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Three people watching snowfields, glaciers and dry areas in Peru's Andean highlands. © Shutterstock/Alberto SEMINARIO

Too much, too little water: Addressing climate risks, no-analog threats and migration in Peru

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Introduction

People across Peru are exposed and vulnerable to a wide range of hazards (Peru, National System for Disaster Risk Management (SINAGERD) et al., 2014), and studies demonstrate that these hazards are key drivers of migration in the country. Hydrometeorological hazards resulting in excess of water (such as torrential rainfalls and floods) or lack thereof (such as drought or glacier retreat) are particularly salient for migration. Climate change has intensified these hazards and will continue to do so, possibly resulting in new and unparalleled impacts on migration.

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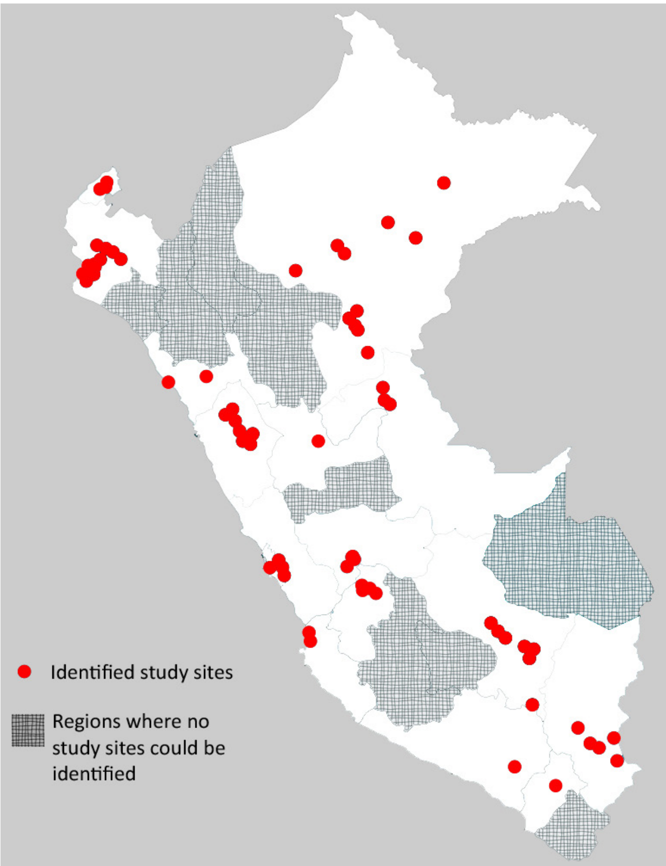
This brief, based on a systematic review and expert interviews (Bergmann et al., 2021), assesses the scientific evidence on the nexus between climate risks and migration in Peru. It discusses the necessity to understand climate migration patterns and improve planning and policies in the short to the medium term, in view of several "no-analog threats", with unprecedented, large impacts that could occur towards the end of the century. Recent policy developments, such as the development of Peru's Action Plan on Climate Migration and the National Adaptation Plan (NAP), could break new ground in addressing these challenges.

People across Peru are exposed and vulnerable to different water-related hazards, which affect livelihoods and can induce migration

Studies on the nexus between water-related hazards and migration exist for all of Peru, as Figure 1 shows. The breadth and depth of evidence on the linkages is strongest for the Peruvian highlands.

Figure 1. Geographic coverage of the reviewed studies of Peru



Source: Bergmann et al., 2021. Produced by Pablo Escribano (IOM) based on data from Jonas Bergmann; figure editing by Jonas Bergmann.

Note: This map is for illustration purposes only. The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the authors, the International Organization for Migration or the Potsdam Institute for Climate Impact Research.

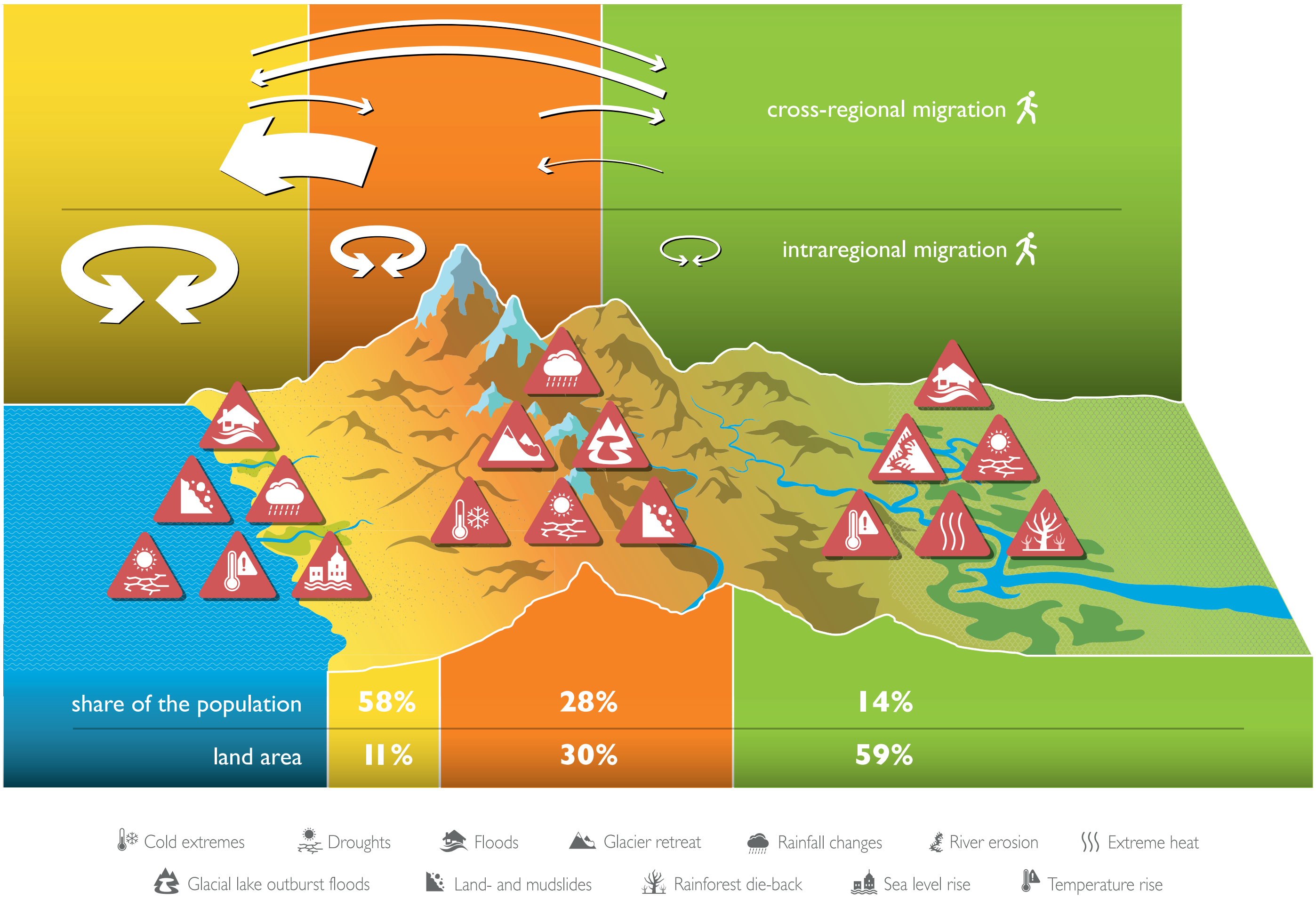
Typically, households examined in the studies are rural subsistence farmers who strongly depend on resources susceptible to climate impacts. Poor rural smallholders affected by climate impacts often have undiversified livelihoods, which increases their vulnerabilities. In Peru, every second rural dweller lives below the national poverty line (World Bank, 2019), and one in five Peruvians is vulnerable to food insecurity due to recurrent hazards (Peru, National Institute of Statistics and Informatics (INEI), 2014; World Food Programme (WFP) and National Centre for Disaster Risk Estimation, Prevention and Reduction (CENEPRED), 2015). Vulnerability is also stratified along age and gender lines. Urban populations are less researched but are also increasingly affected by climate impacts on cities.[1]

People use a range of coping and adaptation strategies to deal with hazards where they live, such as shifting livelihood activities, inputs or production areas. However, traditional techniques are increasingly failing due to changing weather patterns. Moreover, the lack of financial resources, education and training limits other options severely. Recovery from shocks is often only partial. Downward spirals of poverty and deprivation are not uncommon and could manifest more frequently in the future. The evidence suggests that current local adaptation practices have limits in some areas – even if global warming is kept to 1.5–2°C.

Across Peru, findings demonstrate that people use temporary and permanent migration among their many coping and adaptation strategies. When climate impacts affect livelihoods, some migrate from rural areas to the cities to seek new income sources, especially from the highlands to the coast – and, to a lesser degree, the Amazon rainforest. Migration can also occur when hazards deteriorate people's place attachment, for example, when environments erode or sacred glaciers disappear (Adams, 2016; Adams and Adger, 2013). The use of migration depends on age (younger people are more likely to migrate), existing deprivations (poor more likely to migrate) and gender (slightly more men), as well as on the degree of geographic isolation or connectedness to transportation networks. Figure 2 gives a schematic overview of historical migration patterns between and within the three large zones in Peru, overlaid with the hazards mentioned most in the reviewed studies. Climate impacts, especially those exacerbating water scarcity and water excess, will likely intensify these patterns.

[1] Growing urban populations and migration (often to unplanned informal settlements) could raise exposure to water-related hazards. There are close to 3.5 million urban poor in Peru (World Bank, 2019), who tend to live in precarious housing and work informally (Calderón et al., 2015; National Centre for Strategic Planning (CEPLAN), 2016), raising vulnerability to climate impacts.

Figure 2. Net lifetime migration across Peru's three main topographical zones, with relevant hazards shown



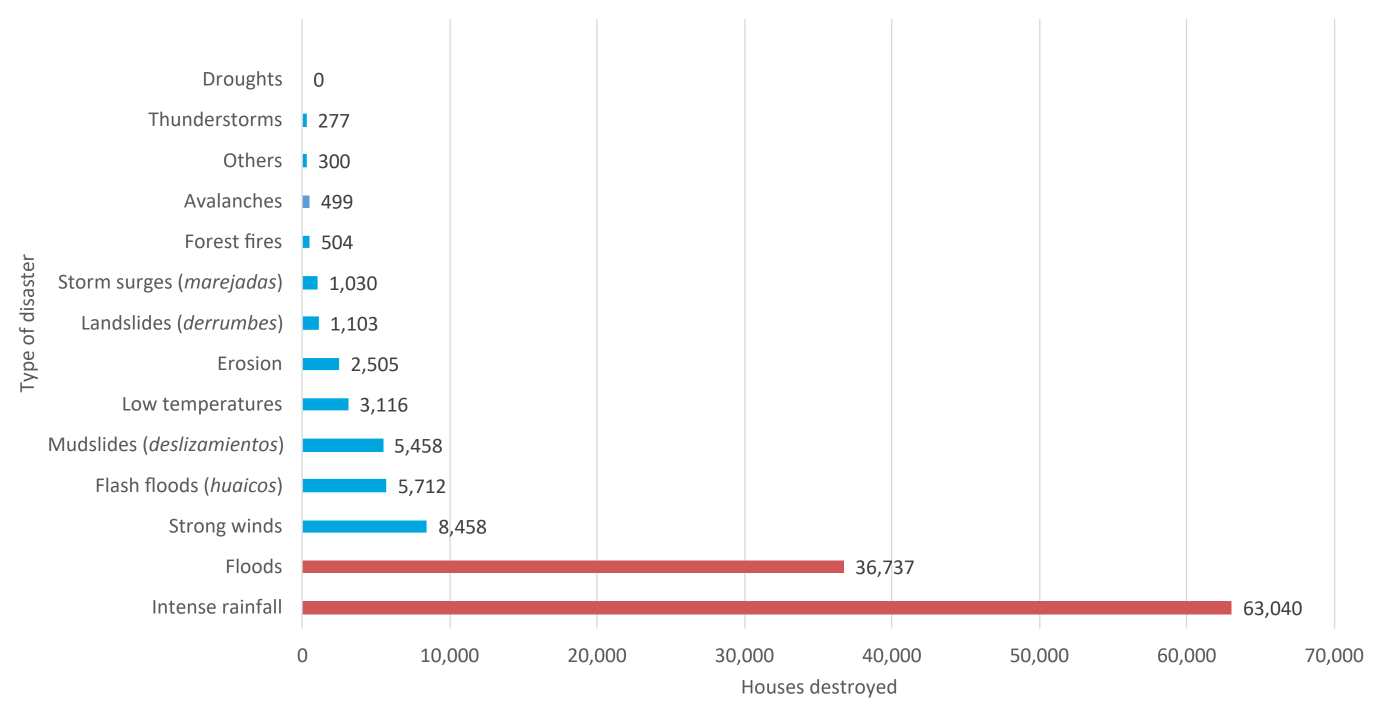
Source: Bergmann et al., 2021. Conceptualized by Jonas Bergmann and produced by webreform GmbH.

Note: The width of the arrows indicating migration is relative to the lifetime migration between and within Peru's three topographical zones, based on INEI 2017 census data. For the calculation, administrative regions were assigned exclusively to one of these three regions. (For example, regions in the selva were Amazonas, Loreto, Madre de Dios, San Martín and Ucayali.) The hazards in the triangles are the ones most often mentioned in the studies identified in this review.

Hazards resulting in excess and lack of water are key and growing drivers of migration in Peru

Hazards related to water excess have been the key force in destroying homes and driving displacement in Peru. As Figure 3 shows, intense rainfall and floods have destroyed more than 100,000 houses between 2003 and 2017. Floods have intensified over recent decades, especially in the Amazon (Barichivich et al., 2018; Bodmer et al., 2018; Gloor et al., 2013; Marengo et al., 2013), where flooding is a major driver of migration and displacement (Hofmeijer et al., 2013; Langill, 2018; List, 2016; Sherman et al., 2016; Sherman et al., 2015; Takasaki et al., 1999). In Ucayali and Loreto, farmers pre-emptively and temporarily migrate during the annual rainy season to mitigate food insecurities, while consecutive or single intensive floods can also drive permanent migration. Studies provide further examples of flood-driven migration and displacement in Huánuco, Loreto, Madre de Dios and San Martín (Peru, Ministry of Women and Vulnerable Populations (MIMP) and IOM, 2015; Rojas-Medina et al., 2008), as well as of attempted flood-driven planned relocation, such as the "New City of Belén" in Loreto (Chávez Eslava, 2017).

Figure 3. Number of houses in Peru destroyed by type of hazard, 2003–2017



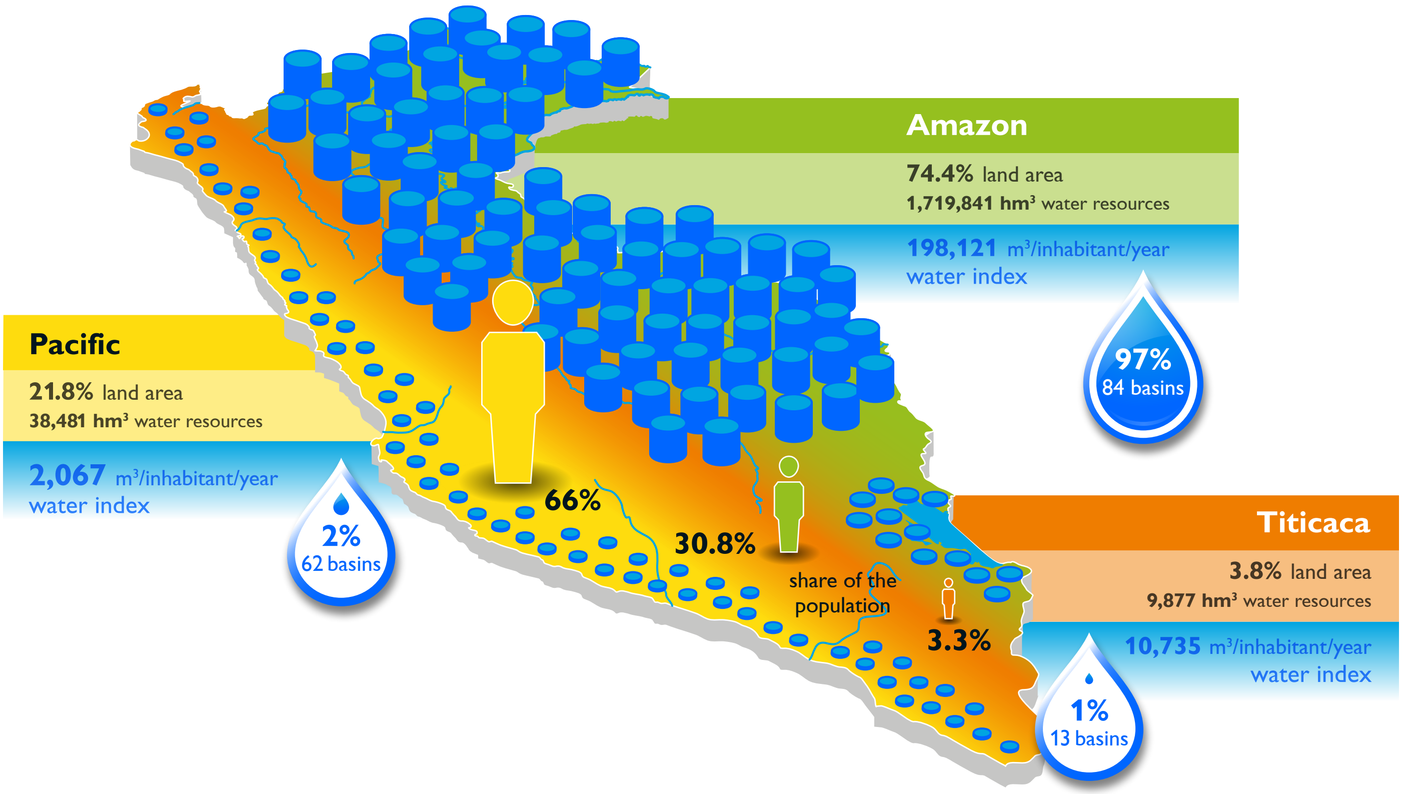
Source: Bergmann et al., 2021. Reproduced by Ole Weber based on data from the National Institute of Civil Defence (INDECI) (2018, p. 211).

Note: Flooding and intense rainfall, the two major sources of destruction, are highlighted in orange.

Along Peru's coast, El Niño events can result in extreme rainfall and flooding, including flash floods (*huaicos*). Observed El Niño–Southern Oscillation (ENSO) variance in the last several decades was significantly higher than in the previous centuries (McGregor et al., 2013). Major incidences in 1925, 1982–1983, 1987, 1997–1998, 2015 and 2017 had devastating impacts on infrastructure, people and their assets (French and Mechler, 2017; Sanabria et al., 2018; Venkateswaran et al., 2017), and caused large-scale displacements in Peru's coastal areas (Bayer et al., 2014; Espinoza-Neyra et al., 2017 and 2018; Ferradas, 2015). For example, the latest coastal El Niño in 2017 led to almost 300,000 displacements (Internal Displacement Monitoring Centre (IDMC), 2019). El Niño events have resulted in several attempted planned relocations across Lambayeque, Lima and Piura (Oft, 2009 and 2010; Sperling et al., 2008; Venkateswaran, et al., 2017).

On the flipside, studies demonstrate that water scarcity also threatens livelihoods and thereby influences migration in Peru. Most of Peru's population already resides in arid areas, as Figure 4 illustrates. Desertification is a major concern, with 24 per cent of the total land area of the country in the process of desertification and 3.8 million hectares already turned into desert (Peruvian Centre for Social Studies (CEPES), 2015; Peru, National Institute for Natural Resources (INRENA), 1996 and 2006; Peru, Ministry of Environment (MINAM), 2016). Peru has also experienced ten episodes of meteorological drought between 1981 and 2018, often linked to ENSO (Peru, National Meteorological and Hydrological Service (SENAMHI), 2019). Close to 13,000 communities with almost 3.5 million people were exposed to drought in 2007, out of which 2.5 million lived in agricultural zones of Peru (SINAGERD et al., 2014). Droughts and dry spells have intensified in many areas of Peru since 1970 (SENAMHI, 2015). Studies show that farmers migrate for income diversification during droughts, such as in the coastal Piura Region (Oft, 2009 and 2010). Flows can be categorized by gender, for example, when men migrate to rural areas to work on farms and women to cities to engage in domestic work (Sperling et al., 2008). Studies have also found that farmers migrate in response to livelihood and food insecurity triggered by rainfall changes and droughts in highland areas in Áncash, Junín and Piura (Heikkinen, 2017; Koubi et al., 2016; Milan and Ho, 2014; Oft, 2009 and 2010; Sperling et al., 2008).

Figure 4. Uneven water availability per capita in Peru's three large drainage systems



Source: Bergmann et al., 2021. Conceptualized by Jonas Bergmann and produced by webreform GmbH based on data from the National Water Authority (ANA, 2018).

Note: In the three drainage systems (Pacific, Amazon and Titicaca), each barrel represents one basin. The combined volume of all barrels per drainage system is indicative of their total water volume.

Rapid and accelerating glacier recession, mainly due to temperature increase, threatens one of Peru's most essential sources of water supply (Chevallier et al., 2011; Rabatel et al., 2013; Veettil and Kamp, 2019; Vuille et al., 2018). There has been at least 40 per cent surface loss among all glaciers since 1962 (Peru, National Institute for Research on Glaciers and Mountain Ecosystems (INAIGEM), 2018); several smaller glaciers have less than 30 per cent of their original surface area remaining and are about to disappear. Losses have been most drastic in recent years: from 2000 to 2016, glaciers countrywide lost an area of about 29 per cent (Seehaus et al., 2019). Once turning points are reached, water stress can rise drastically, particularly during the dry season (Buytaert et al., 2017). This dynamic can enlarge existing emigration dynamics from the Peruvian highlands. Migration motivated by prospects of generating new incomes and remitting money is observed in later stages of glacial retreat, as, for example, in Áncash, Cusco and Junín (Altamirano Rua, 2014; Heikkinen, 2017; Orlove, 2009; Wrathall et al., 2014).

The effects of this climate-driven migration depend on hazard dynamics, household profiles, trajectories and timeframes, and characteristics of receiving areas. On the positive side, migrants may be able to move out of harm's way, and some can diversify incomes, learn new skills and potentially send remittances to other vulnerable people (e.g. Badjeck, 2008; Lennox, 2015; Milan and Ho, 2014). On the flipside, migration can reinforce precarious conditions. In some regions of Peru, it can erode local knowledge and adaptive capacity, as well as deprive sending communities of labour force for labour-intensive agriculture (e.g. Lennox and Gowdy, 2014; Sperling et al., 2008). When men leave, women staying behind may have to shoulder extra workloads and emotional burdens (Milan and Ho, 2014). Migrants also often face other climate risks in urban areas, demanding housing situations, limited access to basic services, food insecurity and psychosocial challenges (e.g. List, 2016; Sherman et al., 2015), as observed in other countries (Vinke, 2019). The risk of mental illness may be higher among women, as one study on rainforest floods observed (Rojas-Medina et al., 2008). Agricultural skills often only have limited transferability to cities and result in disadvantaged positions in labour markets. Few studies look at the impacts of climate migration on destination areas. Studies on disaster displacement demonstrate that hazards can take a high psychosocial toll on people who have lost their homes, livelihoods and assets (e.g. Espinoza-Neyra, et al., 2017; Rojas-Medina et al., 2008). Cases of planned relocation in Peru show that they can carry substantial risks, as planners often overlook salient land and social issues, livelihood necessities such as market access, and people's place attachment (e.g. Chávez Eslava, 2017; Sperling et al., 2008; Venkateswaran et al., 2017).

Simultaneously, people also stay in areas affected by climate change, especially at the beginning of gradual changes (Koubi et al., 2016). Climate change deteriorates the resources of at-risk groups, especially the poorest of the poor, in the first place. People may also stay in their home communities because they are satisfied with their environments, have social obligations or are afraid of leaving, as observed in communities in the highlands of the Lima Region (Adams and Adger, 2013). Interventions supporting local adaptation and dignified migration will be required to safeguard the human rights and development prospects of people staying in increasingly dangerous areas.

Climate change will continue to intensify water-related hazards and could turn them into unparalleled drivers of migration

While non-climatic reasons for moving dominate migrants' motivations in many areas of Peru, water-related climatic drivers of migration are becoming increasingly relevant.

On the one side, high flood risks for crops and/or livestock exist in Ayacucho, Cusco, Huánuco, La Libertad and Pasco, while most other regions in Peru have medium risks (SINAGERD et al., 2014), which can drive migration. These risks are expected to grow in the future. Wet-season discharge may increase (Juen et al., 2007; Andres et al., 2014; Olsson et al., 2017) and the intensity of rainfall events is projected to rise (Christensen et al., 2013; Giorgi et al., 2014), potentially causing more flooding. For example, in the rainforest, wet-season floods are projected to become more severe (Zulkafli et al., 2016) and flood duration, as well as affected areas, are expected to increase (Langerwisch et al., 2013). More frequent extreme (Pacific-scale, as well as coastal) El Niño events could occur (Cai et al., 2018; Intergovernmental Panel on Climate Change (IPCC), 2019; Peng et al., 2019), potentially resulting in a higher frequency of extreme precipitation along Peru's coast (Sanabria et al., 2018). This increase in El Niño events will have synergetic effects with rising sea levels off Peru (Church et al., 2013), which can lead to further displacements (Dasgupta et al., 2009; Gosling et al., 2011; Reguero et al., 2015).

On the other side, droughts threaten the livelihood assets of hundreds of thousands of farmers. High risks for crops and/or livestock exist in Cusco, Ica, Huancavelica, Huánuco, Lambayeque, Tacna, Puno and Piura, with most other regions in Peru at medium risk (SINAGERD et al., 2014) and for which future drought risk is projected to increase (SENAMHI, 2015). Peru will see a tendency towards less rainy days overall (Christensen et al., 2013; Giorgi et al., 2014), which could accentuate the uneven water distribution across the country. For example, the south-eastern Andes and the Titicaca basin could experience longer dry spells (Christensen et al., 2013; Giorgi et al., 2014; Sörensson et al., 2010). Glacial melting rates will accelerate soon, with peak river runoff projected in 20–50 years in most areas (Adams et al., 2014). Taken together, long-term climate scenarios show reductions of dry-season runoff from 2050s onwards (Andres et al., 2014; Juen et al., 2007; Olsson et al., 2017).

The challenge will be greater as climate impacts become more severe in higher emission pathways (Xu et al., 2020). In a high global emission pathway resulting in 4°C global warming or more by 2100, impacts could become unmanageable over the long term. In this scenario, three severe threats without precedent in Peru's long history could arise in parallel by 2100:

(a) First, future deglaciation would be near-complete, between 91 per cent and 100 per cent of glacier volume (Radić et al., 2014; Marzeion et al., 2012). While this would temporarily lead to more meltwater and higher water availability, once peak meltwater is reached, stream flows will decline and water stress will rise drastically, particularly during the dry season (Buytaert et al., 2017). Water stress and outburst floods from glacier lakes (Carey, 2005; Frey et al., 2018) could damage ecosystems and pose dire challenges to human consumption, hydropower and agricultural production, as well as mining. Local adaptation may help to reduce some of these losses (Veettil and Kamp, 2019), but when hazard impacts exceed adaptive capacities, displacements can result.

(b) Second, sea-level rise of up to 0.7 m by 2100 (Church et al., 2013) could lead to losses of land, built capital and livelihoods by Peru's coastline (Gosling et al., 2011; Dasgupta et al., 2009) in the absence of adaptation measures (Nicholls, 2011). Besides, more frequent extreme El Niño events, storm surges and flooding, on top of higher sea levels (Reguero et al., 2015), could periodically drive more displacement and planned relocation in coastal areas with growing populations.

(c) Third, the rainforest's habitability would be at risk due to practically year-round extreme heat stress that exceeds the body's thermoregulatory capacities (Andrews et al., 2018; Mora et al., 2017; Dunne et al., 2013). This development could occur in tandem with massive rainforest degradation or dieback (Masson-Delmotte et al., 2018; Nobre et al., 2016), with severe implications for local livelihoods. Combined impacts could displace an increasing number of at-risk groups, such as subsistence farmers from the rainforest, while others could end up trapped in dire circumstances.

In a high-emissions future, these three "no-analog" threats could arise simultaneously, result in parallel disasters, and trigger both gradual, pre-emptive forms of migration and displacements, as well as entrapment of an unprecedented scale.

This analysis emphasizes the urgent need to drastically reduce global greenhouse gas emissions for countries like Peru to have a chance for managing impacts, although still challenging even when global warming is limited to less than 2°C. For example, projected glacier volume losses would still range between 78 per cent and 94 per cent for the Central Andes by 2100 (Marzeion et al., 2012; Radić et al., 2014), and extreme eastern Pacific El Niño events could still occur about twice as often in this century (IPCC, 2019). While significant risks would still ensue, a lower-emissions future would offer more space of manoeuvre for local adaptation and more rural areas could preserve their habitability.

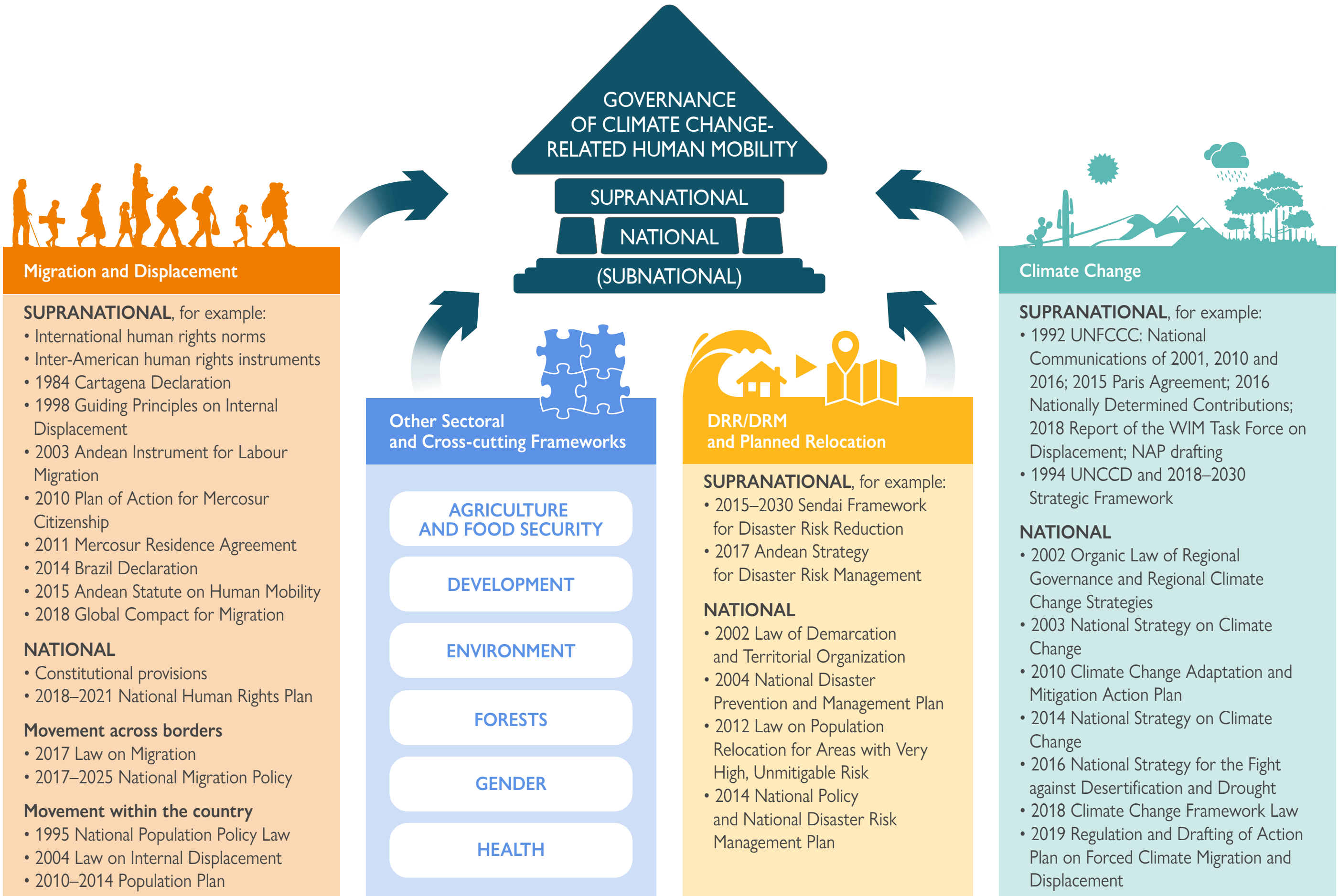
Rapid action is needed to leverage a comprehensive governance approach to climate migration

Peru's smallholder farmers and urban poor are not responsible for the climate crisis, yet their lives and cultural heritage are being increasingly jeopardized by its effects, making improvements in governance an imperative for Peru.

The country disposes of several laws and policies that provide a valuable starting point. For example, as Figure 5 illustrates, existing legislation on internal disaster displacement, disaster risk management and planned relocation, as well as international human rights norms, could help to support local adaptation and to protect people on the move. The recent Peruvian Framework Law on Climate Change and the Nationally Determined Contributions (NDCs), with its adaptation priority areas, constitute major progress. Yet norms could still be linked better and implementation could improve. Barriers include centralization, division of sectors and lack of subnational capacities (French et al., 2020). For example, while disaster risk management funding has increased, subnational entities often struggle to access funds and implement programmes adequately.

Peru could seize an important opportunity to build a cohesive, intersectoral and long-term strategy to address climate migration across all levels of government. The country is presently developing an Action Plan to Avert and Address Forced Migration due to the Effects of Climate Change (or, simply, the Action Plan on Climate Migration) and its NAP, both of which could break new ground for protecting vulnerable groups against the effects of climate change. The Action Plan is anchored in Peru's Climate Change Framework Law (Government of Peru, 2018) and its Regulation (MINAM, 2019), which stipulate two goals: (a) avoid negative effects of migration for receiving areas and (b) avert negative consequences for migrants' well-being. In parallel, the Government develops Peru's NAP based on the five adaptation priorities detailed in its existing NDCs: agriculture, forests, fisheries and aquaculture, health, and water.

Figure 5. Laws and policies relevant to the climate change–human mobility nexus in Peru



Source: Bergmann et al., 2021. Conceptualized by Jonas Bergmann and produced by webreform GmbH.

Note: NAP – National Action Plan; UNCCD – United Nations Convention to Combat Desertification; UNFCCC – United Nations Framework Convention on Climate Change; WIM – Warsaw International Mechanism for Loss and Damage

Across the Action Plan and the NAP, four priority areas for action on migration can be identified.

(a) **Enhancing persistent knowledge gaps**

This includes improving data and capacities, for example, to enhance the understanding of who is at risk of forced migration and what is needed to adapt locally where viable. Investments in Peru's National Institute of Statistics and Informatics (INEI) could help to take advantage of existing data collection instruments, such as the National Census, the National Household Surveys and the Demographic and Family Health Survey.

(b) **Preventing forced migration, given its challenging effects**

Measures must be designed to prevent forced migration in the five NAP adaptation priority areas and integrating them concretely in the Plan of Action. Local adaptation efforts, such as livelihood strengthening and diversification programmes must work together with disaster risk reduction and management institutions, such as the National Institute of Civil Defence (INDECI), the National Centre for Estimation, Prevention and Reduction of Disaster Risk (CENEPRED), and the Presidency of the Council of Ministers (PCM). For example, the Peruvian Ministry of Agriculture and Irrigation could spearhead measures that:

(i) Invest in subsistence farmers' ability to adapt to impacts locally, for example, in improved agricultural techniques and climate-resilient crops;

(ii) Develop capacities of local administrations to deal with local impacts, for example, by funding training in and personnel for agricultural resilience and water management.

(c) **Assisting affected people, given that not all forced migration can be avoided**

There is a need to protect and attend to migrants, their families and people staying behind, together with host communities, through programmes by the Ministry of Development and Social Inclusion

(MIDIS) and MIMP. Simultaneously, destination areas must be prepared via the Ministry of Housing, Construction and Sanitation, in cooperation with the Ministry of Health and the Ministry of Education. For example, measures could be taken to:

(i) Enhance the protection of and service provision for migrants, along with investments in host communities;
(ii) Prepare key urban destination areas and their margins for hosting more inhabitants and addressing the local effects on infrastructure, services, markets and social cohesion;
(iii) Build bridges between disaster management and displacement care to ensure that displaced people receive the necessary assistance;
(iv) Support people staying in affected communities.

(d) **Supporting beneficial migration, given that migration can have adaptive potentials in certain cases**

For example, MIDIS could support measures to:

(i) Identify areas that may degrade so much that they will not be suitable for dignified livelihoods in the future, and support their inhabitants in acquiring skills to move early enough and to achieve an adequate standard of living afterwards;
(ii) Provide incentives for migrants to settle across more municipalities suitable for their needs, beyond the major hubs;
(iii) Multiply the positive adaptation effects of internal remittances to rural areas, and of the transfers of skills, knowledge and investments.

CENEPRED, PCM and other relevant actors could facilitate planned relocation as a last resort, giving special attention to people's rights and well-being, in line with best standards and based on existing laws.

Both the NAP and the Action Plan should consider the cross-cutting impacts of migration in terms of gender equality, interculturality and intergenerational consequences (refer to Bergmann et al., 2021).

Policymakers could also consider integrating climate migration in other relevant frameworks to improve policy coherence. For example, integration is advisable in the National Strategy on Climate Change, the National Forest and Climate Change Strategy, the National Strategy for the Fight against Desertification and Drought, and the National Plan for Food Security and Nutrition, as well as the Climate Change Adaptation and Risk Management Plan for the Agrarian Sector.

Finally, Peru could use its foreign climate policy to foster action that prevents forced climate migration and supports affected people. For example, Peru could revive the Climate Ambition Alliance leading up to the Conference of the Parties in Glasgow in 2020 to raise the level of ambition in global emissions reduction, which could reduce climate impacts and forced migration. Peru could also champion initiatives within the Group of 77 and the Group of 24, for example, to build inclusionary cities for migrants, strengthen South–South cooperation on climate migration and generate adaptation funding to support dignified migration from areas where local adaptation is impossible.

Actions taken in this decade will be critical in determining the magnitude of future climate impacts and their migration outcomes in Peru. As rising climate impacts may make migration necessary in more regions of the country, Peruvian policymakers, civil society and international actors will need to join forces to protect people's dignity and preserve their agency in determining their future. Current policy developments present timely opportunities to address the climate–migration nexus.

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