used by the different sectors.	Network	Nat.

		Determinant	Scale
9	Engagement of the state with local universities is increasing, recognizing that adaptation actions must be based on robust science. One of the MMAyA's first actions after the drought event was to engage scientists from several local universities to help with adaptation strategies and operational projects. There are significant capacities within the local universities, and engaging with the local scientists brings an element of quality control since universities disseminate and share information within the academic community.	Knowledge	Nat.
10	Universities have closely engaged with local authorities and communities, recognizing the benefit of combining ancestral knowledge (e.g., ways of predicting droughts) with modern science. There are examples of joint-knowledge production, where scientists engage with the local communities to first educate them about the issues and then jointly frame the design of the project, such as an early warning system.	Knowledge	Loc.
11	The SENAMHI has been issuing warning alerts three days in advance to allow authorities to manage the potential emergencies. Moreover, it is contributing to enhancing early warning systems (e.g., creating a scale of green, yellow, orange, and red alerts).	Regime	Nat.
12	The SENAMHI has shared its methodologies through the regional climate centers in South America. For example, it has greater involvement in the Regional Climate Center for the South of South America (CRC-SAS).	Network	Nat.
13	In terms of climate modeling, the PPCR has worked with international universities on climate scenarios to better understand trends and impacts.	Knowledge	Nat.
14	Permanent communication between the SENAMHI, EPSAS, and other institutions has been strengthened in order to monitor events in any of the reservoirs with the aim of disseminating information effectively through the media.	Network	Nat.
	Integration of Climate Change in Planning Efforts		
15	The MMAyA recognizes that large financial investments are required to ensure systems against climate change are robust in the long term. Previous focus has been on responding to each event and avoiding large investments. Now there is recognition that rainfall deficits may become more severe, causing multi-annual problems, and this requires large financial investments in alternative water sources. Investments in preventive action will prove more economic in the long run than the costs associated with responding to disasters repeatedly.	Regime	Nat.
16	Climatic impacts have led to leverage and better allocation of resources. Also, this issue is now taken into account in the national and subnational management plans.	Regime	Nat.
17	The Framework Law of Mother Earth and Integral Development to Live Well (Law 300) is a candidate for the 10 most important global policies in the world (according to the FAO) and includes guidance on governing, managing, and using water. Guidance for preparing Territorial Integral Development Plans requires identification of ecosystems and environmental functions in all territorial, municipal, and departmental plans. This represents operationalization of Law 300.	Regime	Nat.
18	The Plurinational Authority of Mother Earth (created under Law 300) is considered to have great potential as a strategic entity that can channel resources, and it has the necessary legal framework and legal power to implement climate change adaptation mechanisms.	Regime	Nat.
19	The SENASBA has introduced intended nationally determined contribution indicators within the sector plan. Nonetheless, these indicators need to be reviewed and some are considered too ambitious.	Regime	Nat.

		Determinant	Scale
20	The Mi Agua 4 project is considered pioneering with regards to integrating adaptation measures into development plans. Mi Agua 5 will go one step further to include implementing prioritized adaptation measures in identified vulnerable regions.	Knowledge	Nat.
21	Increasing use of department-level risk maps as well as environmental impact studies to manage flood events in the region has become evident in the municipality of Tiquipaya.	Knowledge	Reg.
22	Communities (e.g., Tiquipaya) have drawn up local management plans, taking into account risks and problems at the basin level. Such plans have then been translated into proposals and projects aimed at solving such risks and problems with the help of an inter-institutional platform.	Knowledge	Loc.
23	Making use of ancestral knowledge is evident in the irrigation sector and is a component of training programs undertaken by the MMAyA. This knowledge is considered important in project design so that projects are not only based on engineering and conventional knowledge.	Knowledge	Loc.
24	As a result of the recent water crises, the solutions applied to alleviate emergencies have been extrapolated to other places with similar situations in order to take preventive measures. For example, in Potosí and Santa Cruz, preventive actions have been taken based on the experiences of other regions.	Network	Reg.
25	The Water and Sanitation Cooperation Group aims to exchange information and update policies and financial plans.	Network	Nat.
	Progress in Intersectoral Planning		
26	Intersectoral planning is evidenced by the creation of the Production Under Irrigation platform by the Vice Ministry of Water Resources and Irrigation together with Ministry of Rural Development and Land and the Vice Ministry of Drinking Water and Basic Sanitation. The aim is to coordinate actions so that when, for example, an irrigation investment is made, it produces synergies with other sectors and has a positive impact on rural development. Social development and improved livelihoods generally correlate with enhance adaptive capacity.	Network	Nat.
27	Work is ongoing on the water law. There were 10 workshops in a 12-month period that resulted in a proposal led by the Vice Ministry of Water Resources and Irrigation. The aim is to have an agreement regarding the drinking water sector by the end of 2018 and then refocus on the energy, industrial, and mining sectors.	Regime	Nat.
28	The Vice Ministry of Water Resources and Irrigation is investing in research and development in the irrigation sector, particularly exploring issues of efficiency and productivity, and examining the impact of irrigation on local employment and livelihoods.	Regime	Nat.
	Improved Technical and Institutional Capacities		
29	The Bolivian State, beyond its political circumstances, has been able to highlight ministries specialized in specific issues, such as the Vice Ministry of Water Basins. This is considered as a step forward in the last decade, since, in the past, the Ministry of Environment focused on sustainable development but, within that, there was very little specialization.	Regime	Nat.
30	As a result of the recent disasters, institutional infrastructure has been improved, with better management and good technicians in key positions. For example, there have been improvements in management at EPSAS, and improved technical capacities in the water companies, water authorities, and the MMAyA.	Regime	Nat.

		Determinant	Scale
31	The government is more aware of the need to have additional technical staff in order to make advances with water issues.	Regime	Nat.
32	According to EPSAS, back in the 1960s, the reservoir factor was 0.6 (i.e., water was stored for 6 months). Nowadays, the factor is 0.8 and the goal is 1. This increase in reservoir factor represents improved preventive planning, with more water stored for drought conditions.	Regime	Reg.
33	The claims process at EPSAS has improved, meaning there is greater accountability in ensuring water infrastructure is well maintained. If a user claims to be affected by poor water infrastructure, EPSAS is required to carry out an inspection. Claims must be adequately addressed, as regulated by the AAPS. Well maintained water infrastructure can lead to improved water efficiency.	Regime	Reg.
34	During extreme events, at the national level, resources have been prioritized. For example, during an El Niño event, resources were assigned through a Supreme Decree.	Regime	Nat.
35	The AAPS is establishing a consultancy unit to rethink and analyze the regulation system, based on lessons from the recent drought crisis, where deficiencies in monitoring and enforcement were identified.	Regime	Nat.
36	The SENASBA is strengthening EPSAS by establishing a sustainability unit responsible for the technical and resilient management of water and sanitation. The unit's goal is to identify processes to manage and evaluate risks, assess vulnerabilities, and increase climate adaptation and resilience.	Regime	Reg.
37	The Knowledge and Innovation in Environment, Water, and Sanitation program of the Spanish Agency for International Development Cooperation has been working in a joint effort with the AAPS, the Vice Ministry of Drinking Water and Basic Sanitation, and the SENASBA to design a sustainability program for EPSAS. Such a program integrates technical management of water and sanitation; management of strategic and operational planning; contingency plans; and administrative, financial, and commercial management.	Regime	Reg.
	Improved Water Saving Efforts		
38	Hydrometeorological events have raised awareness about the importance of the effective use of water, both not wasting water and saving water, as well as to be prepared for such events.	Knowledge	Nat.
39	Ground-level adaptation responses were seen during the recent drought crisis, highlighting civil society's awareness and willingness to learn. Neighborhood councils provided a mechanism through which authorities could transfer knowledge about water care and management to civil society. Since the disaster, people in La Paz are more careful in how they use water, making better use of water and saving water where possible. One example is recycling shower and sink water for toilet use.	Knowledge	Loc.
40	The state government recognizes that providing more water is not a solution on its own, and that individuals and families must be engaged in effective water management, understanding the need to use less water and choosing to use water more efficiently.	Network	Loc.
41	In 2017, overexploitation of the ground water through well drilling led the Authority of Mother Earth to prohibit this activity unless it is done for social benefits, not for private individuals.	Regime	Nat.

		Determinant	Scale
	Greater Participation and Involvement of Civil Society		
42	During the crisis situation, civil society helped those affected by the disaster. For example, during the flood in Tiquipaya, the local population mobilized to assist those in need.	Knowledge	Loc.
43	Training processes have been carried out in local communities, leading to greater knowledge about the impacts of climate change. For example, some members of the Women's Organization in Defense of Water were able to access measurement equipment to measure the level of water in the lake.	Knowledge	Loc.
44	There have been positive experiences of community-led integrated watershed management plans being developed and implement in micro-basins, with effective platforms that bring all stakeholders together. In these micro-basins, communities have historically taken ownership of their environment and the water and have taken care of it. These experiences could be built on by the state and upscaled to larger, more complicated basins.	Regime Network	Reg.
45	Water summits have been held in order to raise awareness among civil society and to unify communities from the upper and lower parts of the basin. For example, this has been evident in Tiquipaya.	Network	Reg.
46	Workshops have been held in order to raise awareness of the importance of water at the local level, and such events have led to the consolidation of local associations and clean-up initiatives. For example, in the lake sector, the Women's Organization in Defense of Water was created in response to greater awareness regarding water after a workshop held by the Sustainable Water Center.	Network	Reg.
47	The Women's Organization in Defense of Water, a local association, participated in the social forum of the inter-institutional platform of the directory plan of the Katari basin.	Network	Reg.
48	In the lake sector, local communities have implemented cleaning activities through laws. For example, the "Desaguadero law, I want you clean" established that cleaning must be done twice a year. Moreover, local communities are willing to engage with media to push the Municipality of El Alto to take action and stop affecting other municipalities with waste from the city's sewers.	Regime Knowledge	Loc.
49	The Lake Titicaca program, which is under development, aims to address solid waste and wastewater treatment. It will also include a risk component.	Regime	Reg.

Source: Authors' elaboration) *Bridges that align closely with identified barriers are linked according to the numbering in Table 4b.

10.2. Bridges and Barriers Relating to Regime

Preparatory and Contingency Planning

A general consensus emerging from the field interviews and workshop discussions about the recent water crises was that, once the response was finally underway, the actions of authorities and civil society were quite satisfactory; however, there were delays in recognizing the crises and many people noted severe deficiencies in preparatory processes. In the case of the drought, well-documented issues with monitoring and enforcement of contingency plans were discussed, and the AAPS (the authority for water and sanitation) is reviewing the regulatory system. Another key issue is the lack of clear protocols that could provide operational guidance on how to respond, aiming to streamline the processes of decision-making, issuing alerts, and responding. Risk legislation sets out the division of responsibilities but, operationally, guidance is lacking. There is likely potential here to build on international cooperation efforts to learn from experiences and best practices in other countries.

A core challenge at the heart of water governance in Bolivia—that also impacts preparation for extreme events—is the lack of a legal framework to prioritize water allocation. Although the National Constitution (from 2009) recognizes water for drinking and sanitation as an essential human right and the highest priority, there is no regulatory guidance beyond this as to how water should be prioritized for other sectors and sensitive users such as hospitals. This becomes a critical constraint for contingency planning during times of low water levels, when legal guidance (but also flexibility) is needed to allow water to be redistributed from one user or sector to another. Efforts are underway to revise the water law from 1906, with a series of attempts led by the MMAyA. However, bringing all sectors to the table to reach agreements continues to be a challenge, particularly the energy, industry, and mining sectors, which are often reluctant to enter into negotiations (see also Section 10.4, *Bridges and Barriers Relating to Networks*).

Long-Term Planning in the Context of Climate Change

Taking a broader perspective, historically, integrated basin planning has not been widely evident in Bolivia, but it is a key instrument of the National Watershed Plan. Therefore, increased evidence of its applicability should be seen for major basins or national-level actions, also with support of the PPCR, considering upstream and downstream linkages, and how plants, soil, and water interact and are affected by climate change and other environmental stressors (particularly pollution of water systems). The *Framework Law of Mother Earth and Integral Development to Live Well* (Law 300) offers great potential as a legal framework to guide sustainable governance, management, and use of water, and to provide the basis for territorial planning in the context of the Integral State Planning System (SPIE). For example, Law 300 is operationalized in Territorial Plans for Integral Development, where it is mandatory to identify ecosystem and environmental functions, including climate change adaptation measures. Law 300 also provides for enhanced adaptation through institutional mechanisms led by the Plurinational Authority of Mother Earth. There may also be possibilities to learn from positive experiences at the micro-basin level, where community-led watershed management plans have been implemented, empowering local communities to take ownership of and care for their local environment. Local communities typically have the skills, experience, traditional knowledge, and networks required to undertake activities that increase resilience and reduce vulnerability to wide-ranging climate risks (Forsyth, 2013). Hence, such experiences from micro-basins in Bolivia could potentially be scaled up for larger basins.

Finally, on a fundamental level, stakeholders perceived an apparent culture of focusing efforts and resources on responding to and recovering from disasters, rather than investing in long-term strategies to reduce the risks of disasters in the first place. Financially, it is in the aftermath of a disaster that resources may be easiest to leverage, while securing national or international financing for preventive actions can be more challenging. In addition, stakeholders noted that government authorities tend to focus planning on shorter time horizons (aligned with their terms in office), rather than taking a longer-term view of preventive actions, the benefits of which may only be seen years later. However, interviewees suggested that ministries are now recognizing that large financial investments are required, particularly as climate change may cause multi-annual water shortages that would stress the system far beyond the experiences of 2016/17. Likewise, in the irrigation sector, there are investments in exploring issues of efficiency and productivity, and mechanisms to improve rural livelihoods. To take this further in a transformative approach, an intersectoral long-term perspective is required, such that investments across sectors are guided by overall common development objectives that consider watershed management, sustainable development, and food and water security within the context of a changing climate.

10.3. Bridges and Barriers Relating to Knowledge

Technical Capacities

While various short-comings in information and data inputs to the governance system have been noted, it is equally evident that many opportunities are being pursued, with a basket of programs and projects underway. The limitations in technical capacities across government ministries, the national hydrometeorological monitoring service, water companies, and water authorities that were deemed to have contributed to recent water crises are being addressed through various joint initiatives with international development agencies and under the leadership of the MMAyA. In fact, the need for improved technical capacities has been identified by the ministries themselves, with the number of technical staff increasing. However, a key challenge remains in ensuring that capacities are being strengthened evenly across levels of governance and geographically, meaning that experience and expertise are not only focused within the large or populated municipalities and departments. Another challenge lies in the sustainability of the knowledge and technical competences that are being generated, owing to high staff turnover and the fact that many capacity building programs funded by international cooperation are only short lived.

Knowledge and Awareness of Environmental Issues

While many interviewees talked about a lack of general awareness of climate change and environmental issues by government authorities, but also at the ground level, many respondents also highlighted positive advances since the recent water crises. At the national level, the crises alarmed and awakened the population about the importance of water management, thus providing an opportune time to move forward with innovative and potentially transformative planning while society is sensitized to the needs and issues. There are also many examples of awareness being raised at the local level, through workshops and clean-up activities in the lake sector, more efficient use of water at the household level in La Paz/El Alto, and community-led local management plans being developed in Tiquipaya. However, potential for learning from past disasters and experiences could be better maximized by taking the time to systematically reflect on lessons learned to inform future planning. Questions remain as to whether or not knowledge is penetrating communities and more isolated areas not affected by recent water

crises. In this regard, there is lots of potential to mainstream awareness of climate change and environmental issues into civil society, for example, through the education curriculum or through mass media (TV or radio). There is also potential to increase the use of traditional knowledge for environmental monitoring and adaptation planning. For example, scientists from the Higher University of San Andrés have been working closely with local communities in Apolobamba, focusing on joint-knowledge production processes around the impacts of drought on agriculture and irrigation. Ancestral knowledge is being integrated with training programs undertaken by the MMAyA.

From Knowledge to Decision-Making

In totality, the issues surrounding knowledge are not so much about the availability of data and information (which is improving all the time), but rather about ensuring that this knowledge is shared and tailored to the needs of the different sectors, decision-makers, and civil society. One example of adaptation planning is PPCR support in generating future climate scenarios, but there is little evidence that projected changes in rainfall and runoff are being considered in adaptation decisions. Likewise, data on changes in demographics and the implications for water demand is not being considered. Stakeholders recognized that universities have a major potential role in this process, with significant (and underutilized) scientific and technical expertise in hydrology, climate change adaptation, and disaster risk reduction sitting within the local academic institutions. Hence, clear guidance from the ministries is required, such that the research agendas of universities can be directly aligned with the needs of decision-makers. Universities have the advantage of being able to call on existing networks of international collaborators, which brings a high level of credibility to the knowledge inputs. In addition, universities can usually keep research agendas ongoing to feed into complex and dynamic decision-making processes.

10.4. Bridges and Barriers Relating to Networks

As stated at the outset, bridges and barriers specifically relating to networks were less frequently raised in the interviews and workshops, although there is close overlap between many issues of knowledge and the way in which knowledge is then shared and communicated (under the network indicator of knowledge partnerships).

Centralized Water and Climate Information System

One of the potential adaptation mechanisms emerging directly out of lessons from the recent water crises has been the planning of the SNICA. The lack of a national climate service that integrates information from the SENAMHI and other monitoring programs to make this information available to decision-makers and other stakeholders was identified as a key barrier to the response actions of authorities. The SNICA is intended to fill this void, providing a platform and institutional context where different users of climate and hydrological information can access a centralized information system. As a direct consequence of the 2016/17 crisis, further resources have been directed to the SNICA to establish a drought monitoring system.

Intersectoral Cooperation

The need for integrated basin management and intersectoral planning has been recognized (see also Section 10.2, *Bridges and Barriers Relating to Regime*), but there are challenges to achieving the required levels of cooperation between the different sectors and actors. At the administrative level, there are challenges in coordinating with the municipalities and departmental governments. Watershed management clearly requires engagement with the departmental

governments who are often better equipped, with longer-term budget and better technical resources, to support implementation of adaptation actions. Despite a strong mandate at the policy level and at the level of sector plans, intersectoral planning is hindered by the refusal of some sectors (specifically mining, energy, and industry) to participate in negotiations and discussions. In part this links back to the lack of a legal framework that would oblige all actors to participate in such processes, but also there is a lack of incentives for actors from these sectors to enter negotiations.

Stakeholder Engagement

Stakeholder participation and coordination is working on two different levels. First, at the level of strategic basins, in Cochabamba, the Rocha River platform[9] and the Departmental Water Agenda provide a scenario for long-term coordination among different actors. Second, in La Paz/El Alto, the Katari River platform and discussions about metropolizing EPSAS provide environments to enable stakeholder discussions and negotiations. Furthermore, within particular basins, and in the lake sector, there are several encouraging examples of community-driven platforms and other modes of organization leading to positive actions. One example is awareness-raising workshops that have led to the consolidation of local associations (e.g., United Women's Organization in Defense of Water) that now undertake regular legally prescribed clean-up initiatives along the shores of Lake Titicaca. Furthermore, the United Women's Organization participates in the inter-institutional platform of the directory plan of the Katari Basin. Another example is the differing voices of communities living up and down the valley in Tiquipaya that have been heard through a series of water summits to achieve local basin management plans. These examples are in line with acknowledging at the state level the need to strengthen linkages between the state and civil society in order to achieve effective water governance.

11. Persistent, Passive, and Transformative Responses

In this section, we look at the full range of evidence analyzed from the stakeholder interviews, workshops, and desk-based review to provide a systematic evaluation of case evidence according to the assessment framework. For the core determinants of adaptive capacity (Regime, Knowledge, and Networks), the evidence is reviewed in line with the set of indicators and their corresponding operationalized criteria (Table 5). Following the approach of Hill (2013), positive fulfillment of the criteria indicates more transformative outcomes (see Box 4), mixed fulfillment suggests more persistent outcomes, and negative fulfillment suggests passive outcomes.

Box 4. What Do Transformative Governance Mechanisms Look Like?

In recent years, there has been exponential growth in the number of academic reviews providing conceptual discussions on the theme of transformation and its association with adaptation to climate change (see Few, Morchain, Spear, et al., 2017, for a recent review). Beyond these academic discussions, concrete examples of transformation often focus on the end goal, such as a transformed river delta, and less so on the individual mechanisms that enable the journey toward transformation.

9 In this context, a "platform" is an institutional structure that supports a group of watershed stakeholders that executes Integrated Watershed Management Plans in different vulnerable watersheds country wide.

In the Summary for Policymakers, the IPCC (2014) describes transformative mechanisms as those that lead to climate resilient pathways for sustainable development, while at the same time helping to improve livelihoods, social and economic well-being, and responsible environmental management. In the CIF context, four dimensions of transformation have been defined according to an independent evaluation group of the World Bank (2016):

1. **Relevance:** Addressing a major constraint or problem of critical importance to development.
2. **Depth of change:** Causing or supporting fundamental change in a system, market, or behavior.
3. **Scale of change:** Approaches and innovations on a national or global level.
4. **Sustainability:** Financial, economic, and environmental sustainability of results after the engagement ends.

Importantly, transformation should be viewed in the context of a country's own visions and approaches to achieving sustainable development, and in accordance with its national circumstances and priorities. In other words, there is no single end goal for which all countries should be aiming, as each country's situation is different.

A detailed review and analyses of the case evidence is provided in Table 5. What follows is a short written and graphical synthesis of the case evidence that aims to elucidate where progress toward transformative change is evident and to establish key gaps and challenges in building adaptive capacity in the Bolivian water sector. This section provides the evidential basis for the policy recommendations that follow in Section 12.

What emerges from the systematic application of the assessment framework is that, across all determinants and indicators, the evidence is predominantly mixed, with identified weaknesses in the governance system being offset by encouraging examples where institutional changes, policies, projects, programs, and altered mindsets are leading to positive changes and building adaptive capacities. Given the mixed nature of this evidence, the current adaptation processes observed in Bolivia can be characterized primarily as examples of persistent change, representing adjustments largely in response to actual climate impacts affecting the water sector, including direct responses to the recent drought and flood crises. Examples of transformative processes are certainly evident for many indicators (green rows in Table 5) but, in our assessment, only lead to overall positive fulfillment of two indicators (see Perceptions in Table 5b and *Knowledge Partnerships* in Table 5c). It is also clear that for some indicators the case evidence suggests more passive processes, where adaptation and change is not being facilitated.

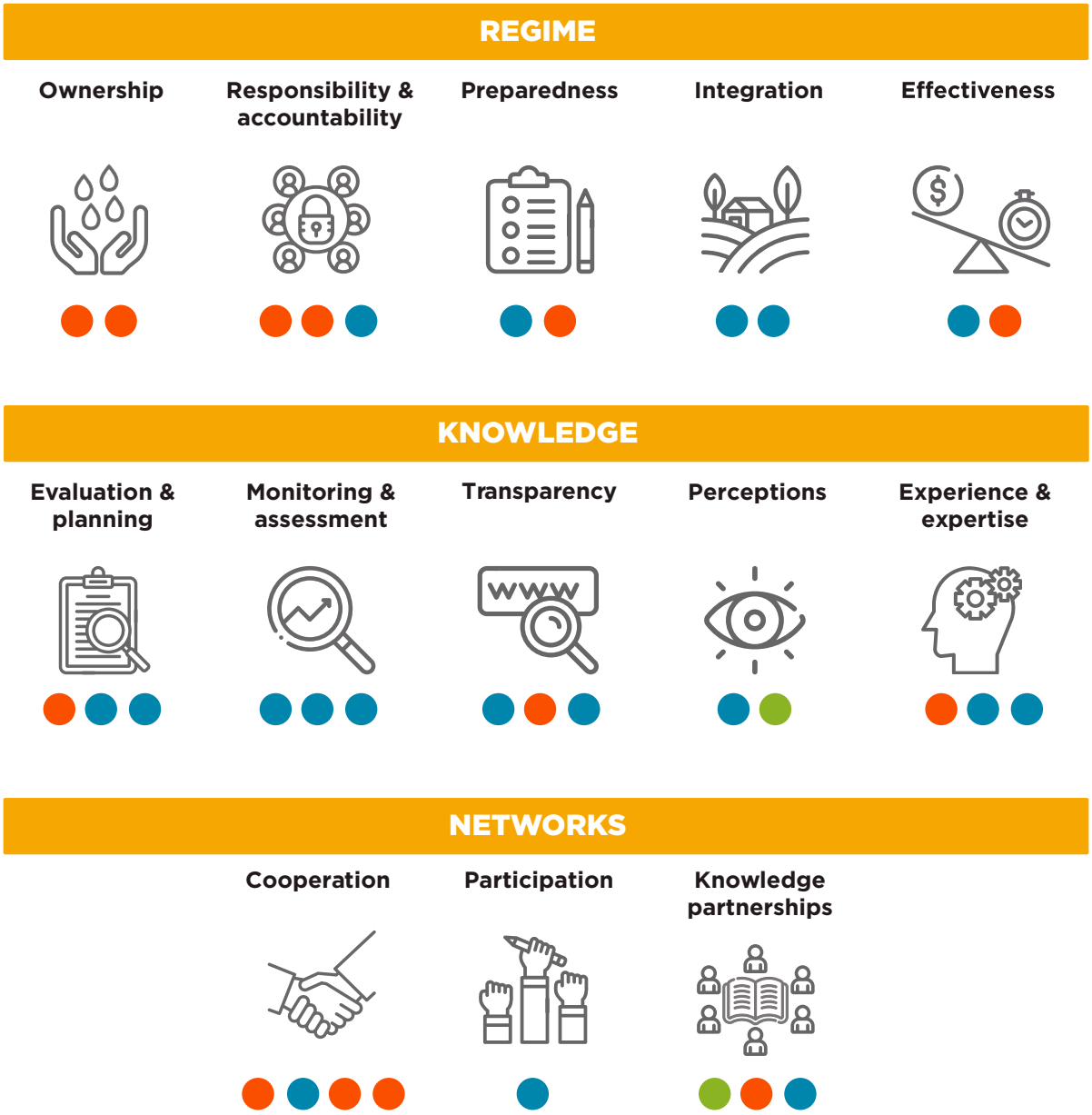
The lack of an updated water law is a fundamental challenge that arises for several indicators and that limits or prevents the building of adaptive capacities. Without a strong legal framework, operational protocols and decision-making tools for managing extreme events are considered to have reduced potential, as the necessary regulatory guidance is lacking for key issues like prioritizing water (see *Ownership, and Responsibility and Accountability* in Table 5a). The Vice Ministry of Water Resources and Irrigation has reported positive progress in its efforts

to consolidate a water framework that integrates different sectors. However, a major challenge lies ahead because it needs to engage the energy, mining, and industrial sectors in the drafting process. With some sectors refusing to engage in negotiations, a lack of incentives to encourage this engagement, and the potential for processes to become blocked, intersectoral cooperation at the state level is seen as a weakness of the governance system. The mixed or negative fulfillment of criteria relating to *Responsibility and Accountability* (Table 5a) and Cooperation (Table 5c) strongly reflect both the vertical stratification of the Bolivian governmental structure (from the state down to the municipal level) and the horizontal compartmentalization of water governance across different sectors. Both systems lack the flexibility and necessary high levels of collaboration needed to respond to extreme events and to implement truly intersectoral approaches to integrated basin planning.

One of the key thematic focus areas of adaptive responses initiated since the recent flood and drought crises has been strengthening technical and knowledge capacities, an area in which the PPCR has also been particularly active. The indicator Evaluation and Planning (Table 5b) shows that planning horizons remain relatively short and, despite the increasing availability of data on future climate scenarios and risk, forward-looking transformative adaptation planning is not yet widely evident. When flood walls and other defense structures are repaired after a disaster without considering how flood characteristics might change in the future and without establishing a secure budget or strategy for long-term maintenance, the system may eventually degrade, representing passive change. Therefore, significant potential exists to integrate hydrometeorological, climate, and risk information into decision-making, with an emphasis on long-term planning, strengthening bridges with academic institutions, and ensuring capacities to interpret information are built across all levels of governance. Improved partnerships between the state and academic institutions is one way to integrate and disseminate knowledge for decision-making, which will facilitate transformative change.

Also on the theme of knowledge and knowledge partnerships, **a positive outcome of the recent crises has been improved awareness of climate change and water issues among stakeholders, which has generated openness to learning and to altering behavior and thinking.** Such an environment enables development and implementation of transformative responses, provided the spirit of openness and the willingness to learn can be sustained over the longer term. Learning also needs to be better institutionalized through exchange and support mechanisms, such that experiences and best practices resulting from recent crises bring far-reaching and long-term benefits.

Figure 9. The types of adaptation processes currently active in the Bolivian water sectors, based on the classification of case evidence that has been reviewed according to the 13 indicators established under the assessment framework (based on detailed evidence presented in Table 5).



(Source: Authors' elaboration)

Table 5. Operationalized indicators of adaptive capacity, with case evidence synthesized from the interview transcripts. Green means positive fulfillment of the criteria (suggesting transformative processes); purple, mixed fulfillment (persistent processes); and red, negative fulfillment (passive processes).

(a) Regime Indicators

Indicator	Operationalized Criteria	Case Evidence
Ownership	**Consistency and Certainty** Legal certainty about ownership and user rights at multiple governance levels.	The 1906 water law is insufficient to address water rights and, to date, efforts to update this regulatory framework have not been successful. The definition of water rights is vague: "the water passing through the land belongs to the land owner as long as it does not affect others." A 1945 update to the law further specified that "no water right includes the right to deny access to water to downstream water users." Under the constitution (2009), access to water for drinking and sanitation is acknowledged as an essential human right, and the government of President Morales has expressed commitment to a rights-based governance framework. To date, the challenge for the governance system is to balance the distribution of water rights for different users, but, in case of extreme events, remain flexible enough to allow water to flow from one type of use to another under contingency plans.
	Coverage Coverage of all water rights and uses.	In the absence of a clear legal framework, different sectors are governed by separate laws, which creates severe challenges for mid-to long-term planning, and means there is no legal basis for prioritizing water use during extreme events. Efforts led by the Vice Ministry of Water Resources and Irrigation are ongoing to consolidate a legal framework (or some other type of regime that relies on jurisprudence and what works and what does not work in particular cases) that integrates across different sectors. In addition, the existing legal framework has no provision for groundwater rights and hence, extraction of ground water is unregulated. The water framework needs to coordinate all uses and integrate them into a national regulatory system, developing updated provisions for environmental concerns (e.g., regulating industrial water use). Currently, there are companies that use huge amounts of water and pay nothing.

Indicator	Operationalized Criteria	Case Evidence
Responsibility and Accountability	**Consistency and Certainty** Clear legal authority and regulations (embedded in law or policy) to enable decision-making to address water-related challenges.	The existing water law establishes the Bolivian government as the overall authority responsible for water management, currently led by the MMAyA and its vice ministries. Under the Administrative Decentralization Law, departmental governments are responsible for integrated basin management, while municipalities are responsible for local management (under the Municipalities Law). However, there is a lack of flexibility to deal with extreme events, where impacts may be at the municipal level but causes may be at the basin (departmental) level. At the operational level, during extreme events, committees and officials are assigned according to risk legislation (Law 602 and its regulation) and sector regulations (e.g., AAPS guidelines and instructions), but this legislation lacks clear operational guidance and protocols. Contingency plans established for the major cities affected by the 2016/17 drought did not include emergency mechanisms or operational protocols. The legal authority to force evacuation from flood prone areas is lacking, and the pressure, political influence, and lack of awareness of the communities prevents the implementation of buffer zones.
	Division of Responsibilities Clear division of tasks and responsibilities, against which stakeholders can be held accountable.	The division of responsibilities is clear from a regulatory point of view, but challenges arose during the 2016/17 drought when individuals failed to take action or did not know how to take action. Large crises involving major cities tend to escalate directly to the ministerial level, highlighted by an invisibility of mayors and departmental actors during the 2016/17 crisis. In this instance, the Ministerial Water Cabinet, consisting of representatives of all the main ministries, was responsible for coordinating generally recognized (even internationally) rapid and efficient emergency actions at the national level. In Tiquipaya, despite functional clarity in the division of responsibilities to address risk situations, within the department and municipal authorities, overlaps and gaps in planning and risk prevention regulation make it difficult to track responsibility and support accountability measures.
	Enforcement Clear responsibilities and capacities for monitoring and enforcement.	The AAPS adequately regulates mid- to large-scale water operators, but many of the small, local operators are not regulated. Water companies are required to submit contingency plans to the AAPS, but during the 2016/17 crisis there was a failure to activate early warnings and contingency plans. When data or information is not forthcoming from the operators, there is little that the AAPS can do to take action. However, learning is evident, with ongoing strengthening of management and technical capacities, guidelines for the presentation of contingency plans have been improved and the AAPS is establishing a consultancy unit to rethink the regulation system. In relation to flooding, there has been a failure to enforce regulations around land use, land degradation, and pollution in flood prone areas.

Indicator	Operationalized Criteria	Case Evidence
Preparedness	**Pre-emptive Planning** Emergency provisions and preparedness for hydrological extremes.	In general, the response of authorities and officials to the recent water crises has been considered reactive, rather than proactive. At the time of the 2016/17 drought, there were no national or basin-level drought management plans in place, including indicators and thresholds, or response actions for different drought stages. The contingency plans developed by the water operators lack emergency mechanisms or protocols. There has been learning and now processes are underway to develop such plans, including actions supported by international experts. For both high and low water extremes, traditionally the focus has been on responding to and recovering from disasters (and this has for the most part been reviewed favorably), but longer-term, future-oriented preparatory and preventive planning has not been so evident. However, the ministries are recognizing that a shift in focus is needed, requiring large financial investments in preventive actions to climate-proof the water sector.
	Prioritization Proportional reduction or prioritization of water rights and uses, and other resources (personal and financial) to deal with hydrological extremes.	While the constitution identifies water for drinking and sanitation as an essential human right and highest priority, beyond this there is no regulatory guidance as to how water should be prioritized for other sectors and sensitive users such as hospitals. Access to quality water services is low in poor and marginalized communities, potentially making them the most vulnerable during hydrological extremes.
Integration	**Risk Management** A cross-sectoral risk management perspective integrated with adaptation planning.	At the national level, the legislative framework for risk management exists (Law 602 and its regulation), including measures to prevent disasters and adapt to changing climate conditions. Further, the National Watershed Plan includes a chapter on climate change and risk reduction. However, operational progress to integrate risk management perspectives into adaptation planning has been slow. The master plan for River Rocha (a focus basin of the PPCR) is making rapid progress in reducing risks relating to flooding and landslides, as well as issues of water quality, but is seen as offering less potential for dealing with risks of water scarcity because there is no legal framework to enforce or motivate stakeholders to take the risk of drought into account.
	Systemic Integration Sustainability of social-ecological systems as a recognized goal.	Integrated basin planning is a key instrument of the National Watershed Plan, which emphasizes the importance of human development and environmental sustainability. Operationalization of the Framework Law of Mother Earth and Integral Development to Live Well (Law 300) requires identification of ecosystem and environmental functions in preparing Territorial Plans for Integral Development. However, what is missing in economic and social development planning is the intersectoral perspective guided by long-term development objectives. For example, there are goals relating to water use for each sector (e.g., electricity development, land under irrigation, and land productivity), but the need for integrated objectives is also recognized—food sovereignty, improved quality of life, and ultimately, sustainable development. Locally, integrated watershed management plans are being developed and implemented for micro-basins, building on the fact that communities have historically demonstrated ownership and increasing sensibility in caring for their environment and water.

Indicator	Operationalized Criteria	Case Evidence
Effectiveness	**Holistic** Incentives to use water efficiently and effectively across multiple uses (including conservation).	Currently there are no real opportunities to adjust or implement water-use tariffs if needed. Several water users identified the need to explore tariffs as a means of incentivizing more efficient use of water and to control the demand side, but they acknowledged this would be a sensitive political issue, especially regarding prices and regulation.
	Capacity Matching resources (financial, human, and technical) at the enforcement level.	There is uneven distribution of resources across levels of government, with national departments having access to more financial resources over a longer period of time than subnational governments. There are critical gaps in the human and financial resources needed to fulfill their principal mandate and functions at the departmental and municipal levels, as well as within national services (e.g., the SENAMHI). There is also a difference in resource availability between large urban and smaller rural municipalities. There has been significant strengthening of human capacities at the ministries, but there remains a lack of clarity about long-term sustainability of financial resources for the regulatory authorities and for related support and capacity building programs (e.g., the AAPS and activities undertaken by the SENASBA).

(b) Knowledge Indicators

Indicator	Operationalized Criteria	Case Evidence
Evaluation and Planning	**Reactivity and Longevity** Development of both short-term coping plans and longer-term adaptation plans.	Short-term coping plans are evident in the form of contingency and emergency plans. Seasonal El Niño and rainfall forecasts are considered in developing contingency plans, which are revised based on observed data from the monitoring network. The outlook for the Cochabamba Water Agenda goes to 2022, considering information on projected water supply and use. Longer-term science-based adaptation planning considering future changes in climate (and related uncertainties) is, however, not widely evident. The approach to planning is more reactive (including knowledge and lessons from recent events) than proactive in preparing for the more uncertain future. For example, basin-level risk maps are generated based on past events but do not consider how risks will change based on future climate scenarios. Flood defenses are being rebuilt without considering future changes in event magnitude. A noted exception is the irrigation sector, where studies have been undertaken to consider the longevity and viability of reservoirs based on a 2° warmer climate.
	Socio-environmental Integration Integration of climate, environmental, and societal impacts into planning process.	Under a bi-ministerial resolution between the Ministry of Development Planning and the MMAyA, information about climate change and related environmental issues needs to be considered for pre-investment in projects in the water and sanitation sector. Such information is being generated, including in partnership with local and international academic institutions, but it is not being optimized for the needs of decision-makers. For example, considerable efforts have gone into generating long-term climate projections (e.g., with Nebraska University), but this information is not feeding into adaptation planning. A fundamental knowledge gap on the water demand side is the lack of projections of future changes in water use. Instruments (e.g., INFO-SPIE) that could better integrate information about environmental degradation and the vulnerability of ecosystems have been underutilized. Information about water quality is given limited consideration in managing flood and drought events.
	Data and Analyses Appropriateness and application of the data and analytical contribution to the decision-making process.	A wealth of information is being generated, but the format and complexity is such that it is not always appropriate for the needs of decision-makers. For example, contingency plans prepared by the water companies are lengthy and authorities could easily overlook key information. Early warning systems should be based on simplified indicators with clear thresholds. The climate model outputs required for long-term planning are produced in a format that is not intuitive or easy to interpret. Hydrological modeling results are generally too coarse to inform flood risk planning at the micro-basin level. Partnerships between the state and academia would enable research activities and associated knowledge generation to be tailored to the needs of different sectors and of decision-makers. The PPCR has already identified challenges regarding analyzing and interpreting hydrometeorological data, and training is underway to improve capacities.

Indicator	Operationalized Criteria	Case Evidence
Monitoring and Assessment	**Consistency** Consistency across data sets and coordination in collation.	Strengthened capacities and engaging the SENAMHI in regional (e.g., Regional Center of the Climate of the South of South America) and global (World Meteorological Organization) programs is helping align monitoring and assessment methods with international best practices, and the planned SNICA will facilitate coordination in collation. However, in addition to monitoring by the SENAMHI, other actors are undertaking their own monitoring, such as the Water Supply and Regulation Service of the Piraí River at the departmental level, and hydropower companies with their private networks and databases. Unfortunately, this data is not coordinated with the activities of the SENAMHI and is not foreseen to feed into the SNICA.
	Diversity Diversity of inputs into the decision-making system.	On the water supply side, there is a lot of information available from various programs, many of which were initiated following the recent crises in partnership with local and international academic institutions. This diversity of inputs brings challenges, as there are noted discrepancies in the results from different programs and institutions, leading to issues of quality control and validation. Data inputs need to be reconciled with a series of key indicators that can serve as inputs to decision-making. On the demand side, gaps remain regarding the impacts of changing demographics, urban–rural migration, and consumption patterns. Monitoring and modeling future changes in ground water is lacking.
	Coverage Spatial and temporal extensiveness and accuracy of the monitoring network.	The density of the SENHAMI hydrometeorological network is being improved, but heterogeneity in distribution remains. Many stations are concentrated near populated areas, particularly around major urban centers, such as La Paz, Cochabamba, and Santa Cruz. Observations from higher elevations and glaciated catchments are relatively sparse, which is a limitation in forecasting both droughts and floods. The heavy rainfall that caused the flood in Tiquipaya fell in a poorly measured catchment area. Where stations are being installed under new projects, maintenance plans need to be established to ensure the stations remain operational long term, beyond the lifetime of the project. The longer the time series becomes, the more valuable it is for establishing climatic baselines and for calibrating models.
Transparency	**Availability** Availability, relevance of, and access to information on water resources.	Information collated by the SENHAMI is open (web-based), and the establishment of the SNICA will significantly improve access to weather, hydrological, and climate data for authorities, decision-makers, and water users across various sectors. The SNICA should include future climate scenarios, as this information is currently scattered across various projects and access is not clear. It will be important that the SNICA provides an entry point for all sectors and users, including civil society. For example, civil society groups claim that data on water quality (pollution and contamination) is not currently being shared with them. In Cochabamba, risk maps are available through the Departmental Watershed Service, but there is no provision to update these maps.
	Communication Communicating relevant information for extreme periods and capacity building.	Communication between the state and civil society has been criticized, particularly in the lead up to the 2016/17 drought. During the crisis and in the aftermath, the MMAyA engaged with the media and neighborhood councils to communicate information about the causes of water crises and actions to better manage water use. The Ministry of Education and the Ministry of Communication were directly involved in public education, and the military also contributed. These actions were reactive. What is lacking is a broader program of societal education on issues of climate change and water extremes, and the need for adaptation. Strong links between state and civil society are considered crucial to empower civil society to share responsibility in solving problems.
	Simplicity Non-technical language used when communicating with the general population.	Within the SENAHMI website, the weather forecast page is the most visited, showing that people trust and understand this information at least to some degree. Risk information is communicated to risk management units for further dissemination using the simple and internationally accepted color scheme—green, yellow, orange, and red levels of risk. What is challenging is how to communicate uncertainties in climate forecasts. The general population tends to lose trust in scientists and authorities when forecasts do not match reality. Further, some of the most vulnerable communities do not have access to visual media, so radio needs to be used more for education and emergency response.

Indicator	Operationalized Criteria	Case Evidence
Perceptions	**Awareness** Awareness of climate change impacts among stakeholders (including civil society).	There are mixed opinions among the stakeholders regarding awareness of climate change. Generally there has been greater awareness of water issues in Cochabamba than in La Paz/El Alto. However, awareness is currently very high as a result of the recent crises, from the state to the local level. In Tiquipaya, the recent flood raised awareness about the need for integrated basin management, but there are challenges regarding risk zoning and property rights. People see the flooding as an extreme one-time disaster and are not prepared to move. In relation to both droughts and floods, there is concern that after one or two years without a crisis people will return to how they behaved prior to the crises. The media does not help because the focus is current events, not potential future crises. In some cases information is distorted or misinformation is distributed and confusion ensues. Hence, there needs to be mechanisms to maintain awareness of and build knowledge for mid- to long-term problems related to climate change and required actions.
	Openness Openness to learning and willingness to adopt new solutions or paradigms.	The engagement of all levels of government, regulatory authorities, water companies, and other stakeholders in this study is testimony to their openness to learn and to improve existing systems. Based on lessons from recent disasters, there has been changes in management and significant strengthening of capacities within key institutions. Further, the AAPS is comprehensively reviewing the regulatory system. The large number of projects involving international cooperation (both on a political level and in the academic sector) highlights a willingness to learn from other countries and experiences. In the immediate aftermath of the drought, learning is also evident locally in La Paz, where households have been adopting practices to conserve water. The challenge now is to build on this spirit of openness that often exists in the immediate aftermath of a disaster, to ensure lessons are institutionalized, and to implement transformative actions for the long term.
Experience and Expertise	**Knowledge Distribution** Even distribution of knowledge across institutions and stakeholder groups.	Generally the level of knowledge and technical capacity declines from the national level down to the departmental and municipal levels and, at all levels, there is a problem of building institutional memory in the face of high staff turnover. Lack of knowledge on how to interpret climate and risk information and how to respond were identified as limiting factors for the municipality of Tiquipaya during the recent crisis. There is strong technical expertise being generated within universities, but linkages with the state need to be formalized to ensure this knowledge feeds into decision-making.
	Preparedness and Response Technical competence, range of expertise, and training needed to prepare and respond to hydrological extremes.	The process is very much ongoing, but technical capacities are being strengthened within the water companies, regulatory authorities, and ministries, addressing key weaknesses evident in the response to the recent water crises. Several respondents noted that, as a result of these strengthened capacities, the water sector is now in a position to effectively manage an event equivalent to the 2016/17 drought, but they recognized that a more extreme event would likely overwhelm the system and lead to another crisis. Hence, there is a need to consider not only past lessons, but also future climate scenarios and impacts. A further challenge is to ensure that capacities are built across all scales of governance (the focus so far is mostly at national level), and that systems are in place to ensure ongoing training and renewal of expertise (considering staff turnover can be high).
	Knowledge Social memory and traditional knowledge feeds into adaptation planning and environmental monitoring.	There are positive examples of traditional knowledge feeding into adaptation planning and environmental monitoring. Integrated basin planning takes into account traditional knowledge, uses, and customs. In the irrigation sector, ancestral knowledge is being integrated with training programs and project development undertaken by the MMAyA. Universities are engaging in joint-knowledge production with local communities, recognizing that traditional methods of, for example, forecasting drought conditions, can complement modern scientific approaches. There is potential to build on these positive experiences and mainstream traditional knowledge for hydrometeorological monitoring and forecasting, and to integrate traditional response strategies into adaptation planning.

(c) Networks Indicators

Indicator	Operationalized Criteria	Case Evidence
Cooperation (Collaboration)	**Negotiation** Ability to negotiate, resolve conflicts, and reach agreements on water distribution, security, and pollution.	The ability to reach agreement on water distribution is fundamentally limited by the lack of a legal framework. There is a problem of some sectors simply refusing to engage in negotiations or agreeing to do so only if favorable conditions are agreed to for their projects. The SENASBA is undertaking training with water companies in using tools for conflict resolution. At the micro-basin level in Tiquipaya, there are differing perspectives between communities living upstream and those living downstream, with each blaming the other. Water summits aim to unify these communities. Improvements in the claims process at EPSAS aim to reduce conflict between water users and the supply companies.
	Modes of Organization Institutional platforms for actors to collaborate and cooperate across different sectors, uses, and scales.	Lack of communication and coordination between levels of government, between water companies and the mayor's office, with water authorities, and with end users have been identified as factors contributing to the recent crises, but efforts are underway to improve collaboration. At the national level, the water information platform foreseen within the SNICA will provide an institutional context to bring together providers and users of climate and weather information. A cross-ministerial platform (under development in the context of Nexus) provides a mechanism for intersectoral planning. Basin management plans being proposed under the PPCR will have platforms on three levels: (i) an executive platform for authorities, departmental and municipal governments, and ministries; (ii) a social platform for users and economic actors; and (iii) a platform for consultants (e.g., non-governmental organizations and universities).
	Incentivization Mechanisms to incentivize cooperation among water stakeholders within a basin.	Incentives are lacking to encourage the critical energy, mining, and other industrial water sectors to join negotiations. Another example is people's refusal to leave high-risk communities, despite incentives. In response to the disaster in Tiquipaya, the government established a budget to relocate households out of high-risk areas and the municipality provided land in safe areas, yet people still would not move.
	Collaboration Trust, power balances, and the mixed nature of support structures.	There appears to be effective collaboration at the ministerial level between the irrigation, rural development, and water sectors, including progress on revising the water law. However, economically and politically powerful sectors such as mining can block progress. Interconnections between different institutions can be complicated by differing political visions, both within and across sectors. Trust in the academic sector is eroded when hydrometeorological forecasts do not match reality. The general population's lack of understanding of climate and environmental issues has led to distrust of authorities.
Participation	**Inclusiveness** Providing stakeholders a voice in decision-making, including civil society.	For large basins, decision-making is in the hands of municipal and state governments (departmental governments have a lesser role) in combination with the water authorities and supply companies. Mechanisms for civil society to directly participate in the decision-making processes appear limited in these areas. On the micro-basin level, however, the watershed management bodies provide a platform where anyone living in a basin can participate in decisions concerning conservation and water management, recognizing the value of integrating local knowledge into the decision-making process. Therefore, an opportunity exists to build on positive experiences at the micro-basin level and to upscale these lessons to larger basins.

Indicator	Operationalized Criteria	Case Evidence
Knowledge Partnerships	**Integration and Dissemination** Partnerships and clear processes to integrate scientific information into decision-making.	The SENHAMI operates with a central office and eight regional offices, which are then responsible for maintaining a connection with the different actors through the municipalities, departmental governments, and mayors. The SNICA will significantly improve the integration of data from the SENHAMI and other providers into decision-making. Previously, no formal interface existed between the state and academic institutions, except for on some local and specific investigations. The government is undertaking an analyses that will establish a call to the universities with two main objectives: (i) to respond to the priorities of the different sectors, and (ii) to develop a critical mass of scientific professionals, teachers, and graduate students that will establish careers linked to the water and sanitation sectors. The PPCR has focused on bridging the crucial gap between know-how and decision-making, ensuring that available knowledge feeds into management decisions. Decision-support systems for integrated basin planning developed in the Mizque pilot basin are currently being adopted in other basins and mainstreamed into the National Watershed Plan.
	Exchange and Support Informal or formal networks to share and exchange best practices, lessons learned, and technical solutions.	Any learning that has occurred has been ad hoc rather than through any established networks or platforms. For example, in Potosí and Santa Cruz, preventive actions have been implemented based on experiences in other regions. Broader, institutional learning has not occurred because such learning has not been systematized. A formalized space is missing where lessons can be assimilated and data on past disasters compiled and exchanged. International cooperation leads to technical solutions and best practices being transferred from other regions, but these projects are short lived and do not typically establish longer-term mechanisms of exchange and support.
	Societal Outreach Strong linkages between the state and civil society.	Several mechanisms for societal outreach exist, but evidence suggests that knowledge and awareness is not spreading to the general populace. Neighborhood councils provide a mechanism through which authorities can transfer knowledge about water care and management to local populations. Water summits and workshops have been held to raise awareness about the needs of integrated watershed management in Tiquipaya. In the area of Lake Titicaca, community workshops have focused on issues of pollution and water quality, and the participation of the United Women's Organization in Defense of Water in the inter-institutional platform of the directory plan for Katari basin has improved information flow with the state. What appears to be missing is a state-level, coordinated program that transfers simplified knowledge on climate change and water issues to the broader public through mass media, education in schools, and other mechanisms.

Source: Authors' elaboration.

12. Recommendations for Building Adaptive Capacity and Transformative Change

Building on the evidence and analyses presented in Sections 9, 10, and 11, we converge here on a listing of core challenges in the current process of building adaptive capacity in the Bolivian water sector, and we align these findings with the design elements of the PPCR in Bolivia. The first grouping of recommendations deals mostly with deeply rooted challenges related to Regime, before moving on to challenges in Knowledge and Networks. However, we recognize that many of the key challenges and associated recommendations are cross-cutting. For example, to address challenges in long-term planning, improvements in feeding information and data into planning is needed (Knowledge) together with improvements in providing financial and technical resources (Regime). The intention here is to clearly identify where the components of the PPCR are contributing, or could contribute, to building adaptive capacity and facilitating transformative change. It is important to note that we are not undertaking an assessment of the PPCR and its achievements in Bolivia. Rather, given the early stage of the program, we are focusing on the objectives and anticipated outcomes of the individual PPCR components, as contained in the publicly available project documents. Within the broader context of the CIF, we identify how the findings and recommendations align with the Dimensions for tTansformation and arenas for intervention as defined by this program.

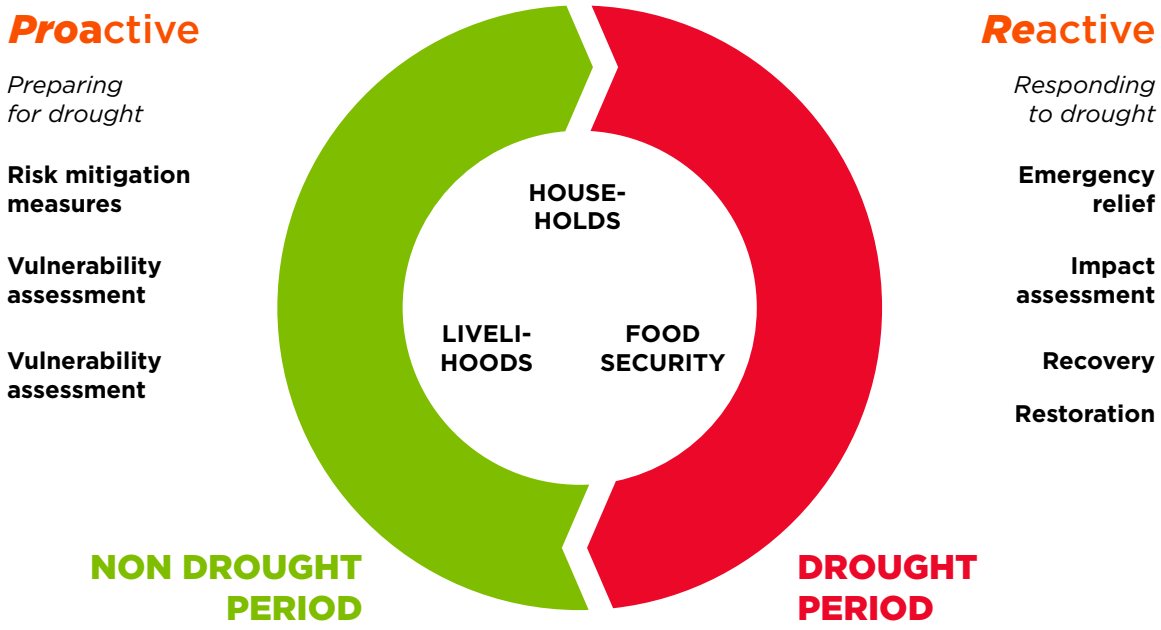
12.1. Challenges in Preparatory and Contingency Planning for Extreme Events

All three components of the PPCR[10] in Bolivia are potentially contributing to better preparation and contingency planning at national and subnational levels. Primarily, actions are expanding technical capacities within key institutions and improving the quality of and coordinated access to centralized hydrometeorological data for decision-making (e.g., the SNICA) and developing decision-support systems. Remaining gaps and possible contributions are outlined below.

Establishing operational protocols: The PPCR could contribute to the development of clear protocols that provide operational guidance to the water companies, authorities, and ministries on how to respond to and communicate with civil society under various scenarios of water stress. Such protocols should aim to streamline the process of decision-making, issuing of alerts, and other response actions. This will require working across levels of governance to ensure there is the required flexibility in the division of responsibilities, particularly between the municipalities (were impacts are often felt) and the department (where causes may originate at the basin level). PPCR Component 2 focuses on improving EPSAS management, which could be further supported by developing operational protocols. Lessons and adjustments are also likely to result from the review of the regulatory system that is being undertaken by the AAPS. Best practices and guidance from international experts could feed into the design of these protocols. For example, the Euro-Mediterranean Regional Programme for Local Water Management of the European Commission established comprehensive drought management guidelines that, although they are now more than 10 years old, provide highly relevant guidance for other regions as well (Iglesias, Cancelliere, Gabiña, et al., 2007). A key point to be emphasized is that such plans or protocols must be flexible and continually updated as new knowledge accumulates, technologies evolve, new programs are developed, and institutional responsibilities change. Efforts under the PPCR to establish operational protocols should also be well positioned within a broader risk management cycle (Figure 10), such that improvements in the reactive phase are equally supported by efforts in proactive, preparatory planning.

10 (1) Strengthening the national capacity to manage climate change. (2) Multipurpose drinking water and irrigation program for the Batallas, Pucarani, and El Alto municipalities. (3) Integrated Basin Management (Rio Grande).

Figure 10. Drought risk management cycle



Source: Brüntrup and Tsegai, 2017.

Strengthening the regulatory framework: The ongoing struggles to update the regulatory framework provided by the existing water law of 1906 leads to a crucial gap in the ability to prioritize water access during periods of water scarcity. In fact, some stakeholders that were interviewed identified the lack of a universal regulatory framework as a fundamental limiting factor for the potential implementation of mechanisms that are being developed under the PPCR. This leads to the question of how can the PPCR support or enhance the difficult and complex process of establishing a strong regulatory framework. Realistically the contribution of the PPCR may best focus on raising awareness at all levels to increase understanding of the importance of a universal regulatory framework that establishes clear user rights and how it can serve to facilitate adaptation planning. At the national level (Component 1), the PPCR could support the Vice Ministry of Water Resources and Irrigation in its ongoing effort to consolidate a regulatory framework that integrates different sectors by drawing on experiences from other countries and regions to provide technical input and support mechanisms in the drafting process. Emphasis should be given to establishing flexibility and a clear hierarchical prioritization in the distribution of water rights during emergency situations, enabling the governance system to better respond to climate change and related threats.

12.2. Challenges in Long-Term Planning and Integrating Climate Change

Transformative change requires thinking beyond short time horizons to establish adaptive responses that are robust against a range of possible future climate scenarios, institutionalized, and sustainable. Responses include basin management plans, infrastructure development, and disaster risk reduction strategies.

Integration of climate scenarios into planning: Component 1 of the PPCR aims to improve technical capacities to integrate climate resilience into planning, including institutional training in the use of high resolution climate scenarios to help in the decision-making process. In this training, it will be crucial to ensure improved understanding and interpretation of the range of values and associated uncertainties in climate scenarios, which for hydrological variables remain large, emphasizing decision-making in the face of uncertainties. While there is a tendency to produce more and more complex climate analyses, we recommend the PPCR focus on mainstreaming simple approaches that can support decision-making and adaptation planning (for an example see Box 5). Climate resilient planning means adequately accounting for the full range of future scenarios when designing physical response strategies (e.g., constructing multi-year reservoirs and expanding irrigation systems [Component 2] and flood protection systems [Component 3]). As a specific example, under Component 3 of the PPCR, in the Rio Grande basin, flood defense systems will be established or rehabilitated. A concern with rehabilitation is that the pre-existing design may be inadequate for the magnitude of events that could occur 30 or 50 years from now based on further climate change. Failure to adequately account for future climate scenarios in project design can, in the worst case, lead to maladaptation. Where uncertainties are high, opportunities for low-regret adaptation options can be explored (response strategies that bring immediate benefits to a community irrespective of how the climate may evolve). For example, creating green spaces in high-risk land areas is a common example of low-regret adaptation. Another is soft measures such as building community awareness and raising the response capacities of those living in high-risk areas.

Box 5. Climate Corridors for Adaptation Planning in Peru

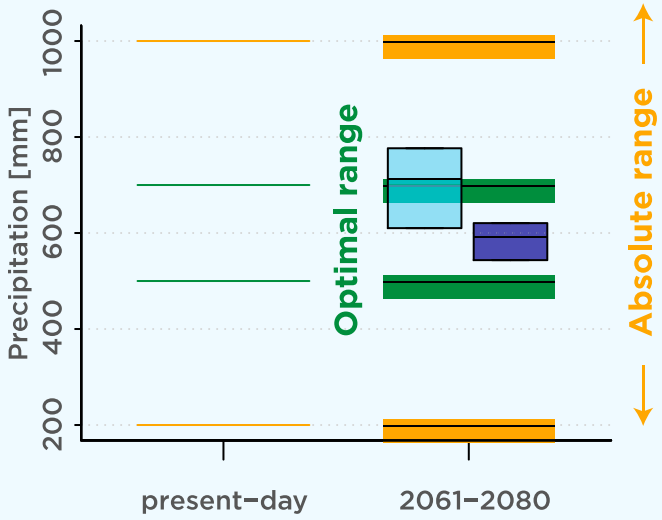
The concept of climate corridors has been introduced to improve how climate impacts are considered when planning development projects (Orlowsky, Calanca, Ali, et al., 2017). The concept recognizes that human activities, such as agricultural practices, hydropower generation, and basic sanitation requirements, are feasible only within a certain range of climatic conditions. Comparing such climate corridors with future projections provides an intuitive and easily communicated means with which to assess future adaptation needs. The climate corridors themselves—optimal and absolute ranges of temperature and precipitation for a given activity—are identified through a participatory bottom-up process in close engagement with local stakeholders and authorities.

Under a project focusing on water resources and food security in Peru, climate corridors were analyzed for typical crops in the region (e.g., maize), considering change in water demand (using a simple crop model) and change in water supply from precipitation. The analyses showed that, even when considering uncertainty in the crop's future water demand and variability in projected changes in precipitation (some models showing a decrease, some an increase), the ensemble of model results mostly remained within the optimal corridor for maize growing until the end of the 21st century.

Maize growing in Curahuasi, Peru

Future projections of precipitation from large-scale climate models (light blue box), and downscaled regional climate models (purple box) are compared with optimal and absolute ranges (corridors) for growing maize. These corridors in the future include uncertainty relating to water demand of the crop.

Figure mofified from Orlowsky et al. (2017).



Producing transparent results that are straightforward to interpret, climate corridor analysis provides an intuitive yet quantitative way of feeding climate change information into adaptation planning. Conceptually simple, climate corridor analysis specifically targets the cross-sectoral stakeholder dialog. A main advantage of the approach is that the integration of local information in a bottom-up approach, apart from increasing the accuracy of the analysis, additionally creates opportunities for local stakeholder involvement and capacity building. Hence, climate corridor analysis is seen as a tool that can improve mainstreaming of knowledge from climate science into strategic multi-sectoral adaptation planning and be a vehicle for knowledge transfer and ownership.

Risk mapping: Existing risk mapping (e.g., as created by the Departmental Watershed Service) is typically calibrated based on past extreme events and may not remain valid under future climate scenarios. It is therefore recommended that the PPCR work to ensure that future-oriented flood and drought risk mapping is available as a basis for integrated basin planning (Components 2 and 3). Future-oriented mapping should consider projected changes in climate and hydrology, ideally including scenarios of changes in demographics and water demand. Updated risk mapping should complement the early warning systems planned for the Rio Grande (Component 3) and needs to account for potential high magnitude, low probability events, and so-called climate surprises. Risk maps need to be dynamic, updated as new information on climate changes and societal vulnerabilities is generated. All information should be tailored to sectoral needs and supported with a strong campaign of awareness raising at the local level.

Sustainability of financial and technical resources: Long-term plans can only be realized if supported by the necessary technical and financial resources. Examples were raised in the case of Tiquipaya where flood protection systems deteriorated over time because resources were not in place to establish a long-term maintenance program. Similarly, there are examples from many countries where early warning systems have become defunct once external international support programs have ended. Also, knowledge platforms and other tools are often linked to finite project cycles and disappear once the operation phase is over. One issue is financial, but personnel is also a problem because high staff turnover means that the benefits of training and capacity building programs can be short lived. There is heavy emphasis on capacity building across the PPCR components, and we recommend that these activities become institutionalized

to the extent possible, such that training programs live on. The establishment of clear maintenance protocols will help in this regard. Furthermore, it can also be hugely beneficial to engage local community organizations in the long-term maintenance of monitoring, early warning, and defense structures, establishing a sense of ownership and partnership within the community. On the financial side, strong coordinated project proposals developed and submitted jointly by municipal and departmental governments are considered more likely to receive national funding. The PPCR could facilitate and support this process.

Table 6. Summary table with key examples of how the PPCR in Bolivia aims to contribute to transformative change in water governance (according to foreseen outcomes), and how design elements could be adjusted or added to strengthen its contribution. (Source: Authors' elaboration)

CIF Arena of Intervention	How the PPCR Aims to Contribute	What Adjustments Could Strengthen the Contribution of the PPCR in Bolivia	Dimensions for
Financing 	• Create a resettlement plan for flooded land, including payment and compensation mechanisms.	• Ensure that financial plans are in place to support long-term sustainability of adaptation responses established under the PPCR. • Arrange for ongoing maintenance and support programs for platforms, projects, risk reduction strategies (flood protection, early warning), and other infrastructure.	Relevance Sustainability
Governance and Engagement 	• Develop participatory communication campaigns about sustainable water management and health. • Start a productive initiatives program for women. • Train the drinking water and sanitation committee to operate and maintain the drinking water system.	• Integrate joint-knowledge production, where traditional knowledge feeds into adaptation planning, integrated basin management, and decision-making. • Build on experiences and upscale approaches that are working at the micro-basin level where high levels of engagement and ownership are evident.	Relevance Scale
Institutions 	• Strengthen institutional capacities to integrate climate resilience in public planning, management, and investment. • Train operator staff in resilient and sustainable water management. • Establish conflict handling and management program.	• Strengthen capacities for preparatory and contingency planning, through design of operational protocols. • Institutionalize capacity building programs being developed under the PPCR so that in-house staff training can be maintained over the long term. • Develop a tool or platform to support intersectoral planning, focusing on integrating non-climate data with the planning process (e.g., socioeconomic and ecosystems). • Formalize linkages between academia and the state by establishing a national research program.	Relevance Sustainability

Knowledge and Information 	• Strengthen the national climate information system, including a website to disseminate data and an increased monitoring network. • Strengthen flood and drought early warning systems. • Provide gender- and youth-focused water-use and health education in communities.	• Improve the integration of climate scenarios into planning, accounting for model uncertainties. • Update risk mapping based on climate scenarios. • Ensure data is tailored to the needs of different sectors, including civil society. • Mainstream climate change and environmental education through a coordinated national program, engaging schools and media. • Use local traditional knowledge for hydrometeorological monitoring and forecasting, and in adaptation planning.	Relevance Depth Scale Sustainability
Policies 	• Integrate climate resilience into planning. • Implement climate change-oriented integrated watershed management plans for select basins. • Create guidelines to integrate climate resilience with pre-investment studies in the irrigation sector.	• Support efforts to consolidate a regulatory framework that provides clarity on water rights and guidance for prioritization during times of water scarcity. • Work across ministries to establish a set of broad intersectoral development objectives that can guide strategic programs designed around these objectives.	Relevance Depth
Practices and Mindsets 	• Prepare community adaptation information sheets. • Have women participate in water-use and health education campaigns. • Establish family solar greenhouses.	• Set up education and awareness programs at the local level to focus on the value of water as a resource that is to be protected and cared for. • Educate to change perceptions about risk and to create understanding risk maps, providing a foundation for implementation of resettlement plans.	Relevance Depth Sustainability
Technologies and Infrastructure 	• Improve water-use efficiency using modern irrigation systems. • Build water treatment plant. • Construct dams.	• Complete research and development to better understand linkages between irrigation efficiency, productivity, and livelihoods, in order to optimize interventions in the irrigation sector.	Relevance Sustainability
Markets	Not evident	Not evident	
Natural Capital	Not evident	Not evident	

12.3. Challenges in Governance across Sectors

The governance of water in Bolivia, like in many other countries, is strongly compartmentalized across different ministries, with each sector having its own goals, objectives, and political agendas. Transformative change requires planning and investments that are guided by broader development goals that cut across the various sectors, supported by the necessary data and information.

Establishing intersectoral development objectives: The PPCR can play a role by designing strategic projects within selected pilot basins, where outcomes are targeted toward overall sustainable development objects. This would be ambitious, moving away from typical sector-specific objectives such as increasing area under irrigation or increasing households with access to drinking water and moving to a series of larger objectives focusing on improved livelihoods, ecosystem productivity, and health. The PPCR can lead the way, with projects that incentivize cross-ministerial engagement, encouraging a behavioral shift, and demonstrating in practice how investments can be framed in the context of sustainable development. A key difficulty, which may remain outside any influence of the PPCR, will be the ongoing reluctance of the mining, energy, and industry sectors to participate in intersectoral planning.

Tools for intersectoral planning: International projects active in the Bolivian water sector are generating various tools, some of which are contributing directly to intersectoral planning. For example, the German-funded Nexus program being led by the Ministry of Development Planning is heavily engaged in introducing cross-sector coordination mechanisms. The PPCR aims to contribute to improved intersectoral coordination primarily by establishing platforms to assist integrated basin planning and to ensure all sectors have access to hydrometeorological data through the planned centralized SNICA system. Nonetheless, there is a gap in the availability of tools or platforms that integrate information on socioeconomic dimensions, environmental degradation, and the vulnerability of ecosystems into the planning process. Existing tools, such as INFO-SPIE, could be updated, enhanced, and tailored to better support cross-sectoral development projects and objectives.

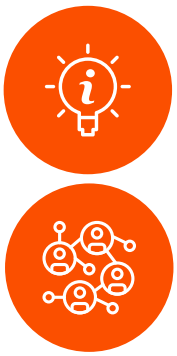
12.4. Challenges in Hydrometeorological and Climate Services

Hydrometeorological and climate services is a clear focus of the PPCR in Bolivia, with outcomes emphasizing strengthening the SNICA and improving the availability, adequacy, and accuracy of hydrometeorological data and forecasts. Hence, there has already been considerable progress (see Table 5b in Section 11) as a result of interventions that are establishing new monitoring stations and building technical capacities and with the design of a centralized exchange platform (the SNICA). Opportunities to increase the depth and scale of these interventions remain.

Tailoring data to sectoral needs: Increasing the volume and reliability of data is key, but it is equally important to ensure that the data is processed and shared in a way that best meets the needs of the various stakeholders, from decision-makers through to the general public. Particularly for model-based data, the diversity and complexity of results can lead to confusion. We therefore highly recommend that efforts to improve hydrometeorological and climate services include extensive and repeated stakeholder consultation to refine the expectations and requirements of those who will use the services. End users should be heavily consulted in designing the SNICA. Less can be more, and in the case of drought or flood early warning

systems, stakeholders have identified the need for a clear set of simple indicators that can be used as a basis for issuing alerts.

Establishing a national research agenda: There is a clear opportunity to strengthen and formalize linkages between the state and local universities and research institutions by establishing national research programs aligned with the needs of the water sector. This means viewing academia as key providers of hydrometeorological data and climate services, not only as users (e.g., Component 3). Universities have the technical and scientific expertise to address urgent sectoral priorities, bring a high degree of credibility through international networks and peer-review processes, and are responsible for developing the next wave of young professionals who will establish careers in water and related sectors. Hence, interventions that strengthen national research capacities can be seen as long-term, transformative investments. An example of an effective platform that facilitates dialog between the state and academia is seen with the ProClim Forum for Climate and Global Change, Switzerland (Box 6).



Integration of traditional knowledge: The process of joint-knowledge production has gained prominence in the context of climate change adaptation. In Bolivia, some university-led studies in the region of Apolobamba have closely engaged with local communities, recognizing the benefit of combining traditional knowledge (e.g., ways of predicting droughts) with modern science. However, recognition of joint-knowledge production is clearly absent in the PPCR in Bolivia, where local communities are viewed as benefactors of the proposed interventions, not so much as active participants in the solution. Traditional knowledge could be captured and included in decision-making through initiatives such as the Intercultural Pedagogical Basins Program implemented by the MMAyA, which creates a space for social and cultural encounters between the communities within the basin and the management of water and other natural resources. Moreover, within such programs, effort could be directed toward training and developing community leaders and local or municipal technicians in hydrometeorological monitoring, benefiting from the close relationship of locals with their natural environment.

Box 6. ProClim

ProClim is a forum for climate and global change in Switzerland that seeks to facilitate both integrated research activities and the necessary linkages among scientists, policymakers, the economy, and the public. ProClim's main tasks are the following:

- To enhance knowledge exchange and networking within the scientific community.
- To further the integration of Swiss research within international programs.
- To promote dialog with decision-makers in politics and business.
- To provide information to the public, the media, and the economy.
- To consult with politicians and the administration.

Key activities include publishing reports and factsheets, organizing round table events and workshops, and maintaining a research infosystem that contains information about, for example, scientists and research programs. ProClim is part of the Swiss Academy of Sciences within a larger platform linking science and policy. It is led by a steering committee made up of leading academics in the field of climate change, impacts, and adaptation, and representatives from the Federal Office for the Environment.

Source: https://naturalsciences.ch/organisations/proclim.

12.5. Challenges in Learning and Innovation

While learning has undoubtedly occurred as a result of the recent drought and flood crises, many stakeholders expressed concern that mindsets and behavior will rapidly revert back to old ways once memories start to fade. This represents a fundamental distinction between persistent change and transformative change, with the latter being characterized by permanent behavior shifts reinforced with mechanisms that ensure learning is institutionalized. On the subject of learning, two main avenues were identified where the PPCR in Bolivia can contribute to transformative change: (i) providing a platform for institutional learning and exchange and (ii) upscaling experiences from micro-basins. Innovation, a cornerstone of transformative change, is evident in several design elements of the PPCR, with particular emphasis on the modernization of irrigation systems.

Establishing a platform for institutional learning and exchange: Any lessons from the recent crises have largely been assimilated and exchanged in an ad hoc fashion. Stakeholders have called for a formalized space where such learning can take place, possibly in the form of a web platform where data and information on past disasters can be compiled and exchanged. Also it would be highly beneficial to establish mechanisms for regional and international exchange on best practices and lessons arising from experiences with climate disasters. Natural hazard or disaster risk reduction platforms are common in many countries, and most have learning and exchange of knowledge as a central component. For example, in Switzerland, the PLANAT National Platform for Natural Hazards has a core mission devoted to coordination, seeking to avoid duplication and improve synergies through exchange of knowledge and experience on a national and an international level (http://www.planat.ch/en/home). The UN Office for Disaster Risk Reduction recommends that, in order to be effective and sustainable, national platforms for disaster risk reduction be built through a nationally owned participatory process that includes the perspectives of different sectors and stakeholders.

Upscaling experiences from micro-basins: There is noted potential in Bolivia to learn from positive experiences at the micro-basin level and to replicate these lessons for larger basins. Stakeholders recognized that communities within micro-basins have historically demonstrated ownership and sensibility in caring for their environment and water, and strong network mechanisms exist at this level to facilitate integrated basin management. The PPCR can look at opportunities to build on these existing mechanisms at the micro-basin level and to expand them for larger basins. When actions grow up from the ground level, society tends to automatically take ownership, leading to a much greater depth of change. Traditionally, adaptation efforts at the grassroots level have been strongly supported by non-governmental organizations, but the PPCR has the scale and government engagement to move beyond isolated projects to integrate community-based actions into higher levels of policy and planning. One of the best practical examples of mainstreaming community-based adaptation efforts into broader planning processes arguably comes from Nepal, where in 2011 the government adopted Local Adaptation Plans of Action as the official framework for national adaptation planning (Reid and Huq, 2014). In this case, Nepal's long history of community-based forestry management and a supportive legislative framework provided a foundation on which to mainstream local adaptation action into national-level planning.

Improving irrigation efficiency: Component 2 of the PPCR strongly emphasizes increasing the use of modern irrigation practices to achieve greater efficiency, for example, as measured by the ratio of water used to water captured. But how does this improved efficiency translate into productivity and ultimately improved earnings for farmers? These are questions being explored by the Vice Ministry of Water Resources and Irrigation with studies aiming to understand

efficiency problems in the sector (learning also from experiences in other countries) and linkages between irrigation, productivity, and livelihoods. The potential to align the vice ministry's studies with activities of the PPCR, and potentially expand research and development along these lines with future support of the PPCR, would help fast-track innovation and optimize water efficiency in the irrigation sector.

12.6. Challenges in Building Knowledge, Awareness, and Engagement at the Local Level

The PPCR has significant potential to influence mindsets and bring about behavioral shifts regarding knowledge, awareness, and engagement at the local level. Component 2 includes specific outcomes relating to awareness and enhanced capacities locally, while participatory processes with engagement of all water users are emphasized in developing integrated basin management plans under Component 3. In addition, stakeholders have identified several arenas in which the impact of the PPCR in Bolivia can be strengthened at the local level.

Establishing water as a resource: Education and awareness programs should focus on changing how society views and values water, such that water is recognized as a resource that is to be protected and cared for, rather than simply as a right that is provided by the state. Increasing access to drinking water in El Alto and across rural communities is an important outcome of Component 2 of the PPCR, but households should also be aware of what goes into providing a secure and healthy water supply. This is about generating a sense of ownership of the resource, ensuring that individuals appreciate their role in preserving the sustainability and quality of the water supply that is provided to them. A concentrated effort in this direction would directly align the PPCR with Goal 6 of the United Nation's 2030 Agenda, seeking to "support and strengthen the participation of local communities in improving water and sanitation management."

Mainstreaming climate change and environmental education: The case evidence was mixed as to the extent to which awareness of climate change and broader environmental issues are penetrating the general populace in Bolivia. However, stakeholders widely recognized that a coordinated program that transfers simplified knowledge to the broader public using mass media, education in schools, and other mechanisms is lacking. Information on television regarding climate change typically focuses on examples from other countries, rather than local issues, and what is taught in schools regarding climate and environmental change is outdated. PPCR Component 2 includes an output related to educating women, children, and youth about issues of water use and health, focusing on 13 selected rural communities. The PPCR could be much more ambitious and initiate mechanisms that strengthen climate change and environmental education on a larger scale. A good starting point would be to work with the Ministry of Education to strengthen the school curriculum for climate change and environmental issues. In some schools, promising pilot studies are underway, providing a basis for replication and upscaling. For example, in Tiquipaya, the World Wildlife Foundation is supporting a pilot project where junior students demonstrate the annual cycle of water based on ancestral knowledge. The aim is to transmit knowledge about water use between generations. The challenge is to mainstream a suite of such activities that engage and motivate different age groups to learn about climate change and local environmental issues (e.g., Figure 11).

Figure 11. *Expedition 2 degrees* is an initiative in Switzerland that uses advanced virtual reality to allow secondary school students to travel through time and experience how glaciers have responded to climate change and to visualize how the local environment will look by the end of the 21st century

Source: http://www.expedition2grad.ch.

Risk perceptions: The case of Tiquipaya highlights difficulties in building awareness about risks and the tremendous difficulties in forcing evacuation of high-risk land areas. Nevertheless, establishing a community-supported program of resettlement away from areas where risks cannot be reduced to an acceptable level is a benchmark example of transformative change. The Delta Program in the Netherlands is one example. Component 3 of the PPCR aims to implement such a resettlement plan from flooded areas, including payment and compensation mechanisms. However, the experience for Tiquipaya indicates that, even with financial compensation in place, strong social, cultural, and community connections can prevent people from agreeing to resettle. Hence, for this element to be successful, a focused local-level campaign of education and awareness about risks is recommended, including understanding risk maps, event probabilities, and the impact of climate change on these risks (Figure 12). Such education by no means guarantees the smooth implementation of a resettlement plan, but it should at least lay a foundation for trust and community support.

Figure 12. Local campaign to raise awareness about risks associated with flooding and landslides near Cusco, Peru

Source: Proyecto Glaciares, CARE.

Integrating traditional knowledge into adaptation planning: Several foreseen outcomes of the PPCR relate specifically to enhanced capacities or improved services provided to indigenous and rural communities. However, as emphasized by Nakashima, Galloway McLean, Thulstrup, et al. (2012), it would also be appropriate to recognize the ability of local communities to modify their actions in response to changing climatic conditions, which is proof of their adaptive capacity and resilience. Along these lines, knowledge generation at the local level should be seen as a two-way process within the PPCR, not only building new capacities within communities, but also providing a space in which knowledge and traditional practices can be integrated into climate change policies and actions. Strengthening this aspect of the PPCR, for example, within the development of integrated basin management systems under Component 3, would align directly with the Paris Agreement, which recognizes that adaptation responses should consider "vulnerable groups, communities and ecosystems, and should be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local knowledge systems..." Indigenous communities are particularly sensitive to the changing climate because of their dependence on and intimate relationship with their natural environment. The threat of climate change, combined with various legal and institutional barriers, make the empowerment and participation of indigenous communities key to enhancing adaptive capacity processes. By including traditional knowledge and resource management practices, the resilience of the local people to climatic variability can be further improved and their vulnerability reduced.

12.7. Alignment with Key Dimensions of Transformation and Arenas of Intervention as Defined by the CIF

In terms of *relevance*, the recommendations outlined above have all emerged from a careful analyses of the barriers and bridges that have constrained or enabled the building of adaptive capacity according to experiences during the recent water crises and from a more nuanced assessment of the case evidence for passive, persistent, and transformative response actions evident in the Bolivian water sector. Given the impact that floods and droughts have on local and national economies, it is clear that building resilience to such disasters and strengthening adaptive capacities is of critical importance for sustainable development in Bolivia. Recommendations such as establishing operational protocols to support decision-making before and during water crises (*Institutions and Policies* arenas) may not ordinarily be considered examples of transformative change. However, when viewed in the context of key barriers in the water governance system of Bolivia identified from the stakeholder interviews, these can become potentially transformative actions. Recommendations that will increase the depth of change mostly focus on the *Knowledge and Information* arenas, but also in the *Policies* arena, for example, by establishing plans and policies based on broad intersectoral development objectives. Opportunities were identified under *Learning and Innovation* to scale up approaches and mechanisms that are proving successful at the micro-basin level and to ensure experiences and lessons in relation to the recent drought and flood crises are scaled up to other municipalities and districts. The *sustainability* dimension is evidenced in recommendations to improve the sustainability of financial and technical resources to support long-term planning (*Institutions* arena) and with actions at the local level to raise awareness, particularly around managing and caring for water as a resource. Such awareness-raising interventions fall under the *Knowledge and Information* arena but also aim to influence local behaviors, and hence, fall within the *Practices/Mindsets* arena.

Overall, we note that many of the recommendations arising from this study fall within the Knowledge and Information arena, with actions that aim to build on the PPCR's existing strengths in Bolivia. Recommended interventions respond directly to the challenges and opportunities identified during the stakeholder interviews, where issues linked to Knowledge often dominated the discussion (e.g., Figure 8 in Section 10.1). Strengthening the planned activities in the key arena of *Knowledge and Information* directly aligns with a core target of Sustainable Development Goal 13 Climate Action of the UN's 2030 Agenda, "to improve education, awareness-raising, and human and institutional capacity on climate change mitigation, adaptation, impact reduction, and early warning." Furthermore, investing in arenas that build knowledge and information, broaden engagement, raise awareness, alter mindsets, and strengthen institutional and societal capacities are considered attractive from a donor perspective, as related interventions typically bring immediate benefits to the target group of actors and in this way can be considered low-regret, high-reward adaptation actions.

13. Concluding Remarks and Perspectives

This study has undertaken a comprehensive characterization of adaptive capacity within the Bolivian water governance system as a basis for evaluating the potential for the PPCR-funded investment plan to address challenges and build on opportunities. The study has been guided by a previously developed assessment framework (earlier applied in Chile and Switzerland) in which a set of governance-related determinants of adaptive capacity (Regime, Knowledge, and Networks) have been operationalized as measurable indicators and corresponding criteria. Under the framework, an exploration of how governance systems have managed and responded to past extreme events and what manifestations of adaptive capacity have arisen leads to an examination of how governance processes have hindered or enabled the building of adaptive capacity in the water sector. The assessment approach is based on participatory stakeholder interviews, where a semi-structured questionnaire was used to elucidate information pertaining to the indicators and their criteria. We focused our assessment in Bolivia around experiences related to the 2016/17 drought that severely impacted the La Paz/El Alto metropolitan area and the flood of late 2017/early 2018 that impacted Cochabamba and the River Rocha watershed. Following a first stakeholder workshop at the onset of the study, elements of the existing assessment approach were fine tuned to ensure key issues raised at the meeting were adequately captured under the indicators and criteria. Questions to be asked during the field survey were revised accordingly. Stakeholder mapping revealed a broad range of 30 key stakeholders who were selected to be interviewed.

The analysis revealed a positively evolving water governance system in Bolivia, starting with the mainstreaming of climate change adaptation into planning instruments in 2011. This is evidenced in the main sector policy, the National Watershed Plan, which includes a chapter on climate change and disaster risk reduction. Particularly over the past five years (2014–2019) and in part due to weaknesses exposed during the recent drought and flood crises, the state has (with support of programs such as the PPCR) further emphasized the role of information systems, monitoring, and early warning to enhance capacities to respond to extreme events and has improved engagement with key stakeholders. Despite these advances, systematic assessment of the case evidence revealed that many challenges remain in building adaptive capacity across all scales of governance and that, although progress is being made in several areas, there is limited evidence that transformative processes are currently being facilitated. Rather, existing

adaptive mechanisms correlate primarily with persistent change, meaning adjustments are being made largely in response to actual climate impacts affecting the water sector, including direct responses to the recent drought and flood crises. Hence, forward-looking perspectives are needed and there are significant opportunities for programs such as the PPCR to fill gaps and build on existing enabling mechanisms to further strengthen adaptive capacities and, ultimately, facilitate transformative change in the Bolivian water sector.

Key recommendations include interventions that focus on the following:

- Establishing clear operational protocols and building flexibility and prioritization within a strong regulatory framework to **enhance preparatory and contingency planning, and response capacities for extreme events.**

- Integrating future climate scenarios and future-oriented risk mapping to **enhance forward-looking, flexible climate adaptation planning**, and ensuring that financial and technical resources are in place to **guarantee the sustainability of these plans**.

- **Improving decision-making in the face of deep uncertainties**, recognizing the importance of flexibility in systems and structures, and exploring potential low-regret adaptive mechanisms that can potentially bring immediate benefits to a community irrespective of how the climate may evolve in the future.

- Establishing broad intersectoral development objectives that can guide strategic projects aimed at improving livelihoods, ecosystem productivity, and health, supported with necessary intersectoral planning tools to **improve coordination in governance across sectors**.

- Ensuring data and associated data platforms are tailored to sectoral needs, supporting the establishment of a national research agenda that formalizes exchange between academia and the state, and integrating traditional knowledge to **enhance hydrometeorological and climate services**.

- Establishing a platform to ensure that learning from past disasters becomes institutionalized, upscaling positive experiences and mechanisms linked with integrated planning and community-based adaptation at the micro-basin level, and investing in research and development for irrigation efficiency to **address challenges in learning and to strengthen innovation**.

- Building awareness of the value of water as a precious resource, mainstreaming climate change and environmental education through the school system and media, changing perceptions and mindsets around risk, and recognizing that traditional knowledge can be central to adaptation planning, all of which contributes to improved collaboration between civil society and the state and **builds knowledge, awareness, and engagement within the general population**.

The PPCR in Bolivia is clearly a well-conceived program that aims to address many of the important challenges and gaps evident in the process of building adaptive capacity across the Bolivian water sector. Recommendations arising from this study are intended to further align

the design elements of the three PPCR components with Arenas of Intervention to facilitate transformative change as defined by the CIF, thereby increasing the potential of the PPCR to generate relevant, far-reaching, and sustainable manifestations of adaptive capacity in the Bolivian water sector. Furthermore, in the broader context of the CIF, lessons and experiences from this study can now serve as a reference for designing water projects and assessing practices in other countries where climate change and water security threaten sustainable development.

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Annexes

Annex 1. Major Institutional and Governance Adaptive Mechanisms in Bolivian (Extracted from the Desk Review)

Scale	Institution/Governance Mechanisms/Adaptive Actions	Explanation
National	Constitution of Bolivia (2009)	**Art. 373, par 1.** Water constitutes a fundamental right for life, within the framework of the sovereignty of the people [...]. **Par 2.** Water resources in all their states, surface and subterraneous, constitute finite, vulnerable, strategic resources, and serve a social, cultural, and environmental function. **Art. 374,** Par 1. The state shall protect and guarantee the priority use of water for life. It is the duty of the state to manage, regulate, protect, and plan the adequate and sustainable use of water resources, with social participation, guaranteeing access to water for all the habitants [...].[11] **Par 2.** The state shall recognize, respect, and protect the uses and customs of the community, of its local authorities, and the rural native indigenous organizations over the right, management and administration of sustainable water. **Par 3.** The fossil, glacial, wetland, subterraneous, mineral, medicinal, and other waters are priorities for the state, which must guarantee its conservation, protection, preservation, restoration, sustainable use, and complete management; they are inalienable, not attachable and cannot be limited.
National	UN General Assembly, 64/292 Resolution on the Human Right to Water and Sanitation	On July 28, 2010, through Resolution 64/292, the United Nations General Assembly explicitly recognized the human right to water and sanitation and acknowledged that clean drinking water and sanitation are essential to the realization of all human rights. The Resolution calls upon States and international organizations to provide financial resources, help capacity-building and technology transfer to help countries, in particular developing countries, to provide safe, clean, accessible, and affordable drinking water and sanitation for all.
National	Law of the Rights of Mother Earth [No. 071 | December 7, 2010]	**Art. 7, par. 3.** To Water: It is the right of the functionality of the water cycles, of its existence and quantity, and the quality necessary to sustain living systems, and their protection with regards to contamination, for renewal of the life of Mother Earth and all its components.[12]
National	Framework Law of Mother Earth and Integral Development to Live Well [No. 300 | October 12, 2012]	**Art. 27** (WATER) The bases and orientations of Living Well through the integral development related to water.[13]

11 https://www.constituteproject.org/constitution/Bolivia_2009.pdf.

12 http://peoplesagreement.org/?p=1651.

13 http://www.fao.org/fileadmin/user_upload/FAO-countries/Bolivia/docs/Ley_300.pdf.

National	2025 Patriotic Agenda	In the Political Constitution of the Plurinational State of Bolivia it has been determined that basic services constitute human rights. These services are not a business and cannot be privatized to generate profit and private profits at the expense of poverty. Likewise, it is the obligation of the Plurinational State of Bolivia to guarantee the full access of the Bolivian people to these services in equitable conditions and in balance and harmony with Mother Earth. We refer mainly to water and sanitary sewer, as well as to health and education services and access to infrastructure and sports training.[14]
National	Sectoral Plan for Integral Development 2016–2020	**Integral Water Management.** Focused on watersheds, where life systems prioritize the relationship between high and low watersheds for the conservation and sustainable use of water. For the provision of water in sufficient quantity and quality for the population, for the irrigation of productive systems and for the flow basis for organisms, ecosystems, and environmental functions [...].
National	National Watershed Plan	The National Watershed Plan seeks to improve the quality of life of communities and residents through integrated watershed and water resource management in Bolivia. The plan undertakes modalities of participation and self-management as a support for human development and environmental sustainability, from the perspective of local cultures and systems of life. The National Watershed Plan has a dual character. It is a guide for the construction and development of a new integrated management plan for water resources in Bolivia and it is a program and action plan for the generation of projects and local initiatives for integrated water management in watersheds and management of natural resources.[15]
National	Sectoral Plan for the Development of Basic Sanitation 2016–2020	The Basic Sanitation Plan is a sectoral instrument of the National Development Plan and lays the foundations of a commitment between national, departmental, and local levels of government to achieve a substantial increase in access to sustainable drinking water and basic sanitation services in general. All of this under the framework of Integrated Management of Water Resources and of participatory and responsible management of entities providing basic services, guaranteeing the sustainability and the non-profit nature of the water resources, promoting the participation of users, transparency, equity and social justice. Respecting and supporting the community systems of peasant and indigenous communities, Drinking Water and Sanitation Services Providers and Associations of services providers [...].[16]

14 http://vpc.planificacion.gob.bo/uploads/recursos/AGENDA_PATRIOTICA2025_QUIEN_HACE_QUE.pdf.

15 http://grus.org.bo/2017/11/01/ministro-de-medio-ambiente-y-agua-carlos-ortuno-socializo-el-plan-nacional-de-cuencas/.

16 https://plataformacelac.org/politica/38.

National	Law 755: Integral Waste Management	The purpose of this law is to establish the general policy and legal regime of Integral Waste Management in the Plurinational State of Bolivia, prioritizing the reduction of waste generation, its use and final sanitary and environmentally safe disposal, under the framework of the Rights of Mother Earth, as well as the right to health and to live in a healthy and balanced environment.[17]
Regional	Basin Management Plans	The development and promotion of River Basin Management Plans constitutes a main axis of the policy of the Plurinational State of Bolivia, in the face of the challenge of managing water resources in the upcoming decades. This challenge involves the accelerated deterioration of water availability in terms of quantity and quality. In this sense, it is our obligation to have water planning instruments that allow us to ensure the availability of this resource to future generations, within the framework of Living Well.[18]
Local	Watershed Management Bodies	A watershed management body is an organization or platform that includes all those who live in a basin and that emerges as an initiative of grassroots organizations that seek conservation and good management of natural resources and the integral development of the territory for the benefit of men and women. A watershed management body gives room for participation in order to make decisions and reach sustainable agreements for the conservation and proper use of the resources of Mother Earth.[19]
Local	Integrated Watershed Management	Integrated watershed management is the set of actions that lead to the sustainable use of the natural resources of a basin. The need for an integrated watershed management project in a micro-basin originates in the need identified by social organizations and families of the communities who, based on a diagnosis and knowledge of their territory, raise this genuine demand before their local or departmental government.[20]
Regional/ Local	Pilot Program for Climate Resilience (PPCR)	The objective of the PPCR is to improve institutional capacity and instruments for integrated watershed and water resource management, as well as financing investments in infrastructure projects such as the construction of irrigation systems and protection of riverbanks.[21]

17 http://extwprlegs1.fao.org/docs/pdf/bol150721.pdf.

18 http://www.cuencasbolivia.org/files/marco_conceptual_y_estrategico_del_pdcrg_(v.0.1).pdf.

19 http://www.proagro-bolivia.org/wp-content/uploads/2016/06/M-4-Comité-de-Cuencas.pdf.

20 http://bibliotecadelagua.sirh.gob.bo/docs/pdf/16.pdf.

21 http://www.bancomundial.org/es/news/press-release/2014/07/25/world-bank-fund-climate-change-adaptation-bolivia.

Annex 2. Semi-structured Questionnaire Used for the Field Interviews

Interview Introduction

Thank you very much for your willingness to be interviewed and for taking the time to speak with me. I am interviewing you to better understand how recent extreme periods of drought (e.g., 2016/17) and/or flood (e.g., 2017/18) has been managed in the XXXXX basin and how prepared the water governance system may be to deal with such events in the future, considering the potential impacts of climate change.

The interview should last around one hour and, if it is ok with you, I would like to record your responses so that afterwards I can translate parts of the interview into English. Your responses are confidential and I will not publish any quotes without first seeking your consent. When preparing results and reports from this study, I will not refer to you by name or other identifiable information.

Section 1: Introductory Questions

1. Could we start with a short description of the organization or institution you are with?

- What is your role in this organization or institution?
- How long you have lived/worked/been engaged here?

2. How was your community/group/organization/sector affected by recent extreme events (2016/17 drought and/or 2017/18 flood)?

Section 2: Governance Questions

Knowledge

3. Prior to these most recent events, do you know about any other drought or flooding event that has occurred recently?

- What was learned from these experiences?

4. Regarding the most recent events, what type of data or information did your organization/group/community generate to help manage the drought/flood?

5. Was there any training or preparation for such events? (Workshops/information at local/regional/national level).

6. Before the event, did coping and/or response plans exist? Have these plans been adjusted or have new plans been put into operation as a result of new knowledge from the event?

7. What kind of technical or scientific information is used to manage water supply and/or flooding in your region? (Examples)

a. Environmental impact studies

b. Weather forecasts

c. Climate models

d. Hydrological models

e. Water quality information

f. Monitoring stations

g. Traditional knowledge

h. Local observation of change

i. Disaster risk maps

8. How do you access this information? (Examples)

9. Was the information clear, applicable, and in a format you could use?

10. Can you give examples of how this technology/information/data was used to manage the extreme situation and how the information was integrated into planning and decision-making?

11. Was this information shared across different groups? If yes, how?

12. Who or what institution should be responsible for sharing information?

13. What improvements in technical and scientific information are required to better prepare for, manage, and respond to these types of events?

14. How did civil society respond during the disaster? What civil-led adaptation actions have resulted from these experiences?

15. After such events, are institutions and civil society aware of what the impacts of climate change represent in Bolivia? If so, how? (e.g., what are the perceived impacts?)

Regime

16. How well was the event managed?

- Were financial capacity and human resources sufficient?
- Were preparation and relief adequate?

17. Who was involved in decision-making about water supply and/or flood management response during the event?

- Were you?

18. Who/what institution/level was the primary decision-maker?

19. When it comes to response actions in case of extreme events, is there a clear division of responsibilities and tasks among the institutions/individuals? Did they act according to such divisions during the past extreme events?

20. Do legal provisions/guidelines exist for managing the water supply during periods of high demand? Or for managing flood events?

21. How were response actions (e.g., water allocation and disaster response actions) prioritized during the extreme events? What was the basis for these decisions?

22. Were any concerns for environment/ecosystems taken into account in managing the event(s)?

23. Is climate change and/or risk management integrated into the planning process within your sector or within any committees you are involved in at the local/regional level?

24. Was there any adjustment/change in the system following on from any of the events?

- Any lessons learned? If so, have they been incorporated into the system?

Networks

25. Within your role, did you have regular involvement with other water managers/water stakeholders/disaster management authorities?

- If so, can you give examples of how you interacted with them?

26. Did any of these groups/individuals particularly block or drive progress?

- How are/were conflicts negotiated and resolved?

27. How do you transfer/share information across these different stakeholder groups, including with civil society?

28. How could the transfer of knowledge (including scientific and traditional knowledge) be improved across stakeholder groups?

Section 3: General Overarching/Concluding Questions

29. How able is the water governance system to respond to these stress periods of too little or too much water?

30. What would you see as the main impediments (legal, policy, political, social) to the system coping with stress periods? How could this be remedied?

31. What differences or commonalities have you seen in the management/response to droughts in comparison to floods? Can you think of any possible reasons for these differences or commonalities?

32. Do you have any final thoughts about how climate change will impact (or already is impacting) water resources and the ability of the water governance system to cope with these impacts?

- Could climate change also bring benefits and new opportunities?

Annex 3. List of Interviewees with Sector Focus, Responsibility, and Geographical Representation

#	Sector	Responsibility	Location, *Scale*
1	Government Administration	Watershed management	La Paz, *National*
2	Government Administration	Watershed management	La Paz, *National*
3	Research	Water resources management	La Paz, *National*
4	Development & Cooperation	Environment/water resources management	Cochabamba, *Subnational*
5	Development & Cooperation	Environment/water resources management	Cochabamba, *Subnational*
6	Government Administration	Planning management	La Paz, *National*
7	Public Service	Environment/water resources management	La Paz, *National*
8	Government Administration	Environment and water management	La Paz, *National*
9	Consultancy	Water management	La Paz, *National*
10	Government Administration	Irrigation management	La Paz, *National*
11	Non-governmental Organization	Environment/water rights	La Paz, *Community*
12	Public Service	Climate and meteorological information	La Paz, *National*
13	Government Administration	Water resources management	La Paz, *National*
14	Research	Water resources	La Paz, *National*
15	Private User Group	Water supply and sanitation	La Paz, *Subnational*
16	Development & Cooperation	Water resources management	La Paz, *Subnational*
17	Government Administration	Water resources management	La Paz, *National*
18	Government Administration	Environment/watershed	Cochabamba, *Subnational*
19	Government Administration	Watershed management	Cochabamba, *Subnational*
20	Government Administration	Territorial planning / gender	Cochabamba, *Community*
21	Government Administration	Climate and meteorological information	Cochabamba, *Subnational*
22	Development & Cooperation	Water resources management	Cochabamba, *Subnational*
23	Development & Cooperation	Water resources management	La Paz, *International*
24	Government Administration	Environment/water resources management	La Paz, *Subnational*
25	Development & Cooperation	Disaster risk reduction	La Paz, *Subnational*
26	Development & Cooperation	Water resources management	La Paz, *National*
27	Government Administration	Irrigation management	La Paz, *National*
28	Research	Water resources management	Cochabamba, *Subnational*
29	Government Administration	Water services	La Paz, *Subnational*
30	Consultancy	Disaster risk reduction	Cochabamba, *Subnational*

Annex 4. CIF Arenas of Intervention

Arena of Intervention	Definition
Financing 	Interventions that leverage, complement, and coordinate other funding sources to evolve financing structures over time, with a focus on crowding-in private-sector financing. Interventions that use capital to buy down costs and/or cover risks in ways that lower longer-term costs and risks through economies of scale and market transparency and development, and that use financial incentives to shift behaviors and decisions in ways that accelerate deployment of low carbon and climate resilient development.
Governance and Engagement 	Interventions that build strong and durable country ownership and support for CIF-supported interventions, that ensure meaningful inclusion, engagement, and empowerment of relevant parties (including women and indigenous peoples), and/or that ensure the full range of salient barriers to transformation are identified and addressed through a programmatic approach.
Institutions 	Interventions that focus on building or strengthening institutional capacity among key public-sector (national, regional, and local) and civil society organizations operating within the country. Interventions that develop or enhance institutional communication, coordination, and collaboration among organizations working in the country, including multilateral development banks and other international partners.
Knowledge and Information 	Interventions that generate, share, and/or diffuse information to enhance knowledge and expertise to support accelerated and scaled implementation of low carbon and climate resilient development. These interventions include research and analysis, measurement and evaluation, learning partnerships, and training and capacity building for local populations.
Markets 	Interventions that expand private-sector awareness, capacity, and opportunities to enter and successfully participate in markets that advance low carbon and climate resilient development, such as renewable energy technologies, low carbon transportation, sustainable forestry, and ecosystem services. Interventions that establish clear, predictable market rules, mechanisms, relationships, and infrastructure to overcome barriers and support private-sector market involvement.

Arena of Intervention	Definition
Natural Capital 	Interventions that work with natural systems to reduce greenhouse gas emissions or make other physical changes to improve ecosystem resilience. This arena includes reforestation and enhancement of forest carbon stocks, increasing the agro-ecological potential of an area, and habitat restoration to protect native species, preserve biodiversity, or improve ecosystem health.
Policies 	Interventions that support the development or testing of laws, policies, or regulations that create an effective enabling environment for deploying low carbon and climate resilient development solutions. This arena includes laws and regulations promulgated through formal legislative and/or public-sector policy-making processes, as well as through policies and plans, and established by key institutions.
Practices/Mindsets 	Interventions that seek to influence individual or private-sector practices, decisions, and behaviors using tools and techniques drawn from social marketing and other fields. These approaches often involve shifting mindsets and individual-level appreciation of opportunities and benefits, and they recognize the power of social bonds and relationships in establishing and reinforcing norms and practices.
Technologies and Infrastructure 	Interventions that support the first use of key technologies in a country to demonstrate their effectiveness, that develop technology deployment competencies in the private and public sectors, and/or that drive reductions in technology deployment costs and risks (e.g., through economies of scale and data to inform investment risk assessments). Interventions that improve the infrastructure necessary for low carbon and climate resilient development.