SECURITY RISKS OF ENVIRONMENTAL CRISES

Environment of Peace
Part 2

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About the Environment of Peace research report

This research report is a product of the Environment of Peace initiative launched by SIPRI in May 2020. It sets out the evidence base that provided the foundation for *Environment of Peace: Security in a New Era of Risk*, a policy report published in May 2022. The report is published in four parts—Elements of a Planetary Emergency (part 1); Security Risks of Environmental Crises (part 2); Navigating a Just and Peaceful Transition (part 3); and Enabling an Environment of Peace (part 4)—as outlined below.

Elements of a Planetary Emergency

Part 1 lays out the conceptual and evidential landscape for Environment of Peace, bringing together data on a wide range of indicators, showing that both security and environmental stresses are increasing.

Security Risks of Environmental Crises

This part, part 2, shows how combinations of environmental and security phenomena are generating complex risks. Through a theoretical framework informed by the literature, Cedric de Coning, Research Professor at the Norwegian Institute of International Affairs (NUPI), and his team explore different pathways from environmental stress to conflict and how the darkening security horizon and environmental crises are interacting to generate different types of risk: compound, cascading, emergent, systemic and existential. The analysis is supported by numerous case studies, spanning a variety of social-ecological systems and different types of risks. This part of the report also discusses options for responding to these complex risks.

Navigating a Just and Peaceful Transition

Part 3 focuses on needed transitions towards sustainability and climate resilience, with special attention given to areas such as land use, energy and climate response.

Enabling an Environment of Peace

Part 4 examines the legal and institutional landscape within which the twin crises—and humanity's responses to them—play out.

Other related materials

Separate annexes assemble a number of in-depth case studies and other input papers that were commissioned to inform the research and analysis of the report. An annex corresponding to each part can be downloaded from the SIPRI website. A comprehensive overview of the report's four parts and the Environment of Peace initiative is also available at the SIPRI website.

2. SECURITY RISKS OF ENVIRONMENTAL CRISES

2.1. Introduction

The United Nations Secretary-General called the sixth assessment report of the Intergovernmental Panel on Climate Change (IPCC) a 'code red for humanity', noting that the evidence is irrefutable: 'global heating is affecting every region on Earth, with many of the changes becoming irreversible'.[1] His message is that climate change is not a future risk—it is already affecting every aspect of our collective lives, including our ability to sustain peace, prevent conflict and achieve satisfactory levels of human security.

The Environment of Peace research report considers how climate change and other environmental crises increase risks to peace and security, and how these risks can be managed to prevent conflict and sustain peace. This part, part 2 of the report, synthesizes some of the evidence on the implications of climate change and other environmental crises for peace and security. It begins by considering how climate change and environmental degradation are interlinked with peace, conflict and human security,[2] before proceeding to explore this relationship through three different lenses. The first lens sets out several pathways through which climate change and other environmental crises exacerbate existing social-ecological vulnerabilities. The second lens then considers how these interlinkages manifest across a broad spectrum of human-to-hard security risks. Finally, the third lens analyses how the interdependencies and entanglements between the social-ecological dimensions of ecosystems generate complex systemic, cascading and compounding effects. It ends by considering gaps between the nature of the risks identified and the relevant governance tools at our disposal.

Throughout, a variety of case studies are used to illustrate how climate change and environmental degradation are already impacting peace, conflict and human security, including migration in Central America; food shocks in North Africa; water security in Iraq; the gendered effects of climate change in the Lake Chad Basin, Mali and Somalia; farmer–herder violence in the Sahel; threats to environmental defenders in Latin America; raising sea levels in Fiji, Kiribatu and other Pacific small island states; transboundary water tensions in

the Indus and elsewhere; and the impact of climate change on the Arctic and the oceans.

2.2. The climate/environment–peace nexus

This second part of the Environment of Peace report analyses the relationships between climate change and other environmental crises, peace, conflict and human security, and the pathways through which these interlinkages manifest. Climate change refers to long-term changes in average weather patterns that manifest in local, regional and global climates, which can most commonly be observed in precipitation and temperature changes over time. Hence the goal of the Paris Agreement to limit global warming to well below 2 °C—preferably 1.5 °C—compared to pre-industrial levels. Environmental crises, on the other hand, refers to the effects of changes in the environment, such as direct environmental degradation caused by human behaviour. The planetary boundaries concept introduced in part 1 of the report identified eight such environmental effects: (*a*) stratospheric ozone depletion; (*b*) loss of biodiversity and biomass; (*c*) chemical pollution; (*d*) ocean acidification; (*e*) freshwater consumption and changes in the global hydrological cycle; (*f*) changes in land use; (*g*) nitrogen and phosphorus cycles; and (*h*) air pollution.

In Somalia, for example, climate change-related extreme weather events, such as droughts and floods, place additional pressure on food and water systems that are already under stress. This stress, and perceptions of future scarcity among communities dependent on rain-fed grazing or crops, can, in some cases, lead to violent conflict between communities over access to land or water.[3] An important message of this report is, however, that conflict is not inevitable. Climate change and other environmental crises can also trigger collaboration and cooperation, such as when communities or states agree to establish mechanisms to co-manage a natural resource.

In contexts where violent conflict occurs—for example, attacks by violent extremist groups on communities in the Sahel—a common outcome is the disruption and weakening of societal resilience, which in turn undermines adaptive capacity, making communities more vulnerable to the effects of climate change on water and food security.[4] In other contexts, such as Syria and Libya, the double burden of climate stress and violent conflict can compound the food insecurity experienced by communities. Over the past two years the Covid-19 pandemic has placed further pressure on the ability of such communities to produce or purchase food.[5]

In all these cases, one livelihood strategy that tends to increase in response to stress induced by climate change and environmental degradation is migration, both internally (particularly urbanization), regionally and internationally.[6] These linkages between climate change, environmental crises, and peace and security are not limited to countries already affected by conflict. In the North Sea, for example, melting sea ice could ease access for new, more

distant, fishing fleets, thereby increasing competition. Such tensions increase the risk of accidents or hostile acts, with negative side-effects for governance and security in the Arctic region.[7]

As a result of the research undertaken by the environmental peacebuilding community over the past three decades, it is now well established that climate change and other environmental crises can negatively affect livelihoods and food security; lead to migration and displacement; and contribute to conflict. Moreover, the reverse is true: war and conflict contribute to environmental degradation and the disruption of social-ecological system processes. Importantly, this research has also shown that the cooperative management of shared resources can contribute to peace.[8]

Some climate- and environment-related effects are direct and individual, such as the inability of humans to survive wet-bulb temperatures above 35 °C.[9] Others are direct and affect city or island communities, such as injuries and damages caused by sudden-onset weather events like tropical cyclones, or rising sea levels that will make some coastal cities and islands uninhabitable. A direct effect does not imply, though, that the outcomes of climate change or environmental crises are predetermined. As is discussed in parts 3 and 4 of this report, the severity of these effects can be influenced by measures aimed at increasing disaster preparedness and the management of natural resources, as well as other adaptation and mitigation strategies.

Most effects of climate change and environment degradation on communities and societies are, however, indirect, in that they are influenced by a variety of intermediate factors. For example, a drought may significantly alter the environmental conditions that two neighbouring communities, say in Iran and Afghanistan, depend on for their livelihoods. Despite both communities experiencing the same drought, the effect on each will be different depending on a number of social, economic and political factors. Let us assume that the community in Iran has a more diversified economy, a more inclusive polity and relatively well-functioning institutions, while the neighbouring community in Afghanistan is mostly dependent on agriculture and that their water management systems and other institutions have been weakened by conflict.[10] Here, it is likely that the latter community will be more vulnerable to the drought's impacts and that the disruptions they experience will be more severe. This will also likely be the case for particular identity groups within both communities, with women, for example, more severely impacted due to their gendered roles in agriculture and the provision of water, and their caring responsibilities towards children and the elderly.[11]

The key point is that although both these communities, and different identity groups within them, are exposed to the same drought, their vulnerability will vary according to a variety of factors, including the adaptive capacity and resilience of their social institutions. As will be discussed, strengthening these adaptive capacities in communities, societies and institutions (across local to global scales) offers an important means by which we can attempt to manage climate- and environmental-related security risks.

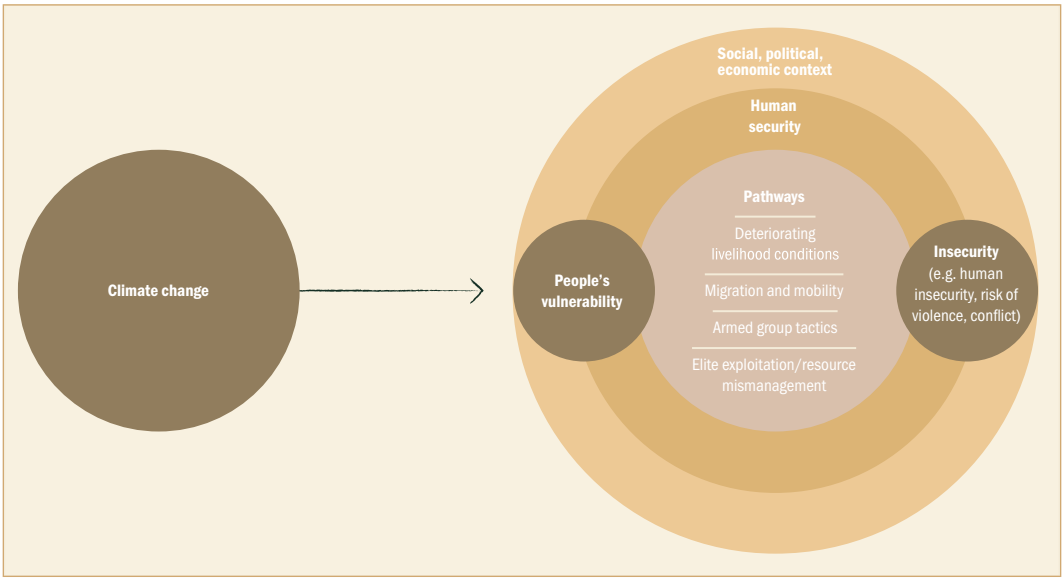

Figure 2.1. Pathways of climate insecurity

Source: SIPRI Climate Change and Risk Programme.

The relationship between climate change and other environmental crises on the one hand, and peace, conflict and human security on the other, are thus not linear or predetermined but mediated by the choices people and communities make.

One way to frame this finding is to explicitly state that climate change and environmental degradation do not cause conflict—people do. Climate change and other environmental crises shape the conditions under which people live and may exacerbate existing vulnerabilities, especially in terms of habituality and livelihoods. How people react and whether they choose to cooperate or compete—including in some cases resorting to violent conflict—depends on a number of additional factors. These include political, security, social and economic considerations, as well as dynamics such as power, agency, identity and gender. Recognizing that the outcomes of climate change and environmental degradation effects are not predetermined but rather depend on human agency is important, as it opens up opportunities for mitigation, adaptation and other forms of prevention or risk management.

2.3. The pathways between environmental stressors, peace, conflict and human security

One way of analysing the relationship between how climate change and environmental degradation affect communities and societies, and the choices they make in response, is to examine the pathways through which these effects impact conflict, peace and human security (see figure 2.1).[12] This section looks at four such interrelated pathways: (*a*) livelihood deterioration; (*b*) changing migration and mobility; (*c*) military and armed group actions; and (*d*) political and economic elite exploitation.[13]

2.3.1. Livelihood deterioration

The frequency, intensity and duration of extreme weather events are increasing under the influence of climate change.[14] In the Sahel, for example, climate change-related drought and variable seasonal rainfall are impacting water availability and soil quality.[15] Human factors, such as unsustainable agricultural practices, can further influence environmental degradation,[16] which has a negative impact on natural resource-dependent livelihoods.[17] Shifting transhumance routes due to changes in environmental conditions can increase competition over natural resources and the risk of clashes between herders and farmers over water and pasture. In Nigeria, conflicts between farmers and herders in 2018 resulted in six times the civilian fatalities than the conflict with Boko Haram.[18] Conflicts related to local-level resource scarcity can end up generating national-level or transboundary international security concerns.

At present, 2 billion people live in countries where fragility, conflict and violence undermine development.[19] When the pressure on an already fragile and conflict-prone society is further intensified by climate change-related stress on water and food security, the risk of violence escalates. Climate change can exacerbate the circular relationships between conflict and food insecurity, with negative consequences for community resilience. For example, the effects of drought and disrupted agricultural exports on global food prices contributed to the onset of the Arab Spring protest movements and, by extension, the conflict in Syria.[20] Resilient food systems are critical for building and maintaining stability in societies vulnerable to conflict. Boosting local livelihoods also makes individuals less prone to recruitment by armed groups. Peacebuilding initiatives aimed at strengthening social cohesion can have a positive spin-off for community resilience to climate change, while initiatives aimed at enhancing communities' adaptive capacity to climate change can have a positive spin-off for community resilience in preventing or managing conflict.[21]

Climate change and environmental degradation can contribute to resource scarcity and deteriorating livelihoods, which in turn can contribute to communal conflicts. Contexts characterized by weak governance, low social cohesion and a lack of livelihood options are at greater risk of conflict. One pathway linking climate change and environmental degradation to conflict and declining human security is thus livelihood deterioration and food security. Although climate- and environment-related livelihood deterioration does not necessarily lead to violent conflict, when coupled with other factors it can exacerbate existing vulnerabilities and so increase the risk of conflict. Thus, how we prepare for and manage these threats can reduce risk, enhance cooperation and sustain peace. Managing and resolving the world's energy–water–food nexus requires significant investments in cooperation (see box 2.1).[22] A collaborative and participatory process of building resilient food systems can also strengthen collective action and align the interests of a broad coalition of relevant actors in the food system.[23]

BOX 2.1. THE WATER–ENERGY–FOOD NEXUS

The world's water, energy and food systems are closely interconnected through mutually interdependent biological, hydrological, socio-political and technological relationships. Water, for instance, represents an essential input for agriculture, fisheries and food processing. It is also used extensively in the energy sector to generate hydroelectricity and cool thermal power plants, and for fossil fuel extraction. Likewise, producing, preparing, shipping and storing food requires energy, as does pumping water from sources to users, treating wastewater and desalinating seawater. Agricultural practices—what crops to grow, how, and where—affect local water cycles and water quality. In addition, many crops can be turned into energy as biofuels. Resource managers characterize these interdependencies as composing the water–energy–food nexus.[a]

Relationships among water, food and energy systems are complex. Decisions in each sector—such as whether to devote limited water resources to agricultural, municipal or industrial uses—can create both synergies and trade-offs with other sectors (municipal and industrial wastewaters, for example, can often be recycled for irrigation).[b] Water, food and energy policies likewise intersect with choices and challenges in other systems, such as land use, livelihoods and the Sustainable Development Goals.[c] Comprehensive approaches that integrate governance deliberations and engage relevant stakeholders throughout the water–energy–food nexus can help in identifying and leveraging synergies, more effectively navigating trade-offs, and ensuring resource security across all three sectors.[d]

[a] Salam, P. A. Et al. (eds), *Water–Energy–Food Nexus: Principles and Practices* (American Geophysical Union/ Wiley: Washington, DC, 2017).

[b] Kurian, M., 'The water-energy-food nexus', *Environmental Science & Policy*, vol. 68 (Feb. 2017); and D'Odorico, P. et al., 'The global food–energy–water nexus', Reviews of Geophysics, vol. 56, no. 3 (Sep. 2018).

[c] Biggs, E. M. et al., 'Sustainable development and the water–energy–food nexus: A perspective on livelihoods', *Environmental Science & Policy*, vol. 54 (Dec. 2015); and Stephan, R. M. et al., 'Water–energy–food nexus: A platform for implementing the Sustainable Development Goals', *Water International*, vol. 43, no. 3 (Apr. 2018).

[d] Albrecht, T. R., Crootof, A. and Scott, C. A., 'The water–energy–food nexus: A systematic review of methods for nexus assessment', *Environmental Research Letters*, vol. 13, no. 4 (Apr. 2018); and Simpson, G. B. and Jewitt, G. P. W., 'The Development of the water-energy-food nexus as a framework for achieving resource security: A review', *Frontiers in Environmental Science*, vol. 7 (Feb. 2019).

2.3.2. Changing migration and mobility

Climate change and environmental degradation can affect food security, and when people are no longer able to sustain themselves one adaptation strategy is to move elsewhere in the hope of being able to produce or find food. Climate change and environmental degradation can also directly contribute to forced displacement or migration, such as when rising sea levels make coastal regions and islands uninhabitable. Extreme weather events are contributing to unprecedented levels of migration and displacement, with 30 million people forced to flee their homes due to weather-related disasters in 2020 alone.[24] According to a 2021 World Bank report, climate impacts are expected to contribute to the movement of more than 216 million people by 2050.[25]

The IPCC warns that climate change and related ecological and environmental factors will amplify the security challenges associated with displacement, mobility and migration.[26] When people are on the move there is increased risk of communal conflicts and other human security hazards, including exposure to organized crime. One particular risk is that new arrivals

and host communities may have to compete for scarce resources, with this rivalry potentially leading to violent conflict. Even when the reasons for migration are not environmental, displaced populations may be at risk from climate hazards. After 700 000 Rohingya fled Myanmar in 2017 in response to violent conflict, they found themselves threatened by storms and cyclones in their new location in Cox's Bazar in Bangladesh, raising human security concerns.[27]

The proximate effects of climate change on neighbouring countries can lead to migration pressures and political instability in transit and host countries. For example, the United States and transit countries such as Mexico are affected by the climate-related migration pressures and instability that originally manifested in Central America and countries such as Haiti in the Caribbean.[28] Similarly, Europe is subject to migration pressures and spillover problems from the Sahel, North Africa and the Middle East, given its proximity to these regions.[29] Climate change and environmental degradation contributed to the complex set of drivers that triggered the war in Syria.[30] More than 6 million people fled the war and humanitarian crisis, overwhelmingly to the neighbouring countries of Turkey, Lebanon and Jordan, although approximately 600 000 ultimately resettled in Germany and elsewhere in Europe.[31] In the European context, fears of increased migration have stimulated xenophobic politics and empowered right-wing political parties, elevating the importance of migration as an issue.[32] In October and November 2021 Belarus even used directed migration as a means of threatening neighbouring Poland and increasing the pressure on the European Union. Migration thus constitutes another pathway linking climate change, environmental crises, peace, conflict and human security.

The pathways linking climate change and environmental degradation on the one hand and peace, violent conflict and human security on the other cannot be understood, however, without taking social, economic and political considerations into account.[33] When violence ensues, which is rare, it is due to the choices people make, not as a direct or predetermined effect of ecological, climate or environmental changes. For example, facing additional climate change-related stress on their livelihoods, people in Central America or Syria may choose to migrate, resulting in tensions between new arrivals and host communities over access to land, water and other resources. Here, a distinction must be drawn between the physical effects of climate change and the choices people make in response to them. These choices are informed by political, security, social and economic considerations, and influenced by power, agency, identity and gender.

While the decision to move is an adaptation choice made in response to changes in the environment and their impact on livelihood options, the conflicts people get involved in arise from the choices they make in their relationships with groups or communities encountered along the way. In other words, changes in the environment may necessitate adaptation, but *how* people adapt is informed by additional influences and considerations. This is

an important observation, as it means that violent conflict is not inevitable and points to opportunities for conflict prevention and management.

2.3.3. Military and armed group actions and political and economic elite exploitation

Both the military and armed group actions and the political and economic elite exploitation pathways provide further examples of how people choose to respond to a given crisis. Climate change and environmental factors shape the terrain in which military and armed actors operate, thus influencing the operational and tactical choices they make.[34] Livelihoods pressures may also mean people are more likely to join armed groups as a source of income, or it may make them more vulnerable to recruitment.[35] In addition, livelihood pressures increase the risk of people turning to smuggling, illegal mining or cultivating such crops as opium poppies in Afghanistan or coca in Colombia, thereby increasing the pressure on law enforcement and providing opportunities for organized crime.[36]

Political and economic elites may, in some contexts, be linked to organized crime or find other ways to gain from the disruptions caused by climate change and other environmental crises.[37] Alternatively, they may simply find themselves under stress when it comes to operating their businesses or practising politics. The effects of climate change or environmental crises can profoundly influence politics—as seen in the impact migration has had on domestic politics in Europe—and even lead to elections being postponed. The choices military/armed actors and political/economic elites make can either increase inequality, marginalization and insecurity, or, conversely, strengthen social cohesion and cooperation, which in turn leads to greater stability. When it comes to managing the effects of climate change and environmental degradation, therefore, these choices impact whether the resilience and adaptive capacities of societies are strengthened or undermined.[38]

Inequalities can shape who experiences increased risks when such choices are made. Gender is important to consider in efforts to prevent or mitigate climate-related security risks. Dynamics related to climate change, peace and insecurity are not gender-neutral, and will affect women, men, girls and boys in different ways.[39] Gender norms and inequalities influence access to resources, mobility and formal roles in public spaces. They shape who is affected by violence and in what ways.[40] Gender intersects with other identity markers, including ethnicity, age, disability, sexual orientation and class, to compound or heighten risks related to climate change and insecurity.[41] Efforts to address security risks related to climate change and environmental degradation must not only consider the specific risks faced by different genders, but ensure the equal and meaningful participation of women and girls in tackling all risks.[42]

Female-headed households are especially vulnerable to the effects of climate change in societies dependent on agriculture, as the gendered roles

imposed on women and girls often mean they are responsible for gathering natural resources such as firewood and water. Social expectations and biases may inhibit women's and girls' mobility when it comes to accessing resources, impeding their ability to adapt to deteriorating livelihoods. Given women are on the frontline of climate change, they often lead or have considerable influence on local adaptation efforts.[43] Similarly, women can play important roles in peace processes, with their expertise and leadership key to successful, inclusive and sustainable adaptation/mitigation solutions.[44]

This section has shown how climate change and other environmental crises can relate to peace, conflict and human security through a number of interrelated pathways. In doing so, it has focused on livelihoods, food security, displacement and migration, as well as touching on military/armed group actions and political/economic elite exploitation. Moreover, it has considered how the effects of these pathways may vary depending on gender roles and other inequalities. While this is not an exhaustive list, it offers insights into the different pathways through which climate and environmental changes relate to peace, conflict and human security. The next section delves deeper into how these effects manifest in different forms of insecurity across the human-to-hard security spectrum.

2.4. Climate and environmental-related risks across the human-to-hard security spectrum

Changes in our climate, ecological and environmental systems trigger not only conventional hard security problems for states stemming from the risk of violent conflict but also broader risks related to human security, both for individuals and societies. Over the past few decades, researchers, policymakers and practitioners have become increasingly aware of the complex interdependencies between, on the one hand, climate change and other environmental factors, and, on the other, various dimensions of human security.[45] These range from adverse effects on people's health and livelihoods to significant disruptions affecting social-ecological systems, leading in turn to displacement, death and injury.

Climate change and environmental degradation pose security risks that extend beyond violent conflict, which has largely been the focus of the climate security literature thus far.[46] While concerns about armed conflict undoubtedly remain a priority, there are other risks to peace and security arising from environmental crises. This broader perspective is a major theme of the emergent practice of ecological[47] and environmental security,[48] as well as the broader field of environmental peacebuilding.[49]

At one end of the scale are large-scale risks to humanity, where environmental crises threaten large-scale loss of life or pose fundamental threats to a community's way of life.[50] This encompasses both existential risks to humanity (or at least parts of it) and concerns about large numbers of

people being at risk of death in the wake of environmental events and related instability or conflict.[51] Large-scale risk of death implies a degree of severity that distinguishes security threats from other kinds of societal problems. This focus on loss of life allows us to look beyond violent conflict as the sole security concern in a world where pandemics and extreme weather events are responsible for a significant share of mortality.

At the other end of the scale are risks to individuals. Heatwaves, wildfires and floods already affect the lives of millions of individuals in both developed and developing countries. One category that stands out in this regard is environmental defenders.[52] In 2020 the murder of environmental defenders accounted for an estimated 69 per cent of all human rights defenders killed.[53] Indeed, the year was the deadliest on record for environmental defenders, with 227 killed.[54] Latin America is consistently the worst-affected region per capita in this regard. The main natural resources fuelling the killing of defenders are mining and extractives, logging, land, water and dams.[55] Women environmental defenders constitute almost 10 per cent of total killings, with a growing proportion of women killed since 2010.[56] The violence and discrimination directed at women draws on deeply rooted gender norms to trivialize their work, contributing to alienation in communities and making it difficult for them to access support services.[57]

2.4.1. Human and hard security in the Arctic

Emerging evidence of the effects of climate change on the global environment has underscored the fact that the polar regions are bearing the brunt of changes in temperature and weather patterns.[58] Ice erosion, warmer conditions, weather extremes, wildfires, and physical and biological changes are being observed with greater regularity at both poles, but in the Far North—with approximately four million people living above the Arctic Circle—climate change has taken on a much more pronounced security dimension. Discussions about the amplification effects of these changes, as well as whether the Arctic has reached a 'tipping point', have become commonplace.[59] As a result, countries in the Arctic, including the USA and the Russia, are starting to frame the region in relation to strategic risks. At the same time, non-Arctic states, including countries as disparate as the United Kingdom, China, Germany, India and Japan, are beginning to perceive the Arctic as a current or potential source of insecurity.[60]

Security risks in the Arctic offer a good example of the two distinct but connected categories of human and hard security, with both directly connected to climate change phenomena.[61] As the Arctic continues to warm, there have been effects not only on traditional lifestyles and customs but also on food security and out-migration. Many specific effects of climate change, including loss of permafrost, have impacted local communities.[62] Moreover, it has been predicted that the population of the Arctic will not grow at similar rates to other parts of the world (and this process will be uneven), and that there will be trends towards greater urbanization and older populations.[63] Other

aspects of individual-level security in the Arctic, including those pertaining to development, education and health, have also intersected with environmental changes in the Far North, while the Covid-19 pandemic has further highlighted the region's fragility and isolation.[64]

It can be argued that for much of the immediate post-cold war period, and arguably up until about a decade ago, it was this interpretation of security that dominated the policy discourse in the Arctic, leading to the concept of 'Arctic exceptionalism'—namely that the region was insulated from the hard security concerns dominant elsewhere in the world.[65] The Arctic Council and various other initiatives aimed at promoting cooperation in the Far North were cited as proof that the region presented too negative a cost/benefit ratio for overt competition. Assuming that this exceptionalism existed in the first place (a subject of much debate), the widespread perception is that hard security has now become an important concern, taking the form of rivalries over resources and influence in regional affairs that involve both Arctic and non-Arctic actors.[66] As the ice cap surrounding the North Pole becomes ever smaller,[67] especially in summer months, so the attention of several governments has turned towards access to resources and transportation routes.

The concern, however, is that this trend increases the risk of 'zero-sum' thinking in the region regarding security, rather than the 'positive-sum' (everyone can win) approach to human security and environmental threats that has characterized many aspects of regional cooperation, including within the Arctic Council. For example, the prospect of extracting fossil fuels in the Arctic became attractive in the years leading up to the drop in global fuel prices in 2014.[68] In particular, Moscow has placed an onus on developing oil and gas in the Russian Far East and Siberia in the hopes of reviving the country's financial fortunes, despite ongoing economic pressure from the West. If there is a dramatic rebound in fossil fuel demand in the short term,[69] this will place considerable pressure on Arctic governments to again consider the Far North as ready to be opened to the extractive industries, despite environmental concerns and questions concerning the effects on local populations.

In addition to energy, other raw materials have become more attainable in the Arctic. One example is the ongoing attractiveness of Greenland as a source of key metals and minerals, including the rare earth elements (REEs) essential for high technological and 'green tech' applications. Access to REEs has become highly securitized recently due to worsening diplomatic situation between the USA, its allies, and China, with the latter a major source of REEs for the global market. Greenland's mineral wealth—now seen as well within reach due to ice sheet erosion and the loss of the surrounding sea ice that previously impeded maritime traffic—has caught the attention of numerous governments, including the USA and China.[70] It has also factored into current debates in the country about the timetable for independence from Denmark. Under the terms of the 2009 Self-Rule Act between Copenhagen and Nuuk, Greenland achieved the right to self-determination and declare independence,

although Copenhagen currently retains oversight of Greenland's defence and foreign policy.[71] The interest shown by Chinese firms in Greenlandic investments has prompted jitters in both Denmark and the USA, while the hapless attempt by the Trump administration to purchase Greenland from Denmark in 2019 further underscored the security implications of access to the island's resources.[72] Although the current Greenlandic government under Prime Minister Múte Egede has sought to dampen plans for future mining and oil drilling,[73] it remains to be seen whether this policy can be maintained in the face of increased international pressures.

Another implication of the loss of the Arctic ice cap has been greater access to northern fish stocks—traditionally a sore point in regional diplomacy (a notorious example being the 'cod war' disputes between the UK and Iceland in the 1950s and 1970s).[74] In June 2021, however, the 'International Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean' came into effect, placing a moratorium on commercial fishing in the area for 16 years, with options to renew. In addition to being supported by Arctic littoral states (Canada, Denmark/Greenland, Iceland, Norway and Russia), the pact was supported by China, the EU, Japan and South Korea.[75] This agreement may very well emerge as an early 'acid test' when it comes to determining whether developing environmental agreements in the Arctic can withstand economic pressures.

In addition to resources, the opportunities presented by the opening of the Arctic Ocean to the international community include the appearance of new transit routes that may eventually connect East Asia, Northern Europe and North America. Long considered impassable due to ice conditions, Arctic passages—including the Northern Sea Route (NSR) connecting Asia and Europe via Siberian waters, and the Northwest Passage (NWP) in the Canadian Arctic Archipelago—are now viewed as emerging secondary maritime routes. This has led to a number of political and legal complications, including over regional sovereignty and the potential for militarization, with these routes perceived to be assets requiring protection from outside interference. The Putin government has placed great emphasis on developing the NSR as part of developing a 'Polar Silk Road' in partnership with China, and has begun moving military personnel and material to Siberia to better monitor the region.[76] In keeping with the concept of the 'security dilemma', however, these moves—which Moscow stresses are for defensive purposes—have been interpreted by the USA and its North Atlantic Treaty Organization (NATO) allies as assertive in nature, with NATO itself looking for ways to respond.[77] As a result, there is a strong possibility of military competition for influence over ever-expanding areas of open water in the Arctic.

From a legal viewpoint, disputes over maritime boundaries previously considered a low priority have been pushed to the forefront of regional affairs due to more of the Arctic being navigable for longer durations. These include the dispute between Russia, Canada and Denmark/Greenland over the legal status of the Lomonosov Ridge, an underwater feature that

stretches to the North Pole itself and is claimed by all three actors as an extension of their respective continental shelves.[78] Any verdict on this matter would have considerable implications for both the economic and political future of the region, especially given the high priority Moscow has placed on developing its part of the Arctic. In addition, the status of the NWP has been a longstanding point of contention between Ottawa and Washington, with the former perceiving the passage as internal waters and the latter maintaining it is an international waterway. The tacit 'agree to disagree' stance between the two government was disrupted when then-US Secretary of State Mike Pompeo referred to Canadian claims as 'illegitimate' in a 2019 speech.[79] With the passage opening up, this policy difference will become increasingly difficult to ignore. While such disputes have thus far remained strictly in the diplomatic realm, the possibility of spillover into the security sphere cannot be discounted, especially if demand for resources intensifies in the near term.

Looking further into the future, there is the issue of sovereignty concerns in the Central Arctic, which at present remains largely impassable save for specialized vessels. Predictions have been made that the Central Arctic may become ice-free in summer months as early as 2035,[80] which would have considerable political as well as environmental implications, given that the middle of the Arctic Ocean—often nicknamed the 'doughnut hole'—rests outside the exclusive economic zones of littoral states and therefore, from a legal perspective, constitutes 'open waters'. Some states have already begun preparations for the day when ship traffic near the North Pole region becomes a reality. China, for example, has indicated—including in its seminal 2018 Arctic policy white paper—that it will seek to make use of the Central Arctic as a regional maritime trade route once circumstances allow.[81] While it remains unlikely that the Arctic will evolve into a maritime trade corridor of the magnitude of, say, the Indian Ocean, its attractiveness as a time- and fuel-saving link between Northern Hemisphere markets will mean sea traffic increases in what is already an environmentally delicate region.

In sum, the economic potential of the Arctic can be observed from several angles, resulting in a rethinking of security perceptions not only by Arctic governments, but several countries outside the region. While China may be at the forefront of non-Arctic states seeking to engage the region, it is far from alone, with several countries in Asia and Europe calling for a greater say in Far Northern affairs, pointing variously to their long histories of exploration and scientific cooperation in the region, their specific environmental concerns, or their need to partner with Arctic states for economic development initiatives.[82] Thus, another strategic side-effect of climate change in the Arctic is that the dividing line between 'Arctic' and 'non-Arctic' actors has become blurred and open to political interpretation.

When examining the overlap between climate change and security in the Arctic, as well as the risks presented, several levels of analysis are required. Firstly, it is important to avoid a state-centric approach to understanding this connection, given that many threats to security in the Arctic exist on an

individual or local level, making it important to distinguish who precisely is being placed under threat by regional environmental conditions. In addition, the Arctic should not be regarded as a blank space at the top of the globe, disconnected from other global environmental concerns. Finally, it is necessary to acknowledge that even with the (debatable) 'turn' to hard power security thinking in the Arctic, the risks posed by climate change affecting the region's populations have not gone away. Addressing insecurities in the Arctic cannot be addressed separately from climate change, nor should it.

2.4.2. Warming, extreme temperatures and human habitability

Heatwaves are dangerous episodes that can lead to death, particularly for vulnerable individuals such as the elderly, the homeless, day labourers who work outside and the poor, who may not have recourse to escape the heat by sheltering indoors in air conditioning. In such circumstances, countries and regions that historically have not had air conditioning may experience large-scale loss of life, as France did in 2003 when a summer heatwave killed as many as 15 000 people.[83] A study in the *Lancet* estimated that in 2019 there were 356 000 deaths worldwide attributable to excessive heat through effects such as dehydration and cardiovascular strain.[84]

Another study examined the historical climate niche within which human society has evolved. Depending on the global warming and population growth scenarios considered, the study projected that, by 2070, some 1–3 billion people will live in areas where mean annual temperatures exceed 29 °C (84 degrees Fahrenheit)—currently, it is largely only in the Sahara Desert that mean annual temperatures top this figure.[85] Such temperatures are well beyond the conditions suited to the agricultural and economic production that have so far supported human development. Other studies have examined humans' physiological adaptability to warmer temperatures. A technical measure called the wet-bulb temperature combines both heat and humidity, reflecting the fact that higher combinations of these factors make it more difficult for the body to cool down. Theoretical analyses have determined the upper bound for human survivability is a wet-bulb temperature of 35 °C, though empirical experiments suggest the thresholds of human adaptability under different conditions may be closer to 25–31 °C wet-bulb.[86] In 2015, for example, more than 3200 people perished in a heatwave striking India and Pakistan that witnessed temperatures of 25–36 °C wet-bulb.[87] Climate projections suggest that by 2100, 75 per cent of South Asia's population may be exposed to heatwaves surpassing 31 °C wet-bulb.[88]

While in some parts of the world climate change will manifest as a dangerous combination of high heat and humidity, other parts of the world will face high temperatures and drought. The IPCC's Sixth Assessment Report finds that climate change has almost certainly led to more heatwaves and has likely increased the chance of compound heatwaves and droughts.[89] Under these conditions, not only is the heat itself dangerous, but greater and chronic risks of wildfires may make it increasingly dangerous for people to reside in

certain areas. Severe wildfires have been visible in recent years, including the devastating bushfires that swept Australia in 2020 and various fires across the Mediterranean, including in Lebanon, Turkey and Greece. Extensive fires have also buffeted other forests not typically thought of as subject to wildfire risks, including the Amazon and Siberia. Meanwhile, the western USA is now experiencing year-round fire risks rather than the typical fire season, with the dangers exacerbated by the growth of communities adjacent to forests. In 2018 the Camp Fire in California claimed some 85 lives and led to damages in excess of $16.5 billion.[90] Should these fire risks become persistent, with places experiencing repeated burns, communities may struggle to find insurance and so rebuild after repeated fires.

There are a range of possible mitigation and adaptive responses to heat-related climate risks. The Indian city of Ahmedabad, for example, launched a Heat Action Plan in 2013 after a 2010 heatwave led to more than 1000 deaths. The plan includes early warning red-alert text messages, building more reflective cool roofs to reduce urban heat-island effects, and efforts to supply water and have hospitals on standby during periods of high temperature.[91] Broader use of air conditioning is another adaptive response that can help shield people from high temperatures. Widespread adoption of inefficient units powered by fossil fuels will, however, only make the climate problem worse. Other maladaptive responses have been considered in some countries, including air conditioning outdoor places like stadiums.[92] Regarding wildfires, communities can reduce risks through, among other measures, urban design that reduces dry tinder near buildings. Though these risks can be managed in the short run, reducing them in the long run will require effective emissions mitigation capable of reducing expected global warming to less than 2°C, as stipulated in the Paris Agreement.

2.4.3. Health and zoonotic disease

Human development, health and environmental change are closely related. As several syntheses have noted in recent years, climate change is likely to have numerous direct and indirect effects on human health across the world.[93] Land use change, climate change, and loss of biodiversity and ecosystem services interact in ways that endanger people's health and wellbeing, increasing their exposure to both infectious and non-infectious disease,[94] water scarcity, food scarcity, natural disasters and population displacement.[95] Understanding the drivers—such as loss of forest cover, construction of water systems, urbanization and demographic change—behind increased disease risks such as zoonoses (see box 2.2) hence becomes critical.

If we think of security threats as constituting profound risks to both lives and ways of life, then disease outbreaks rise to the level of security threats.[96] It was this concern that prompted President Obama to commit up to 3000 troops to West Africa in order to fight the Ebola virus in 2014.[97] While we may think of this as a public health emergency that metastasized to become a global security threat, there are likely environmental roots to the Covid-19

BOX 2.2. ZOONOTIC DISEASES

A zoonotic disease is any disease or infection that can be naturally transmitted from vertebrate animals (mammals, birds, fish, reptiles and amphibians) to humans. Most known human pathogens—the germs that cause infectious diseases—originated in animals. Zoonotic diseases (zoonoses) can be transmitted to humans directly through the air, such as with avian influenza, or through animal bites and saliva, as is the case for rabies. Transmission can also occur indirectly through a 'vector', such as ticks or mosquitoes that carry the pathogen from animals to humans. Many major diseases, ranging from tuberculosis and typhus to dengue, Ebola and SARS, are zoonotic. At least 250 zoonotic diseases have been recognized in the past 70 years, and some 60–75 per cent of newly emerging diseases are zoonoses.[a]

[a] Rahman, Md. T. et al., 'Zoonotic diseases: Etiology, impact, and control', *Microorganisms*, vol. 8, no. 9 (Sep. 2020).

outbreak. This has been the case for such recent disease outbreaks as Ebola, SARS and MERS, where zoonotic transfer from wild animals came about in part because of increased incursions by humanity into natural areas and the handling of wildlife.[98]

Public health researchers have long been concerned that climate change and rising temperatures are expanding the range of disease vectors like mosquitoes and ticks, which spread diseases such as dengue, malaria and Lyme disease.[99] Expanded rates of insect-borne diseases will not necessarily rise to the level of security problems unless they produce especially severe consequences. The Covid-19 crisis has led to wider appreciation of the connections between environmental change and human health. Moreover, Covid-19 is not simply a global health crisis but an international security problem of the highest importance.[100] While conventional security practitioners may question the labelling of Covid-19 and zoonotic transfers as threats to peace and security, the economic and social dislocation of Covid-19—let alone the millions of deaths—represents perhaps the most consequential shock to the international order since the 2008 financial crisis, and perhaps even the cold war.[101]

The Covid-19 crisis is likely a harbinger of possibly more severe risks of zoonotic transfer. There are as many as 10 000 candidate animal viruses with zoonotic potential.[102] While Covid-19 spreads relatively easily, it is less lethal than other harder-to-spread viruses like Ebola, which can kill as many as half of those infected.[103] These disease outbreaks are linked to environmental degradation both through how wild animals are trafficked and sold in wet markets, and the increased interaction with animals resulting from humans penetrating deeper into forested environments.[104] As Schoonover and colleagues write in their foundational report on ecological security, 'the systemic shock arising from Covid-19 throughout 2020 and beyond is a brutal illustration that nations can incur mass casualties, economic devastation, and social disruption that surpass violent conflicts'.[105]

Conservationists and health professionals have seized on Covid-19 to promote 'One Health',[106] a new approach to the environment and health that combines concerns about food safety, antibiotic resistance, wildlife trafficking, conservation and public health in an integrated approach.[107] The One Health approach is not a conventional security agenda, but if we accept that the health impacts of disease can rise to the level of security concerns—as the UN Security Council did with AIDS, Ebola and Covid-19[108]—then avoiding future pandemics and their drivers (including protecting wildlands, reducing wildlife trafficking and improving food safety methods) are high-priority action items from a security perspective.

2.4.4. Sea-level rise and extreme weather events

In the most extreme cases, ecological and environmental changes may pose fundamental risks to human survival. The IPCC, with a high degree of confidence, warns of severe harm and loss due to climate change-related hazards in large urban and rural areas in low-lying coastal regions.[109] Atoll countries such as Kiribati and Tuvalu, with most of their territory scarcely above sea level, are especially vulnerable to salt-water intrusion, storm surge and inundation. Given this, they may become uninhabitable long before sea levels overtop their territory. Such environmental threats are more real and existential for these countries than armed conflict. In an interesting step to mitigate future risk, Kiribati has acquired land in Fiji to supplement its agriculture, in case it becomes impossible to produce enough food on Kiribati.[110] If this scenario comes to pass and the plan works, the people of Kiribati may be able to continue living on the island beyond the point when salination levels make it impossible to grow food there.

These risks are not limited to low-lying island countries. Coastal populations face profoundly difficult choices as sea-level rise and coastal flooding accelerate decisions about managed retreat and relocation. Many of the largest cities in the world are coastal cities. While the survival of larger countries may not be challenged, communities along the coasts—where many people live—face many of the same risks, potentially requiring relocation inland or costly engineering projects to shield them from storm surge, cyclones and tidal activity. Moreover, though sea-level rise is part of the reason many coastal communities are exposed, land use changes—including building in flood plains and loss of natural drainage, such as mangroves—have enhanced coastal vulnerability, as well as the sheer explosion in coastal populations around the world.

Assessing these future risks requires projections of both future emissions and concomitant sea-level rise. In 2019 a study identified ways of correcting bias in digital elevation models in order to estimate how many people were likely to be living in expanded flood zones under different climate change scenarios. The study's high-emissions scenario estimated that some 340 million people would be living below annual flood levels (that is, below high tide) by the middle of this century, up from 250 million presently.[111]

Another study estimated that 625 million people lived in low-elevation coastal zone (less than 10 metres above sea level) in 2000. That number is expected to expand to between 879 million and 950 million by 2030, depending on population growth.[112]

Take the USA as an example. Native populations, who have long faced discrimination and marginalization, face these existential challenges too, from melting permafrost in Alaska to rising seas in the Pacific Northwest to a variety of other hazards that are increasingly making life on already marginal land less tenable.[113] Coastal towns in Louisiana, such as Jean Lafitte, face combined challenges from sea-level rise, subsidence, salt-water intrusion and erosion, raising difficult questions about how much money can and should be spent trying to save coastal communities. Louisiana's $50 billion plan to restore coastal wetlands and help guard against flood risks may not be enough to save some communities, who will instead have to be relocated.[114]

While sea-level rise poses a medium-run challenge to human habitability in some places, the necessity of making hard choices is being accelerated by swift-onset hazards from storms and cyclones/hurricanes/typhoons. Coastal populations in the USA—along the eastern seaboard from Florida to New York, as well as the Gulf Coast—face severe risks from storms and hurricanes, with notable examples including Hurricane Katrina, which devastated New Orleans in 2005, and Hurricane Sandy, which battered the East Coast in 2012. In 2017, three storms—hurricanes Harvey, Irma and Maria—smashed different parts of the Gulf Coast, together causing more than $250 billion in damages as well as thousands of deaths, and requiring the US military to mobilize thousands of troops for humanitarian operations.[115] Moreover, Hurricane Maria destroyed the electricity grid on the island of Puerto Rico, a US territory, leading to thousands of Puerto Ricans suffering without electricity for months.[116]

These risks are not unique to the USA. Densely populated areas off the Bay of Bengal bordering India, Bangladesh and Myanmar have experienced intense cyclonic activity, with large-scale loss of life historically, though India and Bangladesh have done a much better job of preparing for and responding to cyclones.[117] Myanmar, for its part, experienced the catastrophic loss of approximately 140 000 lives when Cyclone Nargis devastated the Irrawaddy Delta in 2008, as the country was ill-prepared, responded fitfully and obstructed the arrival of international assistance.[118]

Some of these risks can be managed with early warning systems, cyclone shelters and other adaptive responses involving climate-proof infrastructure. The enhanced risks of cyclones, however, along with sea-level rise, may exacerbate the habitability problems of some coastal locations, prompting difficult choices about managed retreat. For large countries with adequate land this may prove a manageable task, provided the country has the resources to facilitate movements away from vulnerable areas.

For small islands with limited land the need to move will be more difficult still, as this will likely involve a whole country uprooting itself and finding other

countries willing to take its citizens in. A host of challenging questions for the international system will ensue in terms of sovereignty.[119] Can countries that cease to be viable re-establish themselves as sovereign entities inside other states? If they relocate, will they lose the right to control their territorial waters and exclusive economic zones? These may seem like distant problems, but the Pacific Islands Forum—a coalition of 18 island nations and territories in the western Pacific—is already thinking ahead. In a 2021 declaration, they argued for permanent maritime borders even if their countries shrink in size due to climate change.[120]

2.4.5. The gendered effects of conflict in Lake Chad, Mali and Somalia

Dynamics related to climate change, environmental degradation, peace and insecurity are not gender-neutral and will affect women, men, girls and boys in varying ways.[121] Gender shapes power relations between and within different groups, with gendered norms and inequalities influencing resource access, mobility and formal roles in public spaces. Gender can influence who is affected by violence and in what ways,[122] and can intersect with other identity markers—including ethnicity, age, disability, sexual orientation and class—to compound or heighten risks related to climate change and insecurity.[123]

Equal and meaningful participation by all affected demographics is important when it comes to addressing security risks related to climate change and environmental degradation. Women and girls are often excluded from formal decision making surrounding climate change and insecurity, despite the importance of their participation and leadership in addressing these issues. This is crucial not only for their own human rights and security, but also for wider community wellbeing and human security.[124] Broadly, gender inclusion correlates with higher-quality and more sustainable peace.[125] Furthermore, in certain contexts, women and girls' localized knowledge of natural resources can improve household and community adaptation to climate change.[126] This section provides examples of where climate change and other environmental crises have influenced the security contexts in Lake Chad, Mali and Somalia, and how gender shapes how different individuals are affected by and respond to these dynamics.

In Lake Chad, Mali and Somalia, gender can influence the role played by livelihood deterioration and displacement in increasing an individual's susceptibility to armed group recruitment. In Lake Chad, extremist groups exploit poverty and livelihood loss in the basin to recruit people into their ranks.[127] Gender may affect why different men and women join these groups, with men and boys joining to gain status and acquire the income needed to marry and act as head of household—rewards otherwise denied them due to limited traditional livelihood options.[128] Women and girls, meanwhile, may join due to promises of education and empowerment, or to participate in expected social change. They may also elect to stay with or return to the groups in lieu of

living in internally displaced persons (IDP) camps, which are often associated with a high risk of sexual and gender-based violence (SGBV) and dependence on aid organizations.[129]

In Somalia, boys and young men are mainly subject to recruitment into insurgent groups such as al-Shabab—or any of the more than 60 armed militia groups that operate in the country. They are often at increased risk of recruitment in IDP camps, which have grown in Somalia due to conflict and climate-related factors, including flooding and droughts.[130] Livelihood pressures may also prompt young men and women to join, with al-Shabab offering young male recruits an income, increased status and greater marriage prospects.[131] Some research also suggests that while there have been many cases of forced marriage to al-Shabab militants, for some women and families marriage to an al-Shabab fighter offers the potential for increased financial stability.[132]

In Mali, there is evidence that increasing resource scarcity and related livelihood impacts arising from climate change pressures, population pressures and conflict may contribute to recruitment opportunities for armed non-state actors and criminal groups.[133] In particular, the economic incentives to join armed groups may increase in cases where resource scarcity affects livelihoods.[134] Gender norms influence the roles recruits are compelled to take on. Young men and boys are usually the combatants in armed and criminal groups, whereas women and girls take on more informal supporting roles, including recruiting, gathering information, marrying combatants, and providing other domestic or economic services.[135]

Gender influences how men and women in conflict-affected setting are exposed and respond to risks associated with livelihood deterioration.[136] In Lake Chad, men from pastoralist, fishing and agricultural communities migrate to cities to find work. They are perceived as being responsible for providing for their families, with the social respect they command dependent on their ability to do so. Women, meanwhile, remain at home to care for the family unit, leaving them doubly at risk from the effects of climate change and insecurity in the basin area.[137] Moreover, their ability to participate in market trading is impacted by gender norms surrounding women's mobility, with those who are disabled or from particular ethnic groups subject to even higher levels of discrimination.[138] Even so, women consistently find ways to adapt to their circumstances. In Lake Chad, while women's participation in formal decision making around resource and asset control is limited, they nevertheless innovate approaches to adaptation and resilience, such as utilizing their knowledge of seasonal weather patterns to find and harvest wild rice. This rice is then dried and used for household and livestock food consumption.[139]

In Somalia, gender can influence adaptation strategies and risks in the face of the compound effects of climate change and conflict. During periods of drought, for example, men are often compelled to migrate in order to find water for livestock, while 'women and children are expected to stay at home and care for the other livestock'.[140] Conflict also contributes to shifting gender roles, with women sometimes becoming the primary providers in their households.[141]

Insecurity, exposure to violence and lack of resources can challenge men's capacity to act as breadwinners and so meet masculine expectations. This constrained ability to attain ideals of manhood within conflict contexts can place stress on family dynamics and change gender roles, with women taking on the role of providing for the family.[142] While this may lead to women gaining increased empowerment and financial independence, conservative contexts outside the household continue to create challenges for women's equality, as well as individual and family adaptation to circumstances, through—among other factors—restricting access to economic resources and formal political decision making.[143]

In Mali, women play significant roles in agricultural production.[144] Even so, they face challenges in adapting to climate change, as gender inequalities limit women's mobility and access to land and other economic resources. Evidence from communities dependent on livestock and forest-based livelihoods in northern Mali shows that under drought conditions men will migrate in search of employment. This can increase workloads and inequalities for women, who, in addition to their other responsibilities, remain to provide for their households and care for livestock without additional income. Although this creates heavier workloads for women, it is notable as an example of shifting gender roles, as herding has traditionally been a male responsibility.[145] As in Somalia, broader conservative ideologies can challenge women's adaptation in shifting environmental circumstances.[146]

Climate change and conflict can also heighten the risk of SGBV. Research has shown that women and girls in IDP camps in Somalia often lack access to health services and are at risk of SGBV.[147] More generally, if women in Somalia are required to walk further to gather resources, this puts them at increased risk of SGBV.[148] While SGBV typically affects women, the exposure of men in Somalia to this type of violence should not be ignored.[149] A similar situation can be found in Mali, where women are typically responsible for gathering natural resources such as water or fuel wood, putting them at increased risk of attack if they have to travel farther distances.[150] As in Somalia, men and boys may also be victims of SGBV, though to a lesser degree.[151]

Climate change, environmental crises and violent conflict impact different groups of people in varying ways depending on their gender. In the cases discussed above, resource-dependent livelihoods, gender and environmental deterioration intersect to create risks for different genders. Notably, men and boys are vulnerable to recruitment into armed groups, while women and girls are at a heightened risk of experiencing SGBV. Gender norms and inequalities influence who migrates and what risks they face when they do. Climate change and conflict can also shift traditional gender dynamics, with impacts for both men and women, as highlighted above in Mali and Somalia.

Efforts to prevent and address these risks must include the equal and active participation of all affected groups in decision making. Gender can influence an individual's relationship with the natural environment. Thus, efforts aimed at addressing climate change, environmental degradation

and associated security risks should be built around local knowledge and dynamics, alongside an understanding of the gendered risks men and women face, and the formal/informal roles they play in adaptation and resolving local conflicts around natural resource access.[152]

2.4.6. Farmer–herder conflicts in the Sahel

Another example of climate-related conflict risks is the phenomenon of farmer–herder conflicts in the Sahel and elsewhere in Africa. Pastoralism is a major economic pillar of the Sahel, with livestock production accounting for at least 25 per cent of the gross domestic product (GDP) of Sahelian countries[153] and 40 per cent of agricultural GDP in the Sahel region.[154] Transhumant pastoralism—the migration of pastoralists and their herds between seasonal pastures, often across national borders—is an important part of this practice, accounting for 70–90 per cent of the cattle population in the Sahel.[155] Yet, pastoral production is highly vulnerable to environmental change. Herders depend on rainfall to sustain grazing grounds, which fluctuates according to seasonal and other medium-to-longer-term weather patterns.

The increasing inter-annual variability of rainfall—an effect of climate change—thus portends risks to Africa's 50 million herders, who are among the continent's most vulnerable populations.[156] Precipitation over the Sahel has become increasingly erratic and extreme, with recent decades seeing more rainfall concentrated in stronger and more frequent storms, interspersed with deeper dry spells.[157] Climate models generally project decreasing rainfall days in the Sahel region, with longer dry spells and shorter wet spells. The Sahel is also expected to experience greater precipitation intensities on wet days, while the severity and duration of dry periods will increase, suggesting that both flooding and drought may become more extreme in the coming decades.[158]

Mobility is a critical part of the pastoralist system, allowing herders to sustain the productivity of grazing resources and adapt to rainfall variation. However, the mobility of pastoral communities is increasingly being restricted by agricultural expansion, land policies and local governance, and insufficient or contested water points.[159] In the Sahel, cropland has increased 2.5-fold, to the detriment of critical grazing areas, which have decreased by 13 per cent. In parallel, the livestock population increased 2.5-fold between 1961 and 2009, leading to increased competition for grazing land, particularly during the dry season.[160] In recent years, this has resulted in pastoralists becoming involved in rising levels of violent conflict in the Sahel, claiming thousands of lives across the region.

Accounts that draw deterministic mono-causal links between rising pastoralist–farmer conflict and resource scarcity driven by climate stress are, however, incomplete. In reality, the causal relationships are more indirect and complex. Environmental stress arising from climate change interacts with issues of governance, resource management, and political and economic inclusion, all of which influence the adaptive capacity and resilience of affected communities and societies.

2.4.7. Transboundary water conflict and cooperation

In addition to the internal conflicts highlighted above, water resources or other ecosystems shared between countries can create inter-state tensions, potentially even leading to violent conflict. Alternatively, the shared management of transboundary resources can build trust and cooperation among countries. For example, in the case of upstream dam-building in the Blue Nile by Ethiopia, the Egyptian government's assessment of the potential medium- to long-term effects—in a perceived context of increasing water scarcity caused by climate change—has resulted in Egypt threatening Ethiopia with military action should it continue with its plans.[161]

Numerous other cases similarly demonstrate how shared transboundary water resources can be sources of tension and mistrust. For example, since the 1970s, upstream Turkey has developed a massive irrigation and hydropower infrastructure programme, known as the Southeastern Anatolia Project, in the Tigris–Euphrates Basin. Iraq and Syria regularly accuse Turkey's dams of decreasing downriver flows. Throughout the 1980s and 1990s Syria wielded support for the Kurdistan Workers Party (PKK) insurgency against Ankara as a counterweight against Turkey's alleged manipulations of the Euphrates' water flow. In 1987 the two countries signed dual protocols, with Turkey guaranteeing Syria an annual average minimum discharge on the Euphrates and Damascus pledging to curtail its aid to the PKK.[162]

The Indus River Basin is one of the most important water systems in Asia, nourishing the agricultural breadbaskets of the subcontinent. The Indus also holds considerable hydropower potential in a region where hundreds of millions of people lack access to electricity. Growing populations and expanding economies are driving water demand throughout the Indus Basin, even as environmental pressures and unsustainable consumption practices stretch supplies. On top of this, global warming threatens to upset the prevailing regional weather patterns, disrupting the quantity, timing and location of rain and snowfalls that sustain the basin's water sources.[163]

In the face of growing challenges, fraught hydro-relations divide the Indus's two main riparians, India and Pakistan, which together account for 99 per cent of basin water demand. Persistent tensions between the two states led to the World Bank mediating their dispute, culminating in the 1960 Indus Waters Treaty (IWT).[164] Despite being considered a diplomatic success, the IWT is often characterized as erecting a 'riparian iron curtain' because it physically divides the basin, applying different obligations for the parties on the system's main eastern and western tributaries.[165] Rancour and mutual mistrust surround the treaty in both countries. Pakistani critics assert that Indian infrastructure building on the western rivers detrimentally affects flows to Pakistan, while India counters that these works consist of 'run-of-the-river' structures, meaning they do not possess the technical capacity to withhold significant volumes of water. Born amid the bitter legacy of India–Pakistan Partition, Indus water governance is intertwined with the politics of national

security and territorial sovereignty. The basin's three western rivers flow through contested Jammu and Kashmir, claimed by both countries.

At the regional level continuing turmoil in Afghanistan and remote geography in China have so far inhibited the development of Indus River resources. Even so, water demand in both countries is climbing. Pakistan worries prospective Afghan infrastructure projects could divert flows from the Kabul River, which currently provides 16 per cent of the country's water supplies, with assistance provided by New Delhi to erect 12 dams on the river feeding Pakistani apprehensions of encirclement by its Indian rival.[166] By the same token, some 182 km2 of the Indus's annual flow enters India from China, provoking Indian concerns about the impacts of Chinese designs upstream. Sizeable Chinese investments in Pakistani hydropower projects under the Belt and Road Initiative—with many construction sites situated in contested Kashmir and guarded by Chinese security personnel—similarly discomfits New Delhi.[167]

Since 1960 the IWT has held through two wars and withstood numerous lesser clashes. Despite this, it has little to offer in response to many emerging risks. Negotiated when global warming was unsuspected outside a tiny scientific circle, the treaty contains no mechanism to manage the shifts in water availability potentially engendered by climate change. Moreover, the IWT omits the river's other riparians, Afghanistan and China.[168] Indian and Pakistani policymakers recognize the dangers of mounting water stress on the Indus, with their declared national water policies emphasizing the need for more effective and integrated water resource management and calling for cooperation on transboundary waters.[169] Despite this, water policy in both countries has become highly securitized, framing water governance as a zero-sum conflict of existential threats, endangered sovereignty and national survival.[170] These predominating logics of 'water nationalism' and perceived geopolitical imperatives undermine the prospects for productive cooperation.[171]

2.4.8. Resource conflicts at sea

Resource tensions are stoking a number of maritime conflicts around the world. Historically, ocean resources have been a significant source of international hostilities, even between developed democracies, accounting for over 43 per cent of militarized disputes between democratic states in the half-century following World War II.[172] The Anglo–Icelandic 'Cod Wars' of the 1950s–70s, for example, saw British Royal Navy ships tangle repeatedly with Icelandic patrol boats, with Reykjavik threatening to withdraw from NATO and expel US forces from Iceland.[173] Since the 1970s the numbers of international fisheries conflicts have increased significantly. Many have led to violent confrontations, with warships deployed, crews attacked and vessels seized. Some have even been deadly, resulting in deaths among coast guards or crews.[174]

Growing anthropogenic pressures on the oceans threatens to catalyse future fisheries conflicts. Much of the global ocean is only weakly managed,[175]

with established national and international governance arrangements largely premised on relatively stable fish populations (catch allocations based on historical distribution patterns) and clear boundaries dividing fisheries into zones of national territorial control. Most international fisheries conflicts revolve around disputes over who is allowed to catch which species in what quantity, and where, as well as states' obligations to ensure that fishers comply with the law. The compounding risks of climate pressures and unsustainable fishing practices are further exacerbating these challenges. A large-scale geographical redistribution of world fish catches—propelled by climate change—risks creating 'winners' and 'losers'. Where fish populations fall, contending claimants may race to capture their share, further depleting shrinking stocks. Where fish populations grow, new parties may clash to cast their nets. Where fish migrate between national exclusive economic zones, tensions may flare over the (re)allocation of shifting stocks.[176] The history of maritime resource confrontations suggests that the risk of fisheries conflicts may rise when fishers look to make up falling catches in domestic waters by increasing fishing abroad.[177]

Some of the most fraught fisheries conflicts reflect competing claims not only to fish but the seas in which they swim. In Asia, China, Indonesia, Malaysia, the Philippines and Vietnam—in differing configurations—each assert sovereignty over various islands in the South China Sea, and therefore rights to the surrounding fisheries. All deploy their fishing fleets not only to chase dwindling catches but as proxies to advance their maritime territorial claims, in a collective display of competitive 'ocean grabbing'.[178] Moreover, they have used their navies to intercept and destroy foreign fishing vessels, with Chinese and Vietnamese forces having engaged in fatal skirmishes around the Spratly Islands.[179] Climate change could add a further twist to such territorial contests. The maritime boundaries of ocean spaces, such as territorial seas and exclusive economic zones, are based on terrestrial coastlines. Rising sea levels could gradually submerge many low-lying islands and coastal topographies, obliterating the land-based reference points defining these maritime territories and the resources they contain.[180]

Another issue is that a good deal of global fishing operates outside maritime borders. Flag states have a responsibility under international law both to regulate the distant water fishing activities of vessels flying their flag and enforce these laws against the companies and persons that own and control deep-sea fishing vessels. A significant number of flag states have, however, proven themselves unable or unwilling to uphold their international responsibilities when it comes to ensuring shipowners fish in accordance with applicable norms.[181] Typically, these flag states do not exercise requisite due diligence in preventing or deterring harmful fishing practices—that is, they lack the laws or public administration to monitor and control their fleets or effectively tackle any lawbreaking.[182] In some cases, a flag state may turn a blind eye to harmful fishing practices to appease its own fishing industry and public demand for seafood. In other instances, the flag state is functionally

similar to a tax haven or offshore jurisdiction in that the ship register is fully privatized and outsourced. These ship registers actively seek to attract foreign ship-owning companies to register fishing fleets in their jurisdiction by allowing them to conduct illegal, unreported and unregulated (IUU) fishing on the high seas and in other countries' territories.[183]

Regardless of the underlying motivation, fishing companies are exploiting the legislative and enforcement gap provided by these flag states, with the result that IUU fishing may account for as much as 20–50 per cent of the global fish catch, although such estimates are inherently difficult to verify.[184] Widespread IUU fishing contributes to over-exploitation pressures on many fisheries and undermines legitimate fishing economies, thereby diminishing the resource base, subverting sustainable management, depriving states of revenue, weakening food security, and displacing or destabilizing small-scale and artisanal fisher communities.[185] Even so, the demand for fish continues to grow, meaning that the incentives for IUU fishing—and the resulting conflict risks—are only likely to increase.[186]

Beyond its environmental and economic impacts, IUU fishing is often intertwined with multiple marine resource conflict risks and security threats. The lack of effective flag state jurisdiction leads to enforcement vacuums, which means that IUU fishing often coincides with other illicit activities, from human rights violations in the fisheries labour force to smuggling of narcotics/weapons and marine piracy.[187] In some cases, the peace and security ramifications run deeper than issues of maritime criminality. From Somalia to West Africa popular conceptions link the persistence of piracy in the Western Indian Ocean and the Gulf of Guinea to weak governance and enduring conflict. More considered analyses suggest that the resource depletion caused by foreign fishing vessels has precipitated socio-economic dislocations and a climate of criminality, which in turn has spurred instability and state fragility on land.[188]

2.4.9. Geopolitical tensions and conflict related to seabed mining

The deep seabed—the sea floor below 200 metres depth—contains considerable mineral resources. The Clarion-Clipperton Zone—a Europe-sized area in the eastern Pacific—is alone estimated to hold more nickel, manganese and cobalt than all land-based reserves combined.[189] These and other significant seabed metals, such as lithium and zinc, figure among the so-called 'critical minerals' essential to advancing green technologies and achieving the clean energy transition.[190] Improved undersea exploitation techniques have rendered seabed deposits increasingly accessible, raising the prospects of a marine 'Klondike gold rush' as countries and companies scramble to conquer mineral development's 'last frontier'.[191]

Deep-sea mineral deposits occur in different forms—known as cobalt-rich crusts, polymetallic nodules and polymetallic sulphides—across the world's oceans. Advocates argue that deep seabed mining will deliver high-grade ores with fewer social and environmental impacts than terrestrial

mining.[192] Moreover, proponents argue that given substantial deposits lie within the exclusive economic zones of small island states, deep seabed mining could supply many of these states with needed resource revenues.[193] Many policymakers and analysts also maintain that deep seabed mining can help alleviate 'security of supply' risks arising from growing demand for critical minerals. Retrieving critical minerals from the sea floor would diversify sourcing, reducing reliance on production concentrations in China and certain fragile states.[194]

At present, though, deep seabed mining's promise remains prospective and contested. In practice, deep seabed mining may prove neither economically viable nor environmentally sustainable. Economically, projected long-term demand for critical minerals, which is dependent on rapidly evolving technology pathways, is highly uncertain and could largely be met without mining the seabed.[195] Deep seabed mining operations could also conflict with established commercially valuable assets, such as fisheries, marine protected areas, shipping lanes, submarine cables and telecoms terminals.[196] Environmentally, deep seabed mining poses severe risks. It could decimate fragile deep-sea marine fauna, damage important habitats, stir up toxic sediments and generate harmful wastes.[197] Reflective of these challenges, several states support a 10-year moratorium on deep seabed mining to allow for further research.[198]

The geopolitical issues frequently invoked around deep-sea minerals are also complex.[199] Some analysts consider that deep seabed mining ambitions have already spawned international tensions in the Indian Ocean, South China Sea and elsewhere as major powers jockey to control undersea critical metal resources.[200] Nevertheless, the global picture is variegated. National authorities are responsible for regulating deep seabed mining within their exclusive economic zones. The UN Convention on the Law of the Sea established the International Seabed Authority (ISA) to manage mineral resource activities in areas beyond national jurisdiction 'for the benefit of mankind as a whole'.[201] Despite this, national and international deep seabed mining policy architectures remain in their infancy. The ISA has concluded 31 exploration contracts since 2001, while a handful of countries have issued exploration licences within their exclusive economic zones.[202] However, the only active commercial mining operation to receive approval collapsed in 2019 in the face of civic opposition and financial difficulties—thus, there are currently no fully active commercial deep seabed mining projects.[203] Rather than being an incipient resource bonanza or source of impending great power confrontation, deep seabed mining now appears clouded in economic, environmental and regulatory uncertainty.[204] How any deep-sea mineral gold rush will pan out, if one takes place at all, remains to be seen.

This section of the report has explored the various ways in which climate change and other environmental crises manifest across the human-to-hard security spectrum. In addition to violent conflict, the human security of individuals and communities is at risk from, among other things, excessive

heat, wildfires, extreme weather events, zoonotic disease and sea-level rises. Building on this, the next section turns to the ways in which these risks are interrelated, and how their combined effects exacerbate the complexity of preventing and managing risks related to climate change and environmental degradation.

2.5. Systemic, emergent, cascading and compounding risks

The interdependencies and entanglements between the social-ecological dimensions of our ecosystems generate complex, interconnected and overlapping systemic, cascading and compounding effects. Changes to the biosphere brought about by human activity are increasing the occurrence of regime shifts—large, abrupt and persistent critical transitions in the function and structure of social-ecological systems.[205] Evidence of such shifts can be found in multiple social-ecological systems and at multiple geographical scales, from the local (e.g. pollution in a lake) to the global (e.g. CO_2 levels in the atmosphere). Many of these shifts are also associated with the loss of key ecosystem services underpinning livelihoods, economic activity and human development, such as clean water and air.[206]

Tipping points in the climate system, some of which may induce abrupt and highly disruptive changes, are a good illustration of regime shifts. These include the melting of sea ice and the Greenland and Antarctic ice sheets; changes in ocean and atmospheric circulation; and loss or alteration of critical biomes, such as the large forests in the Amazon and Congo Basin regions and boreal forests in Russia and Canada.[207] Many of these regions and processes are changing rapidly due to human pressures, for example through deforestation induced by expanding soy plantations (e.g. in the Amazon), mining (e.g. in the Congo Basin), palm oil (e.g. in Indonesia and Malaysia) or paper production (e.g. in Russia). Human activities are changing the internal dynamics of these systems and generating tipping points, in turn impacting the stability of the climate system as a whole.[208]

Deforestation, for instance, can denude and destabilize mountain slopes, creating conditions conducive to landslides.[209] The tremendous weight of water retained in large reservoirs can provoke seismic activity in the underlying earth, triggering earthquakes.[210] Through processes characterized as the 'social amplification of risk', human interventions aimed at adapting to or mitigating the effects of these changes may further aggravate the risks and their repercussions.[211] The effects of maladaptation are addressed in part 3 of the Environment of Peace report.

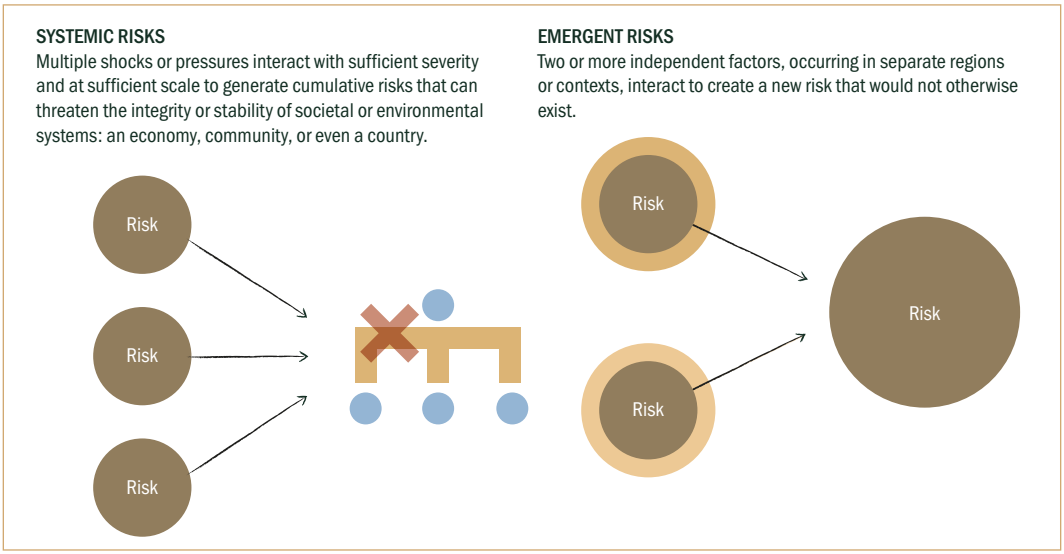

Figure 2.2. Systemic and emergent risks

Source: Environment of Peace.

2.5.1. Systemic and emergent risks

Actions taken in seemingly independent places increasingly affect global social-ecological systems in unexpected ways, resulting in both immediate consequences and systemic and emergent effects. Systemic risks stem from interactions that take place at the interface of multiple systems (e.g. climatic, ecological, political, financial and technological), while emergent risks are when two or more independent factors, occurring in separate regions or contexts, interact to create new risks that would not otherwise exist (see figure 2.2). Both systemic and emergent risks make it hard to identify causes or foresee outcomes.[212]

All large disasters that affect human society present, to varying degrees, complex causal chains. A primary 'natural' event—a cyclone, a drought—generates a sequence of further effects that wreak physical, economic and social damage on people and communities. Natural disasters occur at the interface of human and natural systems, or, stated differently, social-ecological systems.[213] Natural disasters are inherently systemic and emergent, reflecting the impact of environmental or geophysical shocks on exposed human vulnerabilities.

2.5.1.1. Systemic and emergent risks in the global food system

One example is the interconnectedness of the global food system, which increases the risk of disruptions in one place affecting the rest of the system. One-fifth of all food produced worldwide, measured in calories, is traded across borders.[214] Globally, 85 per cent of countries have marginal to low food self-sufficiency, meaning that they cannot satisfy their food requirements through domestic production and must thus rely on the international food trade.[215] A handful of basic staples furnish almost all the world's food energy

consumption,[216] with just three crops—wheat, rice and maize—satisfying 42 per cent of the total global daily caloric intake.[217]

At the same time, a small number of producer countries have grown to dominate the international trade in certain crucial staple commodities. The Russian war on Ukraine has had a significant effect on the global food system, as both countries are major producers of wheat—Russia, for example, produced approximately 25 per cent of the world's wheat exports before the invasion, as well as important agricultural staples.[218] Elsewhere, India provides one-third of global rice exports.[219] This export concentration of staples among a few producers renders the global system vulnerable to shocks affecting these critical suppliers, as well as the trade policies implemented by these states.[220] The interconnectivity of the global food system means that substantial changes in supply or demand, such as those caused by the Russian war on Ukraine, will have wide-ranging repercussions on other parts of the system—including political and security implications for some countries and regions.[221]

The impact of the Covid-19 pandemic on the global food system, alongside a number of climate-related environmental crises, provides a good example of the risks presented by these systemic and emergent effects. The pandemic has shaken food supply chains, with public health policies enacted by governments inevitably upsetting many aspects of food production and distribution. Travel restrictions prevented farmers from accessing markets and workers from moving with the seasons and harvests, leading to labour shortages. Lockdowns and social distancing disrupted processing facilities and marketplaces. Dramatic reductions in air, land and sea traffic hampered the shipping of agricultural inputs and delivery of final products. Processing backlogs and transport bottlenecks augmented distribution costs and increased food loss and wastage, especially of perishables.[222] At the same time, several environmental crises were unleashed on different regions of the world in 2020. A severe drought seared South America, shrinking Argentina's wheat crop by 11 per cent.[223] Much of East Africa confronted a 'triple menace', simultaneously battling coronavirus, floods and swarms of desert locusts.[224] Shifting weather patterns in the Indian Ocean, influenced by anthropogenic climate change, increased temperatures and rainfall over the Arabian Peninsula, creating ideal environments for desert locusts to breed and hatch.[225] Spring 2020 brought East Africa one of its heaviest March–May rainfall periods since 1981, with torrential rains and flooding damaging local crops and promoting the locusts' further proliferation.[226] In Ethiopia and Somalia alone, the pests destroyed 70 000 hectares of land.[227]

The effects of floods and droughts, crop pests and pathogens, armed conflicts, and epidemics or pandemics can significantly stress the global food system.[228] When such shocks disrupt agricultural supplies, prices in the global trading system reflect reduced availability. Numerous analyses have found that rising prices and the degradation of food security can contribute to instability and in turn violent conflict.[229] Government failure to ensure food security can undermine social cohesion and state legitimacy. Perceived patronage,

corruption or inequities in food distribution/aid responses exacerbates societal tensions, potentially incentivizing political protest, social unrest and even rebellion.[230] One of the most striking examples of these systemic effects is the global food system disruptions that, as a result of rising food prices, helped trigger the Arab Spring of 2011.[231]

The interlinkages between food security, environmental crises and the risk of conflict also create opportunities for strengthening community resilience, reinforcing social cohesion and sustaining peace. Resilient food systems are critical for building and maintaining stability in societies vulnerable to conflict. Increasing the resilience of local food systems reduces vulnerabilities and, by boosting local livelihoods, lessens individuals' susceptibility when it comes to being recruited to conflict. The collaborative and participatory process of building resilient food systems can also strengthen collective action and social cohesion, aligning the interests of broad coalitions of food system actors towards sustaining peace.[232]

The intertwining of different domains in social-ecological systems generates networked interdependencies. In contrast to the metaphor of toppling dominos often evoked to depict cascading disasters, systemic and emergent shocks and pressures do not unfurl in one linear direction.[233] Networked systems intersect at multiple points and scales, creating numerous circuits through which reciprocal risks and feedbacks can spread between systems, often with unanticipated results.[234] Multiple impacts may converge via several pathways on a given system, sector or region; or multiple impacts may emerge from a given system, sector or region to others.

Extreme storms, for example, can down power lines, flatten or flood water and power stations, and overflow sewerage and drainage systems. Electricity outages will impede pumping away standing water, purifying contaminated water and piping clean water to affected populations, all of which require energy. At the same time, flooding and water damage to energy infrastructure will hamper the restoration of power. Moreover, in addition to possible deaths and injuries caused by the storm's immediate physical impacts, the loss of water and power services poses significant emergent risks to public health arising from pollution, disease, and degraded hygiene and sanitation.[235]

2.5.2. Cascading risks

Climate change is increasing the magnitude, extent, frequency, timing and duration of extreme events such as droughts, flooding, heatwaves and heavy storms.[236] One way in which risk may increase is when one event spills over into other regions of sectors, generating further impacts that snowball to produce new risks distinct from and potentially greater than the original event (see figure 2.3). Prospective cascading disasters add a layer of risk that is often not fully appreciated in climate change impact assessments, nor adequately incorporated into climate adaptation and resilience planning. Most climate risk assessments focus on specific countries, regions or sectors, and on individual climate hazards. These circumscribed approaches limit the ability

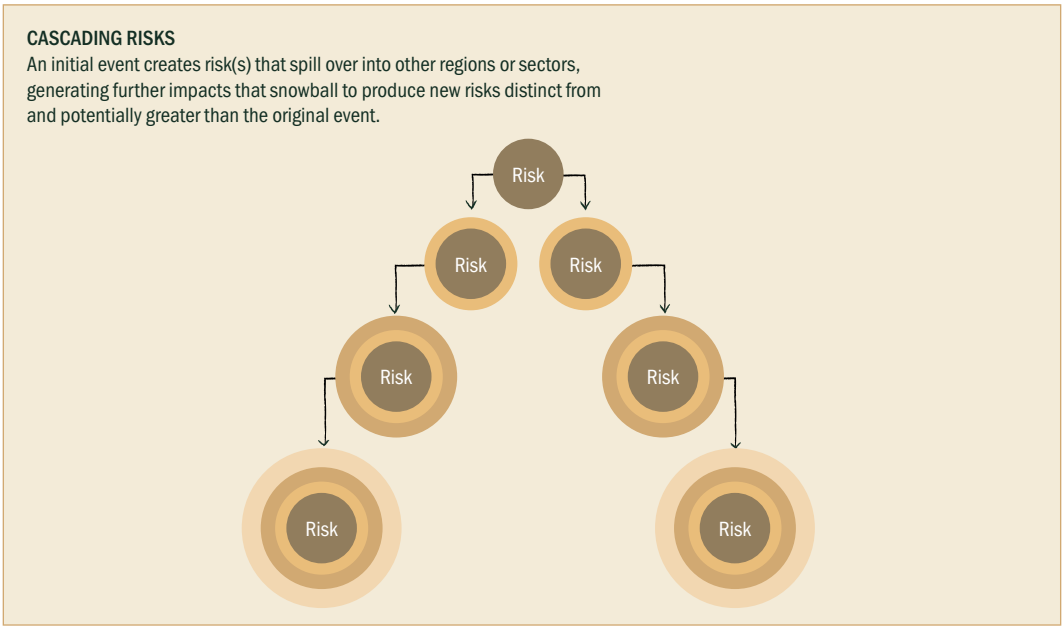

Figure 2.3. Cascading risks

Source: Environment of Peace.

to capture vulnerabilities arising from climate impacts striking other sectors or distant regions, or from multiple hazards combining.[237]

For example, in 2011 severe monsoon flooding in Thailand disrupted global supply chains for electronics and semiconductors, with global industrial output declining by 2.5 per cent.[238] The floods persisted from July 2011 through to early 2012, leading to more than 800 deaths and nearly $46 billion in damages.[239] In another example, droughts decimated harvests in Australia, India, Russia and Ukraine in 2007–2008, contributing to panic-buying in global commodity markets and export restrictions in several wheat- and rice-growing countries. The resultant global food price spikes helped spur 'bread riots' in dozens of countries.[240]

2.5.2.2. Cascading effects of climate change on migration in Guatemala

Another example of the cascading effects of climate change can be seen in how climatic and other factors have contributed to migration from Guatemala, with both human and hard security implications for the people and states involved. Central America is, and projected to increasingly become, a hotspot for climate change due to changes in precipitation that it is anticipated will negatively impact the agricultural sector.[241] Population growth and increased population density are expected to exacerbate these effects, leading to, among other impacts, increased migration.[242]

Migration from the Northern Triangle (El Salvador, Guatemala, Honduras) has sharply increased, especially since 2017.[243] Environmental degradation, extreme weather events, population density, poverty and violence are the main factors driving this migration[244]—particularly with regard to rural families,

whose livelihoods depend on agriculture.[245] Second only to poverty and unemployment, food insecurity resulting from the effects of climate change has been found to be a key push factor in migration from Central America.[246]

Guatemala is a good example of how climate-related factors contribute to migration and increase security risks.[247] Although agriculture constitutes only a small portion of Guatemala's economy (10 per cent of GDP),[248] 48 per cent of Guatemala's population lives in rural areas,[249] with 42 per cent of men and 10 per cent of women employed in the sector.[250] Poverty levels are higher in rural areas, where the poor are most susceptible to climate, political and economic shocks.[251] Inequality is also high in Guatemala, partly stemming from colonial policies.[252] Furthermore, despite having a stable macroeconomic environment, the benefits of economic development have not been evenly distributed within the country.[253]

Violence in Guatemala is significant, with gangs and trafficking the main factors behind the country's high crime rates.[254] Corruption has made already weak state institutions even more ineffective. In addition, the government has not made concerted efforts to address inequality. Elites own most of the country's land and have halted climate adaptation programmes, legal reforms and 'the implementation of social programmes'.[255]

Guatemalan nationals make up the largest number of migrants apprehended at the US border, accounting for about 31 per cent of the total.[256] Several factors have pushed Guatemalans to migrate to the USA, one of which is the impact of climate change. Since a large proportion of the Guatemalan population is rural and engaged in smallholder agriculture, the adverse impacts of climate change have taken a toll on Guatemalans' livelihoods and food security. For example, between 2012 and 2014 an outbreak of coffee rust—which is, among other factors, associated with the changes in temperature patterns Guatemala has been experiencing— destroyed crops, with grave implications for the livelihoods and food security of coffee farmers and workers.[257] Coffee production fell, and wages in the sector decreased by 13–27 per cent.[258] The cost of producing coffee in Guatemala almost doubled during 2011–12 compared with 10 years earlier.[259] Paradoxically, however, the price of coffee has decreased on the global market.[260] These factors have reduced coffee farming's financial return for smallholder farmers and decreased demand for coffee farm workers.[261]

Aside from cultivating cash crops, growing staple rain-fed crops such as maize and beans constitutes another avenue by which poor households can obtain food. Subsistence farmers in Guatemala claim to have experienced changes in rainfall, including a shorter rainy season, a reduction in the frequency of rainfall, an increase in rainfall intensity, and extended dry periods.[262] These changes have negatively affected households' food production and food availability, placing their food security at greater risk.[263]

Combined, these adverse effects on livelihoods and food security have cascaded across geographic boundaries, with the Guatemalan government's failure to respond in any meaningful way prompting people to migrate from

Guatemala to the USA. Meanwhile, the US's response to the large number of migrants arriving at its border has been both securitized and de-securitized. Historically, the US government's strategy has combined both approaches, with development assistance provided to improve the resilience of Central American governments and the countries' economies,[264] alongside funds for 'security assistance to help law enforcement, counter-narcotics, and justice reform' in the Northern Triangle.[265]

In 2018, however, the response shifted towards being increasingly securitized, as the Trump administration installed US troops at the country's border with Mexico.[266] In addition, rather than continue providing development assistance, the Trump administration made an agreement with the Guatemalan government to reduce migrant flows via law enforcement.[267] By contrast, upon coming to power in 2020 the Biden administration initially de-securitized its response, and instead attempted to influence the root causes of migration from Central America to the USA.[268] The administration's four-year, $4 billion plan includes providing development assistance to Central American countries to address 'corruption and the lack of economic opportunities', improving local governance, increasing emergency food assistance, and providing 'income support programmes'.[269]

Although, despite concerns about corruption and other setbacks, the root causes plan remains in place,[270] the Biden administration has been re-engaging in border protection along the US–Mexico border. For example, the administration has been forced by a court order to re-instate the Migrant Protection Protocol, also known as the 'Remain in Mexico' programme established during the Trump administration, which requires those seeking asylum in the USA to remain outside the country while their cases move through the US legal system.[271]

Although the evidence base needs to be further developed, the research cited in this example points to the cascading effects that climate change, together with other systemic effects, can have on people who are dependent on agriculture for their livelihoods. Moreover, it shows how a lack of livelihood opportunities and deteriorating economic circumstances can be push factors for migration more broadly, as well as how migration can increase both risks to humans and inter-state tensions—in this case between Guatemala, Mexico and the USA.

If climate-related transnational migration is to be reduced, then the drivers and root causes of migration must be addressed. In rural communities dependent on agriculture, climate adaptation and mitigation programmes are essential to people maintaining their livelihoods. These programmes will, though, need to be implemented at scale, and in a manner that is conflict-sensitive, equitable and just. Beyond efforts aimed at climate-proofing the agricultural sector, a broader approach that encourages the development of local businesses is also important.[272] Development assistance must value migrants' communities of origin and learn how best to invest in sustainable local options.[273] Such efforts will, however, require participation from the

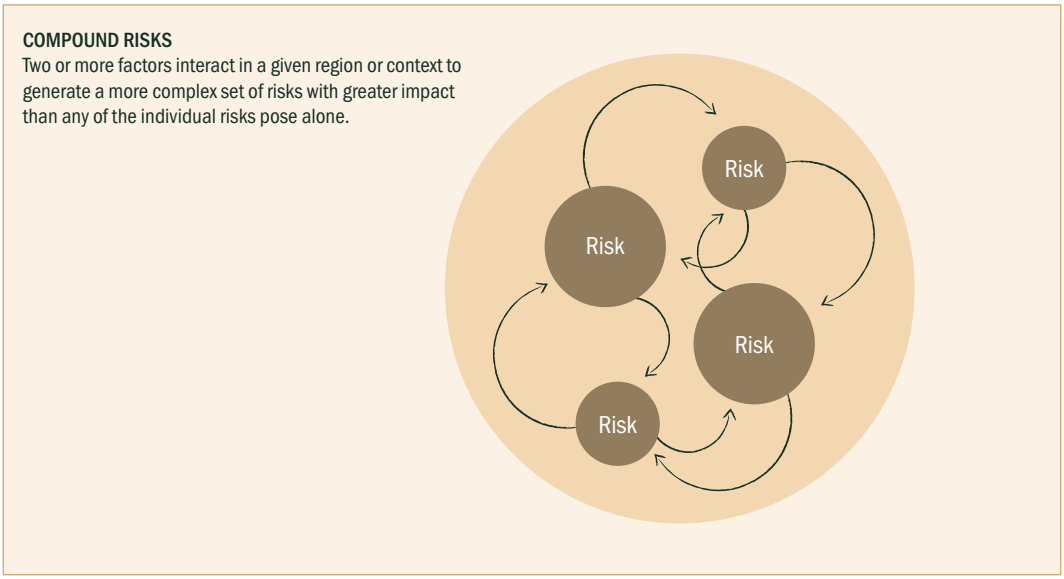

Figure 2.4. Compound risks

Source: Environment of Peace.

state to establish a macro-setting conducive to helping people. This means combatting corruption in all its forms in order to ensure the fiscal resources for adaptation programmes reach those they are intended for.

2.5.3. Compound risks

Compound risks (see figure 2.4) occur when two or more factors interact in a given region to generate a new type of risk that would not otherwise exist. The IPCC warns, for example, that the physical aspects of climate change—such as sea-level rise, extreme events and hydrologic disruptions—pose major challenges to vital transport, water and energy infrastructure.[274] Such disruptions in turn undermine state and community resilience to the effects of slow- or sudden-onset weather events. These kinds of compound risks can generate vicious circle effects that are extremely challenging to interrupt.

For example, across the Lake Chad Basin, violent conflict, governance neglect and climate-related conditions such as droughts have combined to create one of the world's most under-developed regions. Over the past decade, these compounding factors have led to the Lake Chad Basin region becoming a site of extreme humanitarian crisis.[275] The multiple security risks faced within the region must be understood as interlinked.[276]

While the trigger for the current complex humanitarian emergency was the violence perpetrated by Boko Haram and other armed groups since 2009, the region's conflicts and under-development are rooted in the compounding effects of inequality, marginalization and exclusion. The Lake Chad Basin is on the periphery of all the region's states, resulting in decades of governance neglect. The region is characterized by weak governance, under-development, poor infrastructure, high levels of poverty, rising inequality, resentment towards corruption among the ruling elite, low levels of education and low

levels of national integration. These factors have generated a lack of trust between communities and their governments over many generations,[277] setting the scene for intensifying religious fundamentalism and the rise of armed opposition groups.[278] The conflict and humanitarian crisis in the Lake Chad region is sustained by various climatic, environmental, socio-economic and political factors.

The Lake Chad Basin demonstrates the security risks that can emerge when environmental degradation and climate change combine to generate compound effects.[279] Climate change can affect environmental degradation, and vice versa,[280] while different forms of environmental degradation can influence each other.[281] Though climate change and environmental degradation can have mutually reinforcing impacts, their respective causes and effects differ. Environmental degradation, as defined by the UN Office for Disaster Risk Reduction, is the 'reduction of the capacity of the environment to meet social-ecological objectives and needs'.[282] Types of degradation caused by human activity include desertification, soil erosion, biodiversity loss, deforestation, pollution of air and water, sea-level rise and wildfires.[283]

For example, human activity contributes to water stress through increased use and pollution.[284] Over the past century freshwater use across the globe has increased six- to eight-fold,[285] with agriculture accounting for approximately 70 per cent of freshwater usage.[286] Growing populations, changing consumption patterns and economic growth have contributed to this increased use.[287] Pollution further impacts water resources in a context where an estimated 80 per cent of all municipal and industrial wastewater across the globe is returned untreated to the environment.[288] Combining data for both available water quantity and water quality, the most comprehensive global assessment to date has determined that fully 40 per cent of the world population, including much of Asia and the Middle East, now live in areas of severe water scarcity.[289] Severe water scarcity is defined as a water withdrawal to freshwater availability ratio exceeding 0.4. Another study projects that, without climate change mitigation policies, two-thirds of the world population will suffer severe water scarcity by the end of the 21st century, and two-fifths will live in river basins where annual water demand surpasses annually available renewable supplies.[290] Climate change will further exacerbate this stress.[291] Global models calculate that by 2050 freshwater withdrawals will jump 20–33 per cent from 2010 levels, propelled by surging demand from both industry and domestic use.[292]

In December 2015 the southern Indian city of Chennai experienced unprecedented flooding from unusually heavy monsoon rains. Nearly 200 people died, and over 200 000 were displaced.[293] The flooding impacts were not, however, simply a function of the rainfall itself. Chennai is a quickly growing city, and this development has involved significant land use change, including the conversion of mangrove forests—which typically serve as natural sponges to absorb rainfall—into parking lots and roadways with impervious surfaces. Such changes have made the city increasingly susceptible to flooding

from poor drainage.[294] This episode underscores that disasters are not only caused by extreme weather events linked to climate change, but compounded by environmental degradation, maladaptation and other political, economic and social choices.

It is not only freshwater resources that are affected—climate change and other human activity impacts oceans and the cryosphere. Climate change has led to shrinking glaciers and ice sheets, and a decrease in snow cover and Arctic sea ice. Oceans have warmed considerably, globally absorbing more than 90 per cent of superfluous heat in the climate system.[295] Changes in the ocean and cryosphere have an impact on ecosystems and biodiversity, as well as the livelihoods and wellbeing of humans dependent on the resources they provide. Non-climatic factors, including pollution, transportation, and reef and sand mining, can compound the impacts of climate change on these resources, exacerbating the negative impact on local ecosystems and in turn human health, food security and local economies.[296]

Environmental degradation and climate change can thus intersect to worsen community vulnerability during and in the wake of extreme events and disasters. Coastal zone and watershed degradation heightens the risk of flooding and storms, while land degradation aggravates the risk of flooding and the impacts of drought.[297] Social and economic inequalities can magnify the effects of disasters for different demographics. In the areas hit by Hurricane Katrina, for example, structural racism and class were key factors in who was most vulnerable to the hurricane,[298] with black and lower-income residents disproportionately affected.[299] As New Orleans developed over the 20th century, marginalized communities were compelled to live in low-lying, flood-prone, less desirable areas of the city. Meanwhile, wealthier and predominantly white residents moved farther away to suburbs.[300] In Bangladesh, land degradation has intersected with unequal distribution. Wealthier farmers own the majority of land despite representing a comparatively small demographic, which, due to resource scarcity, has led to poorer farmers having to move to less desirable land, sometimes in areas particularly prone to natural disasters like cyclones.[301] Furthermore, in some disaster contexts, as happened in Cyclone Sidr, women account for more fatalities than men due to gendered constraints on mobility or access to early warning and preparedness information.[302]

This highlights how the compounding influences of climate change and environmental degradation—caused by human activity and climatic factors—can interact to exacerbate conflict, undermine peace and increase human security risks. Thus, prevention efforts should include responding to and repairing environmental degradation, preparedness for future climate impacts, and appreciation of how one can compound the risk of the other. Moreover, as demonstrated above, marginalized groups can experience severe effects in situations of compound environmental risk. Efforts aimed at preventing or responding to sudden or slow-onset risks influenced by climate change and environmental degradation must promote the participation of all affected

peoples and identity groups. Ensuring their lived experiences and needs inform the policies and actions taken to support them is vital, as it is the resilience and adaptive capacity of their social institutions that will ultimately sustain the peace.

2.6. The gap between the nature of the challenges we face and the governance tools at our disposal

This report has considered three ways in which we can make sense of the relationships between climate change and other environmental crises on the one hand, and peace, conflict and human security on the other. It has considered the various pathways through which these relationships manifest, the risks posed across the human-to-hard security spectrum, and the systemic, cascading and compounding effects that can arise. Now, we turn our attention to what can be done about it. How can we prevent climate- and environment-related violent conflict, mitigate against risks to human security and contribute to sustaining peace? How can we prepare for and take steps to mitigate the negative effects of climate change and environmental degradation, and how can we strengthen the resilience and adaptive capacities of our communities, societies and institutions? While these questions will be fully addressed in parts 3 and 4 of the Environment of Peace report, this final section of part 2 identifies some of the gaps between the nature of the challenges discussed thus far and the governance tools currently at our disposal.

2.6.1. Scales, mandates and boundaries

One of the key observations to emerge from our analysis is that climate change and other environmental crises do not recognize political borders. Rather, they manifest at the critical intersections of social-ecological systems, both at a local and global scale. Climate change and environmental degradation are systemic and emergent—while some effects may originate in one place or at one scale, they may manifest in different ways at other scales and locations. This means that although steps can be taken to mitigate and adapt locally, it is not possible to address all the causes of climatic and environmental stress at this level, as some will have originated elsewhere in the system. There are very important steps that can be taken at the local to national level, especially in terms of national and sub-national preparedness plans, and investments in mitigation and community resilience. However, many ecosystems, such as water catchment areas, are transnational and require regional cooperation. Other systemic and emergent effects—such as global warming, pollution or the impact of production/distribution policies on global food supply chains—need to be managed and coordinated at the international level.

Unfortunately, there are very few institutions capable of preventing climate change and other environmental-related conflicts, while simultaneously mitigating against human insecurity and sustaining peace across local to global scales. Most institutions are designed to work at one level in the system—local, national, regional or international—and lack the mandate, incentives or capabilities to work with others across these scales. In particular, there is an absence of institutional capability when it comes to monitoring and addressing the negative side-effects arising from the systemic, emergent, cascading and compounding effects discussed earlier. For example, although the commitments made at COP26 fall short of what is needed, the take-away from a climate–peace nexus perspective is that billions of dollars of climate adaptation funding are going to be spent in the coming years, leading to the critical question of whether these funds will be spent in ways that contribute to strengthening social cohesion and sustaining peace. How we go about reducing emissions, and how we choose to adapt and mitigate, has the potential to either cause harm—including triggering conflict—or contribute to sustaining peace.[303] Currently, however, we do not have the institutional relationships in place to ensure these negative side-effects are identified and addressed, or to help direct funding in ways that contribute to peace across local to global scales.

In the peace and security field, for example, the UN Security Council is the body with primary responsibility for maintaining international peace and security. The effects of climate change are evident in many of the countries on the Security Council's agenda. Climate change and environmental degradation are undermining livelihoods in Afghanistan, Iraq, the Horn of Africa, the Middle East, the Sahel and Southern Africa, and in some places these dynamics are exacerbating competition over scarce resources, thereby fuelling ongoing conflicts or triggering new ones. Across the Sahel, South Sudan, Sudan and Somalia, climate change influences the risk of clashes between herding and farming communities over access to land, water and pastures. In Mali, Mozambique and Somalia, the negative effects of climate change on livelihoods have also facilitated recruitment to armed groups.[304] Thus, climate- and conflict-affected countries are trapped in a negative spiral whereby climate change undermines their ability to cope with conflict, and conflict undermines their resilience to cope with climate change.

The African Union's Peace and Security Council has met several times, including at head of state level, to address the impact of climate change on peace, security and stability.[305] Similarly, a number of other regional organizations—including the Association of Southeast Asian Nations, the Organization for Security and Cooperation in Europe, the EU and the Pacific Islands Forum—have recognized the implications of climate-related security risks. The Pacific Islands Forum, for example, issued a declaration in 2018 calling climate change 'the single greatest threat to the livelihoods, security and wellbeing of the peoples of the Pacific'.[306]

Nevertheless, some countries maintain that climate change should not be on the Security Council's agenda on the grounds that it is an environmental and development issue, and as such should be dealt with by the UN General Assembly.[307] Some experts have suggested other forums, such as the Peacebuilding Commission, as being potentially better suited to facilitating member state discussions on climate-related security risks.[308] In the medium-to-long term, the most effective prevention against the worst effects of climate change—including violent conflict over scarce resources—is a reduction in carbon emissions. The General Assembly, along with other UN entities such as the UN Framework Convention on Climate Change (UNFCCC), thus have important roles to play in generating international agreements aimed at reducing emissions and protecting the biosphere. In the short-to-medium term, however, the UN Security Council must assume primary responsibility for dealing with those aspects of climate change that pose a risk to the maintenance of international peace and security.[309]

The Security Council can ensure that UN peace operations and UN-led mediation efforts develop the knowledge and capacities necessary for assessing how climate change influences peace and security in the countries on its agenda.[310] UN personnel should have the knowhow and capabilities to support national governments or, in extreme cases, take direct action to prevent conflict and protect civilians. This also means that relevant UN personnel in headquarters, regional offices, special political missions and peacekeeping operations should be fully able to integrate ecological and environmental factors into analysis, planning, operations, programming and performance assessments.[311] The Security Council should also ensure the UN takes whatever steps are necessary to reduce its own impacts on the environment, including in peace operations.[312]

The way international and regional institutions are currently organized makes it extremely difficult to manage and coordinate interrelated human and hard security risks across institutional mandates. The system is too fragmented, with, for example, the UN Security Council mainly focused on managing violent conflict in specific countries and regions, leaving other bodies to focus on climate change mitigation. In order to make global governance at the international and regional level more fit for purpose, these institutions—or at least some among them—must be able to address systemic risk, as well as identify and act on emerging opportunities, across multiple scales and ecosystems.

2.6.2. Disciplines, departments and domains

Nationally and internationally our systems of governance have been found wanting when it comes to managing the adverse effects of climate change and environmental stress, including those affecting peace, conflict and human security.[313] One of the reasons our governance systems are not fit for purpose is because we have over-invested in specialization, or, conversely, under-invested in integrating our various knowledge systems in ways that enable

understanding of how our social-ecological systems respond to violent conflict or climate change. Universities educate our future scientists in ever more refined areas of specialization, with the consequence that they are unable to relate the dynamics in their narrow field to broader social-ecological systems.[314]

Similarly, at national and international levels, ministries, departments and decision-making bodies have siloed responsibilities.[315] What few coordination mechanisms exist, such as inter-departmental task forces or inter-ministerial clusters, are under-developed and institutionally weak compared to their constituent parts. There is little, often no, accountability for whole-of-system effects, especially over time, leading to endless annual budget cycles linked to the narrow goals of single ministries. While there have been occasional efforts to develop multi-year planning frameworks, these usually lack their own budgets and, thus far, have been unable to meaningfully address the overall effects of climate change and environmental degradation. If we are to successfully prevent or manage the negative effects of climate change and other environmental security risks, it will require committing to trans-disciplinary cooperation and inter-departmental/institutional collaboration on a scale not yet attempted.

At present, the system is too fragmented, with the UNFCCC, for example, focused on reducing emissions, leaving it little scope for synchronization across other parts of the UN and international system responsible for the domains highlighted in this report, such as food security, livelihoods, displacement, migration, public health, environmental protection and climate change. As has been stressed, there will be significant knock-on effects arising from our attempts to radically reduce emissions over the coming decades, with the polices and initiatives chosen holding the potential to either cause harm or contribute to sustaining peace. It is unclear, however, who at the national, regional and international levels has the responsibility and institutional capacity to manage these climate mitigation/adaptation processes in such a way as to minimize conflict and harm while maximizing social justice and peace.

In order to make governance at international, regional and national levels more fit for purpose in this regard, our systems, processes and institutions must be able to integrate information and analysis from a variety of disciplines and departments. Moreover, they must be capable of planning, coordinating and monitoring initiatives that are simultaneously undertaken across several institutional domains. Few institutions or processes, local to global, currently have that ability. We are thus faced with a governance deficit, not in the sense of too little governance, but rather in the lack of adaptive governance required to make sense of trans-scaler and whole-of-system dynamics.

2.6.3. Adaptive governance

The multifaceted nature of climate change and other environmental crises, combined with the dynamic and continuously evolving nature of the societies affected, make the climate–peace nexus a textbook example of a complex

phenomenon.[316] One way of highlighting the unique characteristics of complex systems is to contrast them with complicated systems. A complicated system can potentially be fully understood and predicted, provided sufficient information is available. Designing, building and launching a rocket into space is highly complicated, but once mastered the same process can be repeated with a reasonable degree of predictability. By contrast, non-linearity plays a critical role in the emergence and self-regulation of complex systems. It is not possible to undertake a project—for example, a community violence reduction initiative in Iraq—and predict with any certainty what the outcome will be. Nor can we use a model that has performed relatively well in the past—such as the Truth and Reconciliation Commission in South Africa—and expect it to produce the same result when used elsewhere. This uncertainty and irreproducibility are characteristics of complex systems rather than the result of insufficient knowledge or inadequate planning and implementation. Recognizing these limitations has significant implications for how we manage peace and security risks related to climate change and other environmental crises.[317]

We need a new form of governance that can cope with the complexity of social-ecological systems, including their systemic, emergent, cascading and compounding effects. Such an approach to governance must recognize the value of involving the people affected, as it is their social institutions that will have to develop the adaptive capacities necessary to protect the environment and sustain peace. In order to influence whole-of-system dynamics, this new form of governance also needs to be able to integrate information and analysis across scales and domains. Lastly, it should be guided by the precautionary principle of acting in ways that avoid harm to both the environment and those affected by its policies and actions.

Adaptive governance is geared towards coping with the uncertainty, unpredictability and irreproducibility inherent to complex social change processes.[318] It is an approach that requires those with governing responsibilities, together with those affected, to actively engage in an iterative process of inductive learning and adaptation.[319] An adaptive governance approach does not imply that expert or scientific knowledge is unimportant—rather, it calls for understanding of the distinction between evidenced-based advice and how this should be implemented in a specific social context. For example, while science may determine that the spread of Covid-19 can be prevented by avoiding close contact between people, how this is to be achieved within a densely populated slum community can only be discovered through adaptive practice and learning in collaboration with the affected community. The same principle applies to developing and adapting policies and actions at national, regional and international scales, including those requiring transformative change. We will return to the need for adaptive governance in part 4 of the report.

2.7. Conclusions

Climate change and other environmental crises are not the only, or even main, driver of violent conflict—in many contexts other drivers will be more influential and should be prioritized. Nevertheless, the systemic, emergent, cascading and compounding effects discussed in this part of the Environment of Peace report reveal some of the pathways through which climate change and environmental degradation contribute to human- and hard insecurity. Recognizing the intertwined relationships between climate change, environmental crises, peace, conflict and security helps us understand how climate and environmental effects, when combined with political, social, economic or security factors, can exacerbate existing vulnerabilities and push societies to the brink of their adaptive capacities.

The interdependencies between the ecological and social dimensions of our ecosystems generate complex cascading and compounding effects. Migration, international trade, transnational land acquisitions, the spread of invasive species and technology diffusion are occurring at unprecedented scales, underpinned by a global infrastructure that facilitates the movement of people, goods, services, diseases and information. Nonetheless, an important message of this report is that conflict is not inevitable. Climate change and environmental degradation can also trigger collaboration and cooperation. The relationship between climate change and other environmental crises on the one hand, and peace, conflict and human security on the other, is not linear or predetermined but mediated by the choices people and communities make. People can influence the severity of the effects of climate change and environmental degradation through disaster preparedness, management of natural resources, and other adaptation and mitigation strategies. Whole-of-system approaches will be key to ensuring our local to global governance systems are resilient and adaptive enough to prevent these stressors from inducing negative social effects, including violent conflict.

The focus of this part of the Environment of Peace report has been on the implications of climate change and other environmental crises for peace, conflict and human security. Violent conflict and civil crises erode state and societal trust, cohesion and social capital, and thus adaptive capacity and resilience. They also increase the vulnerability of state and society to the impacts of climate change and environmental degradation—and, vice versa, when the effects of climate change and environmental degradation erode societal resilience, a society's vulnerability to violent conflict and civil crises increases. As is further discussed in part 3 of the report, these effects may be exacerbated by poorly designed adaptation and mitigation strategies.

Although climate change and other environmental crises undermine human security and influence the dynamics of violent conflict, there are no hard security solutions to the causes of climate change and environmental degradation. The most effective way of preventing the worst effects of climate change—including the risk of violent conflict over scarce resources—

is reduction of carbon emissions. However, this requires a significant transformation of our global economy, which may take decades. In the meantime, we can work to enhance our knowledge and capacities, thereby allowing us to better manage systemic, emerging, cascading and compound risks. In addition to factoring climate change and other environmental crises into conflict prevention, peacekeeping and peacebuilding, conflict sensitivity should be integrated into climate mitigation and adaptation, disaster risk reduction and development efforts.

We cannot achieve sustainable peace without safeguarding a sustainable biosphere. This is one of the dimensions of what is meant by an 'environment of peace'—our shared ecosystems are environments within which, and without which, there can be no peace. A core starting point for the Environment of Peace report is thus recognition of the fact that peace, security and environmental sustainability are inseparably intertwined. This means adopting new systems of governance that can identify, analyse and adapt to dynamics at both a social-ecological systemic level, especially where they interface with each other. This will require institutions capable of synthesizing information from multiple domains and coping with dynamic uncertainty, with a view to minimizing violence and harm while maximizing social justice and sustaining peace.

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