



SSRC | Conflict Prevention
and Peace Forum

LITERATURE REVIEW ON CLIMATE SECURITY AND ENVIRONMENTAL PEACEBUILDING: RISKS AND OPPORTUNITIES IN THE ANDEAN REGION

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Prepared for CPPF
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ABOUT THE SSRC

The Social Science Research Council (SSRC) is an independent, international, non-profit organization founded in 1923. It fosters innovative research, nurtures new generations of social scientists, deepens how inquiry is practiced within and across disciplines, and mobilizes necessary knowledge on important public issues. The SSRC Academic Network on Peace, Security, and the United Nations is a new Council initiative that emerged out of a request from the UN Secretariat to provide UN entities and departments charged with responsibility for peace and security with better, more systematic access to new and emerging research around climate security risks in different regions in the world, such as the Andes.

ABOUT THE CONFLICT PREVENTION AND PEACE FORUM

The Conflict Prevention and Peace Forum (CPPF) strengthens the knowledge base and analytic capacity of the UN community in the fields of conflict prevention, conflict management, and peacekeeping. Founded in 2000 as a program of the Social Science Research Council, CPPF grew out of a recommendation of the Panel Report on Peacekeeping (the “Brahimi Report”) of the same year, which highlighted the need for the UN to have quick and unfettered access to external expertise about the geographic and thematic areas in which the UN operates.

ABOUT HÉCTOR MORALES-MUÑOZ

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INTRODUCTION

Climate change is a growing priority for states and communities around the world and the UN Secretary-General has called it the defining issue of our time (United Nations, 2020). The link between climate change and security is indirect, non-linear, and multi-dimensional. While climate change does not cause violent conflict directly, evidence from around the world shows that climate change can multiply risks known to contribute to insecurity (Mobjörk et al. 2016).

Andean America is comprised of the following countries: Venezuela, Colombia, Ecuador, Peru, Bolivia, Chile, and Argentina. Its geographical framework is the Andean Mountain range. The Andean region can be divided into three sub-regions: (1) the Northern Andes, which includes the Venezuelan, Colombian, and Ecuadorian mountains; (2) the Central Andes, which encompasses the Peruvian and Bolivian mountains; and (3) the Southern Andes, which consists of the Chilean and Argentinean mountains. While the north and central Andes constitute the Tropical Andes, Chile and Argentina are considered extratropical Andes, meaning that they lie outside of the tropical region (Schoolmeester and Verbist 2018). Politically, the Andean Community of Nations (Comunidad Andina, or CAN) is composed of all tropical Andes nations with the exception of Venezuela.

This literature review focuses on the Tropical Andes as an ecosystem, which, together with the ecosystems of the Amazon basin, contains more than 15% of the planet's biological diversity (Brooks et al. 2006) and shares the political framework of the CAN. Despite the geographic focus on the Tropical Andes, many of the issues present in this area, such as water stresses, agricultural expansion, and climate vulnerability, could be observed in the mountain regions of Chile and Argentina.

The Andean mountains have been integral to societies since approximately 8,000 years ago, along with their ecosystems, which are characterized by rich natural resources, including land for agriculture and livestock, water and irrigation for agricultural and industrial development, and space for the formation of organized societies (Herzog and Tiessen 2017). The Andean region today has large extensions of transformed landscapes that form a mosaic of different land uses, large rural extensions that include areas for agriculture, livestock, and forest plantations with exotic species, and urban centers with more than 6 million people (Cuesta et al. 2012). However, the Intergovernmental Panel on Climate Change (IPCC) has reported that the countries of the Andean Region have been identified as some of the most vulnerable in terms of climate change. The combined effects of human action, like unsustainable land use or polluting extractive industries and climate change, have brought about a continuous decline in natural land cover at very high rate. As a consequence of temperature increases, the trend in glacier retreat is accelerating, according to the IPCC Third Assessment Report (reported with very high confidence). The issue of glacier retreat is critical in the Tropical Andes, where water availability has already been compromised either for consumption, agriculture, or hydropower generation (Magrin et al. 2007).

Although the literature on climate vulnerabilities in this region is developing (Mark et al. 2010; Lamadrid 2014; López, Wright, and Costanza 2017), there is still a gap regarding the connections between these vulnerabilities and their possible effects on security and peace (Adriázola, Carius, and Rettberg 2012). Thus, this document presents a literature review on the climate-related security risks in the Andean region.

The literature review has five main sections. First, it outlines the main climate pressures and sub-regions that most frequently appear in the literature according to evidence-based reports. Second, it presents the existing vulnerabilities that hinder coping with the adverse effects of climate change. Third, it analyzes the connections between pressures, vulnerabilities, and their possible effects on conflict and cooperation. Fourth, it examines how the impact of climate change action policies affects the political economy in the region. The fifth section concludes with a summary of the findings and gaps in the research.

KEY TERMS

Human Security: According to the UN Commission on Human Security, “human security aims to protect the vital core of all human lives in ways that enhance human freedoms and human fulfillment. Human security means protecting fundamental freedoms—freedoms that are the essence of life. It means protecting people from critical (severe) and pervasive (widespread) threats and situations” (Gómez S. 2012).

Conflict: Implies a disputed incompatibility: two parties strive to acquire an available set of scarce resources at the same time, which can be either material or immaterial (Wallensteen 2006). Conflict in itself is not inherently negative per se; it is often a constructive element of a dynamic society. For example, conflict can allow societies to build on their differences towards a common goal that integrates many interests. Conflict could also be a development motor if dialogue spaces and democratic institutions channel tensions. However, it becomes problematic when the parties use violent means to advance their causes (Melander and Pigache 2007).

Armed Conflict: According to the International Committee of the Red Cross (ICRC), there are two types of armed conflict recognized by international law (ICRC 2008):

1. *International armed conflicts* exist whenever there is resort to armed force between two or more States.
2. *Non-international armed conflicts* are protracted armed confrontations occurring between governmental armed forces and the forces of one or more armed groups, or between such groups arising on the territory of a State [party to the Geneva Conventions]. The armed confrontation must reach a minimum level of intensity and the parties involved in the conflict must show a minimum of organization.

Climate Security: According to the ICPP Fifth Assessment Report, climate security deals with the “assessment of risks climate change poses to individuals and communities, including threats to livelihoods, culture, and political stability” (Adger et al. 2014). Furthermore, when associated with human security, climate security provides a strong basis for developing an integrated view of the multifaceted relationship between material climatic conditions and effects, global structures of inequality, and community-based understandings of core values and their adaptive capacity (Barnett 2003; McDonald 2013).

Environmental Peacebuilding: Environmental peacebuilding comprises the multiple approaches and pathways by which the management of environmental issues is integrated into and can support conflict prevention, mitigation, resolution, and recovery (Ide et al. 2021).

METHODOLOGY

A systematic literature review was conducted via four steps. First, the following key words and combinations for mapping the literature were determined: climate security, environmental peacebuilding, climate risk, climate pressures, climate vulnerabilities, climate change adaptation, climate change mitigation, political economy, climate, conflict, Andean Region, Colombia, Peru, Bolivia, Ecuador, and Venezuela. Second, the keywords were refined through a coding process according to the combinations most likely to give appropriate results in the search engines to answer the main questions of the literature review. Third, using the keywords, we conducted a search in engines such as Scopus

(FAO) have conducted some case studies and policy briefs on the matter with a focus on climate change action and its relation to food security. Furthermore, the Economic Commission for Latin America and the Caribbean (ECLAC) has an extensive library of research reports around natural resources, climate action, and sustainable development. Also, the Latin American Faculty of Social Sciences (FLACSO) has a department for development, environment, and territory with important publications about the political economy surrounding extractive industries.

Specialized research centers, such as the International Center for Research on El Niño (CIIFEN), have also contributed to technical knowledge about food security and agriculture, seasonal forecasts, and adaptation to climate change in the region. The U.S.-based organization Center for American Progress has a specific report on climate, conflict, and migration in the Andes (Hoffman and Grigera 2013). The Igarapé Institute from Brazil is a leading institution in Latin America writing specifically on the subject and has contributed significantly to knowledge linking climate change impacts and different forms of violence under the lens of the concept of human security. Also, the Institute for Environmental Studies at the National University of Colombia, which has a doctoral program on environmental peacebuilding, is starting to develop sub-national research on subjects of environmental governance, peace, and cooperation. One of the initiatives of this program is the Environmental Conflicts Observatory (OCA in Spanish), which maps conflicts around land use, extractive industries, and biodiversity loss.¹ It is important to mention a Colombian-based initiative of seven universities called the National Environmental Forum (Foro Nacional Ambiental) that has developed a series of courses about “Rethinking the Future of Latin America and the Caribbean Alternatives for Social-Ecological Transformation,” which collected a broad set of literature around socio-ecological systems in the continent.²

The results of this review included publications from prestigious journals such as *Global Environmental Change*, *Environmental Science and Policy*, *Environmental Research Letters*, *Climate Policy*, *Global and Planetary Change*, *International Affairs*, *International Journal of Disaster Risk Reduction*, and *Journal of Peasant Studies and Land Use Policy*, among others. Further, for a more thorough literature review, we considered grey literature, policy briefs, and reports written by researchers from international agencies. Among these, the most prominent are the Andean Community, ECLAC, UNDP, UNEP, FAO, and the World Food Programme (WFP).

METHODS FOUND IN THE LITERATURE

What are the methods used to take account of climate security in the Andean Region?

It is important to note that the term “climate security” is not well recognized in the literature in the region (Abdenur, Kuele, and Amorim 2019). This review found few reports that explicitly undertake a climate security assessment of the Andean region.³ However, there is abundant literature in Spanish on socio-environmental conflicts around land use, access, and extractive industries, which, under the framework of climatic conditions that impact human security, is a good point of departure (Bárcena Ibarra et al. 2020, Gudynas 2015, Gligo et al. 2014, FAO and Fundación Futuro Latinoamericano 2019).

1 https://conflictos-ambientales.net/oca_bd/

2 <https://catedra-tse.foronacionalambiental.org.co/biblioteca/>

3 Exceptions are: Adriázola, Carius, and Rettberg 2012, Abdenur, Kuele, and Amorim 2019, and Fuller, Kurnoth, and Mosello 2020.

TABLE 1. METHODS OF CLIMATE SECURITY RESEARCH IN THE ANDEAN REGION

Method cluster	Specific method	Theme
Qualitative	Participatory observation	Governance, institutional arrangements for risk management and water management
	Case studies or comparisons	Social vulnerabilities, impacts of environmental change on livelihoods
	Interviews	Perceived risk of climate change impacts, climate change adaptation
	Participatory research methods (e.g., participatory rural appraisal)	
	Focus groups	
Quantitative	Regression analysis	Land use change, deforestation drivers
	Flood frequency modeling	Flood prediction
	High-resolution carbon mapping approach	Deforestation
	Statistical learning methods	Biodiversity - ecosystems
Transdisciplinary and mixed methods	Species sensitivity	Ecosystem services assessment
	Natural resource management + Participatory action	Agroecology climate change adaptation and mitigation
	Ecohealth	Impacts of climate change on well-being
	Vulnerability and risk criteria of the IPCC	
	Case studies, data sets, interviews, and focus groups	Specific research on climate security

The methods used in the literature about climate security in the Andean Region can be classified into three main clusters. The first cluster is **quantitative methods** that explain the physical climate vulnerabilities (e.g., loss of ecosystem functions, deterioration of glaciers and wetlands). The second cluster is **qualitative methods** that explain the social impacts of climate change which can create sources of violent conflict (for example, how deteriorating agricultural structures can cause food insecurity and exacerbate the vulnerabilities of populations). The third cluster could be named **transdisciplinary methods**, as introduced by the IPCC since its fifth assessment report (AR5). These move the focus from top-down, or science-first, vulnerability assessments to risk management assessments wherein climate change is considered one risk along with many other challenges embedded in a socio-political context, thus opening the door to mixed methods (a combination of quantitative and qualitative methods) and participatory approaches (IPCC 2013, Cordova 2020) (see Table 1). Participatory observation is an approach that comes from the field of anthropology and consists of an outside researcher taking part and assisting another group in undertaking change (Couto 1987). Participatory approaches to doing research include numerous methods that involve research participants collaboratively in the research (Prokopy et al. 2013). Participatory approaches can be especially useful when the project goal is to achieve behavioral change or increase the usefulness of climate knowledge (Torre et al. 2015).

The first column of Table 1 shows different clustered methods of climate security research found in the literature on the Andean region. The second column specifies the methods and the third column shows the themes within climate security that are covered by the literature.

Quantitative Methods

The review identified the use of statistical data to show the increase in disasters due to natural hazards or conduct modelling to determine rainfall variation and floods (Bradshaw et al. 2007, Birkmann and von Teichman 2010, Ríos-Touma and Ramírez 2019). Another important trend in the literature is the use of advanced methods of remote sensing, high-resolution mapping, and process-based modeling to understand climate pressures as well as human and economic activities that create high risks for climate security, such as deforestation and ecosystem and land degradation (Asner et al. 2014, Armenteras et al. 2019, Rueda et al. 2019).

However, the lack of reliable local and national data presents certain limitations to this type of research. For example, in the Bolivian Altiplano, the lack of data has contributed to inaccurate meteorological models; therefore, such models may not be well suited to the complex topology of the Andes (Warner et al. 2009).

Qualitative Research

One observable trend in the literature of the Andes is the use of participatory action research methods combined with measures of the physical properties of the ecosystems. Participatory research and other “bottom-up” approaches offer a unique set of methods, especially in rural regions, for engaging farmer input to develop adaptation strategies that simultaneously address multiple sources of risk and opportunity in agriculture (Valdivia et al. 2010, Wheeler 2017). As a response, participatory mapping, monitoring, research, and knowledge-sharing are processes that enhance the adaptive capacity of the communities and are critical to building resilience (Valdivia et al. 2010).

Furthermore, many of the qualitative methods used, such as focus groups and interviews, require direct interaction between the researcher and the interviewees in rural regions, which becomes important for determining the way people perceive climate risks in their daily lives and for developing strategies accordingly (de Lange, Woodhouse and Milner-Gulland 2016, Vargas, Romero, and León-Sicard 2019, Schneiderbauer et al. 2021). Similarly, many studies have focused on inter-institutional risk management processes using qualitative methods such as participatory observation (Wesely 2019).

CLIMATE PRESSURES AND GEOGRAPHIC HOTSPOTS

What climate pressures and shocks are prevalent in the region? Are there specific sub-regions, communities, and economic or cultural assets that are particularly exposed to these pressures and shocks?

The literature consistently shows that the Andean region is highly vulnerable to climate change (Lamadrid 2014). Four climate pressures are identified, all of which are interconnected: warming temperature and rainfall variability, glacier retreat, floods, and droughts.

Warming and Rainfall Variability. The region faces major temperature warming and unpredictable precipitation variability, with rainfall decreasing in the southern part of the Andes and increasing in the northern part (Adriázola, Carius, and Rettberg 2012). In general, a future temperature increase in the Andes mountains is expected to be above the mean of other ecosystems, especially in Colombia, Ecuador, and the northeastern Andes of Peru (Marengo et al. 2011).

Glacier Retreat. Glacier melting is one of the hot topics that appears the most in the literature as an important climate pressure, or shock, caused by climate change in the Andean region (Bradley et al. 2006, López, Wright, and Costanza 2017, Mark et al. 2017). In the central Andes, glacier retreat is an indirect consequence of rising temperatures. Increasing rain precipitation (rather than snow) on the lower sections of glaciers exposes the ice to the sun's rays, increasing the glacier's capacity for absorbing solar energy, and therefore increasing the rate of melting ice (Herzog and Tiessen 2017). These impacts of increasing temperatures jeopardize water availability in Ecuador, the Páramos in Colombia, the high mountains in Peru, and the Bolivian Altiplano, for example, affecting water consumption and agriculture (Mark 2008, Carey et al. 2016, Jordan 2018).

Floods. Floods and rainfall variability are additional pressures that are prominent in the literature. These are caused by the Southern Oscillation phenomenon (ENSO)—known as El Niño—and La Niña, and affect Colombia, the southern part of the Andes, and the Amazon basin (Adriázola, Carius, and Rettberg 2012, Nieto 2016, French et al. 2020). Various studies link the lack of preparedness and lack of institutional responses to El Niño to increasing catastrophes and social conflicts, such as the 2017 emergency in Peru, which is common for the whole region (Cremers, Ooijevaar, and Boelens 2005, French et al. 2020). This is because urban planning and flooding mechanisms rely on various conditions, including twenty-four-hour rainfall, baseflow, and specific urbanization patterns, soil types, and saturation conditions (Poveda et al. 2020). Natural disasters such as flooding and landslides can cause the displacement of people. The displaced communities usually move to the outskirts of nearby cities. When planning adaptation strategies for such natural disasters, social conflicts may occur between displaced communities, receiving communities, and the state—for example, when working on resettling people living in the outskirts of cities—due to cities' existing high demand for social services and infrastructure, and the increased pressure on these services from the incoming population. Thus, several challenges emerge due to the lack of financial means to acquire adequate housing for vulnerable communities (UN-Habitat 2019). These challenges are aggravated by large-scale deforestation in the Amazon Basin, which causes further unpredictable floods and may push rural communities towards urban areas or deeper into the Amazon (Bradshaw et al. 2007).

Droughts. Finally, and also associated with El Niño phenomena, Peru's coastal plain is suffering increasing climate pressures, including droughts, which extend to border regions. For example, in 2005, during one of the Amazon's worst droughts of the past 100 years, Acre (a western Brazilian state bordering the Pando region of Bolivia and Madre de Dios of Peru) experienced a 300% increase in normal forest fires (Hoffman and Grigera 2013). Also, Venezuela and Altiplano present an increasing risk of droughts

caused by the decrease in annual precipitation and consequent decreasing river flow (Schoolmeester et al. 2016). In Peru, if there were changes in seasonality or prolonged droughts, several sectors could be affected, such as agriculture and livestock. Depending on the magnitude of the changes, the country's hydropower production could be put at risk (Mark 2008).

VULNERABILITIES

Do climate pressures and shocks exacerbate existing vulnerabilities?

Poverty and Inequality. A common theme in the literature is how climate pressures exacerbate existing vulnerabilities in the region, such as poverty and inequality, mainly in rural areas and affecting the agricultural livelihoods of women and indigenous populations (Aparicio-Effen et al. 2016, Havemann 2016, Villalba-Eguiluz and Etxano 2017, Díaz and Saldarriaga 2020). These climate pressures and natural hazards impact marginalized communities, particularly rural women (Meir et al. 2011). Warming temperatures decrease incomes in agricultural communities due to low productivity and create a reinforcing loop of natural deterioration; as a result, farmers migrate their cultivation fields to higher areas (Altieri and Toledo 2011, Nieto 2016).

Rural communities' vulnerability is related to economic development models with a high dependence on extractive industries and adverse environmental effects. This economic model creates inflexibility in terms of diversifying livelihoods for rural populations. Some authors mention that the impact of mining on livelihoods in the Andean region is evidenced primarily by the effects of mines on diminishing water quality and quantity in local communities. In particular, this has effects on water access for agriculture and livestock-based livelihoods by causing health problems for animals, reducing land productivity, and interfering with irrigation. Also, mining frequently restricts local access to land, affecting communities that make a living through agriculture. Finally, mining has altered employment opportunities, mainly because the labor required for mining produces large amounts of immigration of highly skilled mine workers from outside the territory. Immigration has an impact on augmenting local food prices and motivates local people to stop producing food and seek employment in the mines (Loayza and Rigolini 2016, Brain 2017). This phenomenon also has a differentiated gender impact; it has disproportionately adverse effects on women. For example, although women are significantly involved in working in the artisanal mining sector, they are generally less involved in prior consultation, a fundamental right to be able to decide on measures taken in their territories. Furthermore, women receive less income for their labor, thus receiving fewer economic benefits than men do (Jenkins 2014).

Furthermore, people already facing other stressors (such as poverty and malnutrition) are particularly susceptible to increasing frequency and extension of vector-borne diseases (e.g. malaria, dengue, and Zika) in higher elevations, especially where population density is high (Schoolmeester et al. 2016). Governments' low capacity to respond to health, social, and environmental crises further aggravates the problem, as was demonstrated by the response to the COVID-19 pandemic (IDB 2020).

Governance. Governance can be defined as a government's ability to make and enforce rules and to deliver services (Fukuyama 2013). According to the literature on climate pressures caused by rainfall variability and melting glaciers, the existing social and institutional vulnerabilities of communities are consistently exacerbated, affecting their ability to manage water infrastructure in scenarios of shortages or to store excess water (Carey et al. 2014, Schoolmeester et al. 2016, Bell 2021). Communities that are heavily reliant on glacial meltwater are especially vulnerable in dry periods or seasons (Mark et al. 2010). In general, water supply is less reliable for communities dependent on ecosystems such as glaciers and wetlands (Bradley et al. 2006, Reuveny 2007, Scheffran et al. 2012, Schoolmeester et al. 2016). The Pascua-Lama conflict illustrates the lack of governance in water ecosystem services. Pascua-

Lama is a bi-national mine project, 75% of which lies in Chile and the remaining 25% in Argentina. It is located within a biosphere reserve with large glaciers that provide water to the Huasco Valley Basin communities. The environmental authority demanded modifications to the original project, the most important being a prohibition against intervening on the glaciers. Glacier-dependent community organizations that have been affected are highly suspicious of the mine project because the exploratory studies have already shown the effect of the project on the territory and the deterioration of the glaciers. Thus, such projects exacerbate the adverse impacts of climate change in fragile ecosystems such as Andean glaciers. Ecosystem integrity was considered during the negotiations, but the mining operation's actual effects have remained unknown (Rojas et al. 2008, adelphi 2018).

The lack of institutional frameworks to cope with risks, especially in the agricultural sector, is also mentioned in the literature. For example, many Andean rural regions lack the institutional frameworks to help communities cope with weather patterns or to enact policies that provide financial insurance to their crops affected by rainfall variability (Vargas, Romero, and León-Sicard 2019). The literature presents three main governance weaknesses in terms of adapting to climate change in the region. First, several public institutions are constrained by the lack of a mandate relating to climate or the prioritization of climate issues, as well as a lack of information or professional capacity to select and implement adaptation plans and technical solutions. The second weakness is a lack of coordination between the various actors within governance networks. For example, in most countries, intersectoral work between agriculture water resources, biodiversity, and meteorological services is very limited. The third weakness comes from the centralization of government and power, which results in a lack of participation in decision making. This can be a constraint when local interests are not addressed or understood by national governments (Magrin 2015, Rodríguez Becerra and Alejandra Vélez 2018).

Furthermore, the institutional voids that prevent mediation between the interests of multinational corporations and the general population particularly exclude people living in poverty and prevent them from participating in market activities (Rodríguez Becerra and Alejandra Vélez 2018). Power dynamics and corruption aggravate this further, as they cause possible technical solutions for coping with risks to fail because elites determine who has access to valuable resources such as water and land. For example, the lack of land and water access constrains the development of sustainable land use systems, which could stop deforestation and reconcile productive uses with nature conservation (Morales-Muñoz et al. 2021). This also creates distrust and exacerbates social tensions (Lamadrid 2014, Duarte-Abadía and Boelens 2016). However, a significant trend in the literature is the entrepreneurial and creative spirit that remote communities display to cope with risks and adapt to climate stressors without relying on state services (Arregoces 2012, Vargas, Romero, and León-Sicard 2019, Hamza, Eriksson, and Staupe-Delgado 2021). For example, remote communities tend to avoid dependence on external actors when possible and demand a horizontal relationship with their central governments. According to some scholars, decision makers should recognize and encourage the traditional adaptation and indigenous knowledge base that local communities have acquired over a long time. Policies and strategies should align with indigenous communities' traditional practices to prevent climatic shocks (Hamza, Eriksson, and Staupe-Delgado 2021).

Lack of Infrastructure. Another vulnerability highlighted in the literature is the lack of infrastructure in some areas of the Andean region that are highly exposed to floods (e.g., Colombia and Ecuador). The lack of physical infrastructure or inappropriate housing on the hillsides causes losses in plantations or extreme emergencies due to landslides (Hoffman and Grigera 2013). This lack of infrastructure, coupled with institutional weaknesses in planning for sustainable land uses, leads to further vulnerabilities such as unregulated land use changes that damage fragile ecosystems. These damages create a vicious cycle. The main variables of the cycle are droughts and desertification, caused by climate change, that push vulnerable communities to protected areas or drive agricultural industries

to invest in ecosystems that cause deforestation (Gonzalez-Salazar et al. 2017, Quintero-Gallego, Quintero-Angel, and Vila-Ortega 2018, Graser et al. 2020).

Agriculture and Food Insecurity. Finally, the impacts of climate change on agriculture and livelihoods affect vulnerable populations with higher indexes of food insecurity in rural and urban areas (Nieto 2016). The agricultural sector is the most affected by climate change, which is essential when considering that it contributes 5% of the Andean Region GDP and 23% of regional exports and employs 16% of the economically active population. For example, in Bolivia, an average reduction of 20% in rural incomes is expected as an effect of climate change. In Peru, the impact of climate change on agriculture could generate decreases in the production of various staple crops for food security, especially those that require more water, such as rice (ECLAC, FAO, and ALADI 2016). This is particularly significant as research in the climate-conflict nexus suggests that an important mechanism through which climate change can create social unrest is via food insecurity and volatility in food prices (Froese and Schilling 2019, Buhaug et al. 2015, Morales-Muñoz et al. 2020).

CONFLICT, PEACE, AND COOPERATION DYNAMICS

Do these different exposure and vulnerability factors (or perceptions thereof) impact conflict dynamics (or collaboration and peace dynamics) within and between communities and/or across borders in the area/region? If so, how?

Most of the literature around climate security in the region uses the case of Colombia as an example of the overlapping challenges of dealing with high climate change vulnerability together with man-made pressures such as deforestation, unsustainable land use changes, and the recent peacebuilding process with the FARC guerrillas and the Colombian state in 2016 (Baptiste et al. 2017, Valenzuela and Colombia 2018, Ide 2021, Morales-Muñoz et al. 2021, Vélez-Torres and Lugo-Vivas 2021). However, some of the societal tensions present in Colombia that are a product of structural vulnerabilities and exacerbated by climatic pressures, such as inequality, are not unique to this case and also exist in other Andean countries. For example, in Peru and Bolivia, the instability of agricultural practices as a result of climate change is interconnected with a further lack of economic development and soil deterioration. This vulnerability pushes populations to engage in extractive and illegal activities, such as mining or cultivating illicit crops (Hoffman and Grigera 2013). Further, in the Andean countries, national elites have historically employed a development model based on the exploitation of highly valuable natural resources. The economic promises of extractive industries entrap governments in the so-called “extractive imperative,” where extraction must continue and expand regardless of the damage to the environment. The cash flow of extractives also interferes with developing local manufacturing industries, also known as “Dutch disease,” as the literature about capital flows from raw materials in Bolivia, Colombia, and Peru shows (Alarco Tosoni 2011, Baldivieso Freitas 2013, Goda and García 2015). In addition, corruption and a lack of state presence and regulations may lead to an unsustainable development path where international companies exploit the land, leaving an environmental deficit and degrading essential life-supporting resources such as water and soil. Further, it impedes other nature-friendly initiatives from providing sustainable livelihoods alternatives. (Bebbington and Bebbington 2011, Brain 2017, Fisher, Arora, and Rhee 2018, Suarez, Árias-Arévalo, and Martínez-Mera 2018).

Water Governance

Over the last two decades, water governance has positioned itself as a global model that offers equity, efficiency, and sustainability in the use of water resources. In the Andean Region, there is vast experience in Integrated Water Resources Management (IWRM) in practice, and many studies compile the results of

such experiences. IWRM is a concept that has been promoted in the Andean Region for around forty years. It implies the unification of actions for the handling and controlling of water resources to accomplish some goal or objective, such as water provision or agricultural production. “Water resources” means the physical, chemical, biological, economic, cultural, and many other valuable “assets” of the nation’s wetlands, streams, rivers, lakes, and coastal oceans (Cardwell et al. 2006). This approach embraces the cooperation of different actors and technical solutions to overcome water management challenges or possible conflicts. However, the literature shows mixed results with regards to participation, water use efficiency, and conflict resolution. On the one hand, IWRM has indeed transformed governance spaces in many basins in Perú, Bolivia, Ecuador, and Colombia, which has brought economic benefits and water sanitation access. Those economic benefits can be seen in the growing figures of agro-industrial business and mining industries (Damonte and Boelens 2019). On the other hand, IWRM interventions have had major environmental and social impacts that have led to inequalities and conflicts, especially when mining extractives has been the driver of improvements in water accessibility, leaving behind grassroots communities that are unable to escape an overly technical, bureaucratic approach to water resource management (Geng 2018).

More recently, some communities have benefited from the concept of Water Funds or Payment for Ecosystem Services (PES), where communities contribute to protect and restore the natural vegetation cover, ensuring water access to the basin inhabitants (Goldman-Benner et al. 2012, Gandarillas, Jiang, and Irvine 2016). Also, some approaches have brought about water governance from the grassroots level, and have increased local capacities and sensibilization to the management of micro basins. For example, the Provincial Water Users Federation Interjuntas-Chimborazo in the Ecuadorian Andes illustrates how the consolidation of federative organizations through methodological design, facilitation, and financial and logistical support to local societal actors can have an impact on water governance. The Federation has been able to push its claims by tilting established power relations through other means such as protests, mobilizations, lobbying, and negotiations (Hoogesteger 2012).

Another present trend in the literature is about how climate pressures and vulnerabilities interact with water access and governance. Certain studies in particular explore water insecurity in Latin America as an increasing source of tension at the sub-regional level and in border areas (Adriázola, Carius, and Rettberg 2012, Abdenur, Kuele, and Amorim 2019). Others explore how alternatives around water management should be developed within the frame of climate change adaptation, emphasizing sustainability, community participation, and social equality to solve conflicts by peaceful means (Cremers, Ooijevaar, and Boelens 2005, Lynch 2012, Lamadrid 2014).

Since resources, such as land, are crucial for adapting to climate change, land access and use is a major source of conflict in the region. Many authors explain that the lack of equitable access to land and the expansion of the agricultural frontier is one of the root causes of the civil conflict in Colombia (Sánchez-Cuervo and Aide 2013, Garcia Corrales, Avila Rangel, and Gutierrez Llantoy 2019, Zúñiga-Upegui et al. 2019, Murillo-Sandoval et al. 2020). Others see climate mitigation and adaptation strategies as an opportunity; climate action can create paths and open dialogue spaces to create cooperation and foster peacebuilding (Castro-Nunez 2018, Castro-Sotomayor 2018). For example, agriculture-driven livelihood research addressing both climate change and conflict, emerging in Colombia, has shown the connections between supporting agricultural diversification and improvements in farmers’ resilience (e.g., coping with climate variability), while also developing and adopting approaches to emerge from conflict (Castro-Nunez, Mertz, and Quintero 2016). Furthermore, projects that support sustainable land use systems to stop deforestation can improve governance scenarios, create cooperation at the community level, and develop zero-deforestation value chains with social and environmental standards (Morales-Muñoz et al. 2021).

More recently, research about the co-benefits that protected areas bring to well-being and peacebuilding has been conducted in Colombia, Ecuador, and Peru. This research claims that the management of protected areas can enhance governance and dialogue spaces through community participation of farmers, women, and indigenous communities. Moreover, the communities around protected areas also benefit from the development of sustainable livelihood alternatives such as eco-tourism and payment for ecosystem services in their buffer zones (Bebbington 2000, Gorricho and Schultze-Kraft 2021, Kettunen et al. 2021).

IMPACT ON POLITICAL ECONOMY (AND ECOLOGY)

How will the combined impact of climate change and mitigation/adaptation policies affect the political economy (and ecology) of the region?

The literature more prominently addresses the identification and assessment of biophysical impacts of climate change and is less developed regarding its socio-economic impacts (Burton et al. 2002). However, recent literature has found that climate mitigation and adaptation can, and should, lead to different development paths for the region (Chassagne and Everingham 2019). For example, agroecology and different socio-technical solutions for enhancing agricultural production can be coordinated with climate change mitigation and adaptation strategies that are participatory and look for inclusive social models. In this way, rural communities can cope with different institutional vulnerabilities (Altieri 2002, Altieri and Toledo 2011, Mateus Moreno 2020, Sylvester et al. 2020).

Other authors call attention to the importance of developing clean alternatives to the deficiencies of infrastructure. Infrastructure projects and the extractive development models present in the region play a key role in climate and security, given the region's long history of betting heavily on large-scale development projects that leave vast social and environmental footprints (Abdenur, Kuele, and Amorim 2019). Furthermore, according to some authors, the Andean countries should incorporate particular adaptation policies into their development models with a focus on political ecology to protect ecosystems and achieve well-being, especially in mining and energy industries. For example, governments should enhance their instruments for producing effective participatory environmental licensing processes, consultation of indigenous communities in early stages, and free, prior, and informed consent. The authors claim that existing instruments have historically not ensured human security and, on the contrary, formalization processes are rather corrupt and do not create stable jobs or advance the agenda of climate change mitigation or adaptation (Perreault 2013, Damonte 2016, Flemmer and Schilling-Vacaflor 2016, Schilling et al. 2020). Nevertheless, a recent development in this regard is the Escazu Agreement, whose main objective is (ECLAC, 2021):

[...] the full and effective implementation in Latin America and the Caribbean of the rights of access to environmental information, public participation in the environmental decision-making process and access to justice in environmental matters, and the creation and strengthening of capacities and cooperation, contributing to the protection of the right of every person of present and future generations to live in a healthy environment and to sustainable development.

In the Andean Region, Bolivia, Colombia, Ecuador, and Perú signed the agreement; however, Perú has not yet ratified the agreement in its congress. Environmental and social movements have been mobilizing to pressure the governments to ratify and implement this agreement. They see this as an opportunity to prevent ecological crimes and better adapt and mitigate climate change (Maihold and Reisch 2021).

CONCLUSIONS

Throughout the literature, there is consistent evidence that the Andean region is a hotspot ecosystem, with both a rich biodiversity and a greater vulnerability to climate change (Swenson et al. 2012, Abdenur and Rüttinger 2020).

The results of this systematic review of climate security literature in the Andean region show that the field still lacks specific literature that assesses the effects of climate change on security and peacebuilding, as well as the possible impacts of human security policies in terms of climate action and nature conservation. Moreover, there is little research about how to systemically address the warnings that, for the past two decades, have emerged regarding threats to security and peace due to climate change in other geographic regions. These are issues for which populations would need unprecedented levels of trust, cooperation, and coordination; however, the region has moved in the opposite direction. One example of such a trend is in the relations between Colombia and Venezuela, which have deteriorated significantly since the 1990s (Adriázola, Carius, and Rettberg 2012).

In terms of developing cooperation mechanisms, there is a need to coordinate between different stakeholders' climate action policies that bring co-benefits in terms of sustainable development and human security (Bain et al. 2016). For example, cooperation should be encouraged by local governments at the community level. Humanitarian and advocacy actors may have a more immediate relationship with aid and crisis management needs that arise from the adverse effects of climate change, while development agencies, research centers, and sub-national governments may play a more active role in socio-ecological transitions such as community-based natural resource management systems (including water governance), local agroecology projects, nature-based solutions, socio-ecological restoration, and livelihood diversification. At a national and regional level, multilateral agencies, national governments, development banks, and donors can coordinate policies leading to environmental peacebuilding actions by designing hybrid financial instruments that contribute simultaneously to climate action and peacebuilding. For example, Nationally Determined Contributions should be coordinated with development models that contain cleaner value chains, land titling programs, equitable water governance arrangements, and sustainable and resilient food systems to overcome inequity (Morales-Muñoz et al. 2022).

This review shows clearly that more studies in the field of climate security in the Andean region have emerged in the last three years. For example, climate risk assessment studies and scoping studies linking mechanisms of the climate-security nexus exist in the compilation work of the Igarapé Institute, among others (Abdenur, Kuele, and Amorim 2019). These initiatives show the beginning of an increasing awareness and understanding of the climate security risks in the region. As an illustration of this, several interesting studies linking rainfall shortages and intra-familial violence (Díaz and Saldarriaga 2020) or violence and political economies around natural resources (Lynch 2012, Kurtenbach and Rettberg 2018) exist. Nevertheless, there is a gap in understanding more precisely, and at the sub-national level, how different aspects of human insecurity are being exacerbated by climate change, what mechanisms can be implemented, how climate action can be proactively embedded in the peacebuilding lens, and how peacebuilding actions and security policies can have a climate-friendly approach.

The future research agenda for the Andean region should respond to the following questions: how can we create resilient societal systems to withstand specific shocks coming from climate change or violent conflict? Where do these disturbance elements in the fields of climate change and security come together, and what kinds of solutions could overcome both challenges? How can we develop measures for resilience that more effectively integrate economic development with social equality and a political ecology approach? How can we develop financially sustainable forecast mechanisms to understand disturbances to socio-ecological systems? What are the opportunities and risks for Latin

America and the Caribbean in the sustainable transition (e.g. minerals for renewable energy)? How can we reconcile the need for funding for state programs in a region with such high inequality amid highly extractive economic models that exacerbate climate change? Answering these questions requires empirical research in regions that are affected by inequality and violence and that are highly dependent on natural environments.

Furthermore, this review shows that further development of transdisciplinary research should occur. This research should integrate, for example, the development of negotiation skills at the community level to manage natural resources and transform conflicts by peaceful means; in this way, Andean societies can enhance cooperative initiatives around environmental protection and coping with risks. At the same time, developing trust in socio-political institutions is also important for developing resilience in communities and managing critical resources, such as water and land. This is a very important front in the Andean countries and still lacks development, since the interaction between participatory and sociological methods sometimes appears to be disconnected from approaches in the natural sciences to stop deforestation or take account of biodiversity loss. Finally, the field of research on climate security and environmental peacebuilding in the Andean region is picking up. It is important that the connections between climate, conflict, and peace advance at sub-national and sub-regional levels in order to start integrating solutions into national development plans and scaling them up to regional agreements. It is evident that the Andes is a region which, despite high social volatility and structural vulnerabilities, also has great natural wealth and the potential to develop other models of development and ecological diplomacy for wellbeing and prosperity.

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