From Water Insecurity to Physical Insecurity: The Case of Peru’s Melting Glaciers

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Produced by Geordie Jeakins

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Peru’s Melting Glaciers
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Background

Stretching from the Pacific Ocean in the west, to the Amazon rainforest in the east, Peru’s economic development is inextricably tied to its environmental geography. The Latin American country hosts numerous micro-ecosystems within its borders—including desert plains near the coast, lowland jungles in the Amazon Basin in the northeast, and the Andean highlands in the centre—all of which contain unique challenges borne from the pressures of a changing climate.¹

The delicate balance between the Peruvian people and their geography is under threat of being upended by the melting of Peru’s Andean glaciers. In recent decades, rising global temperatures have caused the glaciers of the Andes mountains to melt rapidly. This will result in severe strain for the population of Peru, which directly relies on glacial meltwater for their survival and future prosperity.

Scope

This brief intends to examine the risks associated with glacial melting in the Peruvian Andes. Although a similar process is underway throughout the chain of the Andes Mountains, this report only seeks to analyze the effects on the Peruvian state and its people. Additionally,

the report places a heavy emphasis on the public safety implications of this climate-induced phenomenon, as the ultimate effects of this growing crisis are both political and securitized in nature. In analyzing these threats and their implications, the report also strives to provide potential strategies for managing and mitigating these risks.

**Temporality**

The threat of melting glaciers in Peru has been prevalent for decades. Since the 1970s, glaciers of the Peruvian Andes have contracted by roughly 40 per cent. Future projections estimate that this pace will only quicken if climate change is not mitigated, resulting in the total loss of the Andean glaciers within 50 years.

The temporality of the individual risks that this deteriorating environment poses is far less clear, however. In the short and medium-terms, there are significant opportunities for Peruvian society, as the increased run-off will result in greater precipitation for the traditionally arid plains of coastal Peru. However, significant challenges also exist, both in the medium and long-terms. These include risks of flooding, loss of tourism, and sudden drought. These second-order political and security risks—political instability, displaced persons, and conflict—are likely to emerge gradually over the medium and long-term, but may also suffer acute spikes from natural disasters such as massive flooding.

**Risk Perception**

Although the specifics of climate change models remain unclear, Peruvians have long been aware of the effects of climate change on their surrounding environment.

As research has convincingly shown, risk perceptions toward climate change are heavily determined by one’s personal experience with, as well as their affective (quick, instinctual) response to, the issue. According to the **Dual-Processing Model**, both emotion and cognition interplay to determine one’s risk perception toward climate change. In other words, the linkages that an individual makes between cause and effect are related both to one’s emotional reaction to those effects, as well as one’s pre-conceived notions about the threat. In the case of climate change, this means that an individual is more likely to perceive it as a source of risk if they have experience of its

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effects (i.e. extreme weather events) and have previously appraised climate change as the driver of those threats.

This theoretical model would seem to indicate that Peruvians who are most affected by the climate-induced glacier melting would have the highest risk perception and understanding of the threat. Unfortunately, no polling exits to show public consciousness towards the issue. However, there has been a general increase in awareness of environmental concerns in recent decades, characterized by new government ministries and agencies, NGO groups, and civic engagement. For example, the Peruvian government recently tasked a state research agency to monitor the effects of the melting glaciers on the country’s lakes. In another case, a Peruvian farmer travelled over 10,000 kilometers to Essen, Germany, in order to file a lawsuit against RWE, Europe’s largest carbon emitting company. The farmer, Saúl Luciano Lliuya, claimed that RWE, which is responsible for 0.5 per cent of global carbon emissions, was responsible for 0.5 per cent of the cost of flood prevention measures in his hometown. These instances highlight a budding awareness and concern among Peruvians toward the growing threat of climate-related events to their wellbeing.

Risk Objects

The source of risk for Peruvian glaciers is climate change—specifically, rising global temperatures, originating from increased greenhouse gases in the Earth’s atmosphere.

Pathways-Of-Risk

Rising temperatures have caused Andean glaciers to melt at an increasing rate, leading to greater water runoff from the mountains. This growing trend affects Peruvians in two opposing, yet largely negative, ways: water scarcity and water abundance.

Water Abundance

In the short and medium-term, it is likely that runoff will actually increase significantly. For traditionally arid communities, particularly in the desert coastal plains, this development will come as temporary relief, allowing for unprecedented, if fleeting, agricultural prosperity.\(^8\) However, for other communities, the increased flow will continue to strain the capacity of lakes and rivers, raising fears of flooding for many inhabitants located near major flood zones caused by increased meltwater.\(^9\)

Water Scarcity

Water scarcity is already an endemic problem for much of Peru. In the coastal, desert region, the average annual rainfall is only 10mm.\(^10\) Thus, an overwhelming majority of water demand is met through glacial meltwater. As the Andes glaciers recede, meltwater will initially swell. In the long-term, however, the total amount of meltwater is expected to decrease until little runoff remains.\(^11\) Additionally, rising temperatures also have

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\(^8\) Hinsdale, “Vanishing Glaciers.”


\(^11\) UNESCO and International Hydrological Programme, “The Impact of Glacier Retreat In The Andes”
a tendency to increase evaporation, further reducing water availability. The resultant water scarcity is likely to hinder the country’s ability to effectively meet its growing demands.

Both major pathways of risk are exacerbated by confounding variables, namely demographic pressures. Peru’s population has grown steadily in recent decades, placing ever greater pressures on water supplies for domestic, agricultural, and industrial purposes. Compounding these pressures is the issue of internal migration to Peru’s major urban centres. For example, Peru’s capital, Lima, has experienced a fivefold increase in its population in the past 50 years, compared to the less than threefold increase for the country as a whole. Lima’s population bulge will create enormous pressure on existing water supplies, as water demand is expected to rise from 21.9 m$^3$/s (meters cubed, per second) in 2000 to as much as 30.1 m$^3$/s by 2030. As meltwater declines in the coming decades, these growing communities will struggle to secure alternative water sources. Additionally, in the interim, many of these growing, hastily-built urban centers will a significant risk of flooding from swelling rivers and lakes.

As noted above, the melting Andean glaciers contribute to both water abundance and water scarcity. However, these effects are not evenly distributed throughout the year, and, instead, tend to amplify the seasonality of the region. As a result, increased runoff is far more acute during the traditional wet season, while meltwater is further reduced during the dry season. Furthermore, even in regions where absolute levels of precipitation stays level or increases, it too becomes increasingly concentrated in relatively few, but intense storms, rather than spread out over a season. In this manner, the climate-induced glacier contraction causes drastic swings between water scarcity and abundance, disrupting traditional ways of life and complicating water management practices.

Objects-At-Risk

This report has thus far demonstrated the pathways which climate change-induced glacier retreats can cause water insecurity by disrupting traditional expectations of water resources. The question remains, however, how does water insecurity, be it abundance or scarcity, ultimately lead to political and physical insecurity?

Water abundance presents a more acute, but less long-lasting risk. As noted above, the intermediate increase in meltwater has temporarily swelled lakes and rivers in many areas of Peru. Many Peruvian communities are located dangerously close to these bodies of water. One such community, the town of Huaraz, was hit by a massive flood in 1941.

14 Collyns, “Climate Change Has Turned Peru’s Glacial Lake into a Deadly Flood Timebomb.”
16 Schubert et al., “Climate Change as a Security Risk,” 82.
when a chunk of mountain glacier fell into nearby Lake Palcacocha, killing over 1,800 residents. A repeat of that disaster on a much larger scale haunts Huaraz, whose population has grown 15 times over since 1941. Currently, approximately 50,000 residents live in flood danger zone of the city.

A disaster of this magnitude, be it in Huaraz or one of Peru’s many other endangered communities, could be massively destabilizing for the country. A humanitarian crisis can quickly evolve into a security crisis with the presence of existing political, social, and economic grievances. For instance, the Peruvian government’s endemic corruption and inefficiency can severely limit the effectiveness of official aid and relief efforts in the aftermath of a flooding disaster. The optics of this failure can translate from frustration to unrest to outright violence in a remarkably short time. There are numerous examples of political crises emerging from failures to respond to natural disasters in countries like Haiti, Bangladesh, and India. There is little reason to believe that sufficiently mismanaged disaster response efforts would not translate into conflict in the Peruvian context.

Meanwhile, water scarcity, in most cases, will be a contributing factor, not the sole driver of conflict. For instance, a likely scenario of conflict arising from water scarcity would be from competition between traditional pastoral groups, defending their claims to water resources. Diminishing water supplies could help spark conflict between these social groups by exacerbating existing tensions. In this scenario, poorly-implemented agrarian reform—whereby the Peruvian government had previously sought to forcibly inhibit traditional grazing lands—had already created growing competition for water resources. Similarly, conflict can arise by bolstering existing economic or administrative grievances. For example, the diversion of scarce water resources from domestic use towards agriculture, industry, or energy production, would prompt tensions over unfair treatment; climate-induced water scarcity might act as the trigger which translates that anger into action.

In this way, water scarcity, in and of itself, is unlikely to directly be the sole cause of conflict. Instead, it would more likely help inflame existing tensions, whether they be over government corruption, social, ethnic or religious divisions, or economic inequality.

The Relationship-Of-Risk

Receding glaciers present a distinct security threat for the country of Peru. Rising temperatures from climate change is causing

17 Collyns, “Climate Change Has Turned Peru’s Glacial Lake into a Deadly Flood Timebomb.”
18 Ibid.
19 Schubert et al., “Climate Change as a Security Risk”, 86.
Peru’s Andean mountain glaciers to melt at unprecedented rates.

The excess meltwater from these glaciers, in the short to medium term, will cause significant water abundance, potentially resulting in devastating floods. These floods can be expected to cause significant physical damage and loss of life in local communities. On account of corruption or inefficiency stemming from the authoritarian nature of state institutions, the Peruvian government is unlikely to respond effectively to a flood disaster, which will only serve to increase civilian grievances and potentially spark intrastate violence.

In the longer term, the temporary increase in meltwater will gradually disappear, to be replaced by chronic water scarcity. As water resources dwindle, groups can be expected to take action to defend or secure additional supplies. The growing conflict for ownership of water will likely exacerbate current societal grievances, particularly relating to poor government management policies. Already, Peru’s poor pay roughly ten times the price as the rich; in a future scenario of water scarcity, this injustice will almost certainly breed deep resentment. This resentment, too, could boil over into violence.

Risk Management & Mitigation

Risk Mitigation

On account of the nature of climate change, the risks presented by melting glaciers cannot be effectively managed. Reducing the probability of the Andean glaciers melting requires concerted global action to curb carbon emissions and reverse the trend of climate change. Thus, the risk must be accepted as unavoidable, and efforts should instead be placed on mitigating the impacts of that risk.

Improving Irrigation Efficiency

To reduce the long-term effects of water scarcity, Peru must look to reducing its water consumption across all industrial sectors. However, the need is most acute in the agricultural sector, where irrigation accounts for approximately 80 per cent of water use in Peru. Substantial efficiencies can be gained through effective water utilization processes and technologies, as well as adopting drought-resistant crops. For example, investments to implement more robust measurement systems to track water usage could both reduce consumption and lower costs for farmers. At the moment, however, financial constraints are a huge barrier to these necessary investments. Public-Private-Partnerships could provide a means of overcoming this obstacle, as a partnership between farmers, investors, and the government could provide such projects with private funds in exchange for a portion of equity. Overcoming the funding gap could help Peru make substantial strides in improving its irrigation systems. Additionally, these water savings would be economically beneficial, by ensuring the long-term sustainability

Risk Management

Although there are no effective means of reducing the likelihood of climate-induced glacier melting, the Peruvian government and society has a number of options to reduce the effects of this inevitability. These strategies work to both mitigate water crises before they emerge, as well as build capacity to deal with those crises when they do.

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26 Ibid.

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of agriculture and related industries, which alone account for roughly 17 percent of Peru’s exports.²⁷

**INCREASE DATA COLLECTION**
The increasing variability in precipitation has played havoc with traditional water management strategies. Both droughts and floods are more intense and long-lasting than in the past. As a result, it is critical that the Peruvian government act to improve its data collection measures, to gain a more complete picture of where, when, and in what quantities water is reaching different parts of the country. Peru’s financial and technological constraints are a major impediment to implementing such a robust data collection practice; however, these difficulties can be mitigated by partnering with foreign agencies. In particular, Peru would benefit greatly from geospatial data collected via Earth observation satellites operated by agencies such as NASA, US Geological Survey, National Oceanic and Atmospheric Administration, and EUMETSAT.²⁸ Peru could utilize this data to gain insight on its abundance and scarcity of water, as well as model future trends in order to make predictions and design policies accordingly.²⁹ In this way, a data collection strategy can and should precede, as well as feed into, other mitigation strategies.

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²⁹ Ibid, 49-52.
**Improve Water Management Systems**

Water management in Peru is inefficient, ad-hoc, and far from comprehensive. For example, only two-thirds of sewage waste is actually treated, representing a major source of water waste.\(^{30}\) Although international donors have recently promised $27.5 million in financial contributions to bolster the country’s water systems,\(^{31}\) the Peruvian government must lead the way with far more significant investments, to ensure optimum efficiency and population coverage. In particular, conducting scenario analyses utilizing the Pressure-State-Impact-Response method can help the government prioritize vulnerable population bodies.\(^{32}\) By improving current water infrastructure and extending service to more residents, water management authorities can better adapt to regional variations in water availability. In addition, the governance of these systems should be reorganized, with the overriding goal of ensuring equity of access for every Peruvian.\(^{33}\)

**Implement Land Use Measures**

The medium-term risk of flooding is aggravated

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by the presence of substantial human settlement near at-risk bodies of water. Towns like Huaraz are located in the direct path of a potential flood. These communities crop up in an ad-hoc basis, with little thought to effective land-use. As a result, neighbourhoods are built using shoddy materials, which exacerbate potential flood risks. By enforcing flood-conscious land use measures, the Peruvian government could discourage these communities from congregating in high-risk regions. Save for forcibly evicting residents, the government can do little to move those already-established communities from the danger zones. As a result, the government should prioritize improving early-warning systems to improve the flood evacuation process.34

**Improving Institutional Governance**

Water insecurity can evolve into conflict in the absence of effective governance structures. A government that is corrupt, inefficient, or simply absent is a government that will be blamed for environmental disasters. In order to mitigate these grievances before they morph into calls for violence, the Peruvian government must make a concerted action to curtail corruption, increase transparency, and engage with its citizens. These developments would have the added benefit of increasing the effectiveness of the other mitigation strategies, as a trusted and efficient government is likely to gain significant more buy-in for its endeavours.

This report has detailed the growing dangers posed by climate change-induced glacial melting in Peru. Rising global temperatures have caused a steady melting of the glaciers in the Andes, creating huge risks for many Peruvian communities. The medium-term increase in meltwater may cause intense flooding, resulting in substantial death and displacement. Long-term, the loss of the glaciers will create grave water scarcity for much of the country, potentially leading to water conflict and general unrest. As the process of glacial melting picks up pace, day-by-day, there is a growing imperative for the Peruvian government to plan ahead for these eventualities. Mitigation strategies—improvements to irrigation, data collection, water management, land use, and institutional governance—could prevent future catastrophe.

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34 Collyns, “Climate Change Has Turned Peru’s Glacial Lake into a Deadly Flood Timebomb.”
Bibliography


