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Forum

Twelve research agendas for advancing the peace-sustainability nexus

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ABSTRACT

The world's social and environmental systems are currently experiencing an increase in the number of conflicts and irreversible human-induced changes. While destabilizing, these changes offer opportunities to advance the science involved to promote peace and sustainability. This forum outlines 12 key research agendas essential for advancing our understanding of the peace-sustainability nexus: global challenges (including the Anthropocene, disasters, and migration); socio-ecological systems (such as oceans, water, and heritage); policy solutions (focused on cities, food, and geoengineering); and guiding principles for peace and sustainability (emphasizing gender, justice, and plurality). Each agenda echoes the normative elements of peace and sustainability as processes while situating them within specific contexts. This approach works within limitations when mobilizing capacities to minimize unintended negative impacts of well-intentioned solutions. Beyond examining how each area either strengthens or weakens the relationship between peace and sustainability, this forum also encourages future research to explore the interconnections that might illuminate pathways for meaningful action. The brief overview of research trends and knowledge gaps can support future work in considering the capacities, constraints, and contexts underpinning the peace-sustainability nexus.

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Introduction

The 21st century has seen immense changes in social and environmental systems, the rate, pace, and degree of which are unprecedented and increasing [1]. 2023 recorded the highest number of conflicts since the end of World War II, with the wars in Ukraine and Gaza bearing the highest number of battle-related casualties [2,3]. It was also reported in 2024 that six of the nine planetary boundaries transgressed the safe levels for regulating life on Earth, indicating a loss of resilience and risks of crossing tipping points [4]. Meanwhile, progress in achieving the Sustainable Development Goals (SDGs) has slowed down as climate change impacts, conflicts and geopolitical tensions, and the lasting effects of the COVID-19 pandemic have pushed more people into extreme poverty than ever before [5]. While these changes represent destabilization in our whole earth system, they also present opportunities for collective action to redesign institutions and social contracts to advance a more peaceful and sustainable world.

Peace and sustainability are broad, interdisciplinary concepts and, therefore, are challenging to capture in a single definition and difficult to pursue without understanding their core. Since the 1972 UN Conference on the Human Environment—the first world conference centered on environmental issues—environment and development have become closely linked in policy discussions [6]. These dialogues led to the establishment of the World Commission on Environment and Development, which published *Our Common Future*, also known as the Brundtland Report. This report defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [7]. It is emphasized that addressing the needs of the world's poor should be a priority, within the environmental limits.

Reflecting our focus on global challenges and recognizing its significance in international policy, we conceptualize sustainability by drawing on the principles of sustainable development. Given that sustainable development encompasses more than just environmental limits and economic factors, we also adopt a broader definition in our use of the concept of sustainability to include social, political, and institutional dimensions. Social sustainability emphasizes providing opportunities for individuals from diverse communities to reach their full potential, regardless of their background [8]. Political sustainability focuses on governance structures that can integrate environmental, economic, and social efforts for development [8]. Finally, institutional sustainability refers to the presence of organizational frameworks, rules and regulations that support these initiatives [8]. This comprehensive yet structured conceptualization of sustainability enables our analysis of global challenges to remain both inclusive and systematic.

We also adopt a holistic perspective on the concept of peace. Building on the distinction between negative and positive peace, we define peace not only as the absence of violence but also as the presence of conditions that allow people to fulfill their needs [9]. These needs can be categorized by their purpose—survival, well-being, identity, freedom, or ecological balance [10]. The conditions that support the fulfillment of these needs can stem from environmental, economic, social, political, or institutional structures and systems. Therefore, this holistic view of peace aligns with the broad approach to sustainability, and integrating these concepts enables us to identify the various factors shaping the interaction between peace and sustainability [11].

The definitions above highlight the normative elements of peace and sustainability, outlining the key characteristics or requirements of peaceful and sustainable systems. However, peace and sustainability should also be viewed as dynamic processes [12,13], with shifting goals that depend on the capacities and constraints involved in addressing challenges. These processes do not adhere to simple cause-and-effect relationships. For instance, domestic democratic processes do not automatically lead to international peace, as hypothesized by the democratic peace theory; other factors, such as economic interdependence, also play a role. Similarly, the effectiveness of climate adaptation measures taken in one area may not be applicable to another area facing a different type of disaster.

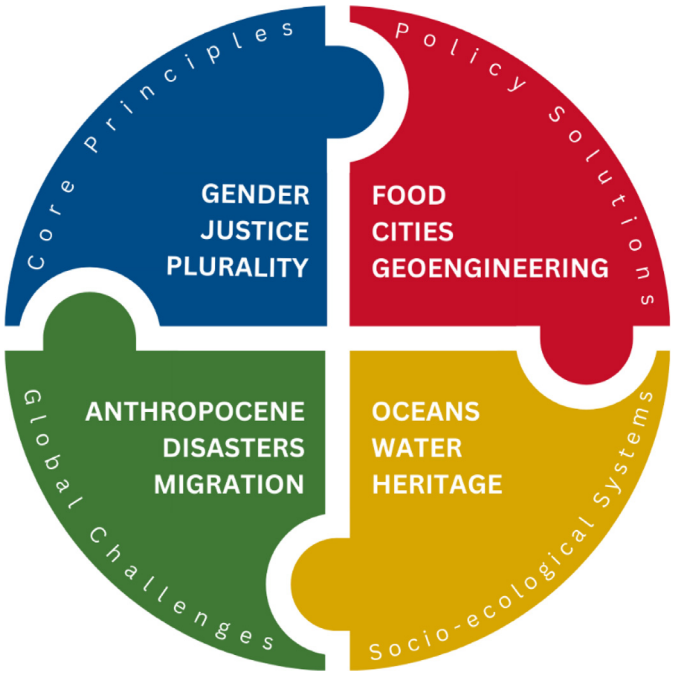

Fig. 1. 12 research agendas for advancing the peace-sustainability nexus.

Rather than following linear causal pathways, peace and sustainability are embedded in a complex web of interconnected factors. In this dynamic context, peaceful and sustainable systems are fundamentally resilient, possessing the ability "to buffer change, learn and develop" [14]. Therefore, studying peace and sustainability as complex adaptive systems is both interdisciplinary and pragmatically essential. In peacebuilding, this perspective emphasizes an iterative process of experimentation and feedback, allowing societies to build institutions capable of coping with and transforming from conflict [15]. In sustainable development, it fosters synergies between economic development, technological change, and resource management [14].

The research agendas presented in this forum highlight the normative aspects of peace and sustainability as ongoing processes and the importance of working within constraints when deploying resources to address interconnected challenges to minimize the unintended negative consequences of well-intentioned solutions. While these agendas can be linked and categorized in various ways, we have structured the following sections around global challenges (the Anthropocene, disasters, and migration), socio-ecological systems (oceans, water, and heritage), policy solutions (cities, food, and geoengineering), and guiding principles for peace and sustainability (gender, justice, and plurality) (see Fig. 1). Further reflecting the nature of a complex system, the 12 research agendas proposed are interrelated—from pairs of topics (e.g., cities and disasters) to broader networks (e.g., the Anthropocene, migration, geoengineering, and plurality). This collection of agendas is not an exhaustive representation of topics related to both peace and sustainability but rather a prompt for future research to contextualize issues and identify pathways in which these issues interact with each other. The brief overview of research trends and knowledge gaps in these areas may also guide future work in considering the capacities, constraints, and contexts that shape the relationship between peace and sustainability.

1. Anthropocene
Dahlia Simangan

Scientific evidence suggests that human activities have pushed the Earth into a new geological epoch called the Anthropocene [16]. In contrast to the stable Holocene, the Anthropocene is characterized by ruptures, as manifested in various biophysical disruptions, such as climate change, biodiversity loss, ocean acidification, and pollution. Despite the announcement by the International Union of Geological Science (IUGS) that it will not officially adopt the term, the Anthropocene remains an important concept, especially in making sense of the relationship between human and natural histories. Several scholars have written about the implications of the Anthropocene for peace, conflict, geopolitics, and international relations [e.g., 17–20]. It provides a normative foundation for governing peace and sustainability in the age of global environmental change.

Environmental changes affect the conditions that support or undermine peace and security. For example, resource scarcity due to climatic factors could lead to competition that could exacerbate existing tensions, while resource abundance due to energy transitions could fund violent activities in conflict-affected societies [21]. Meanwhile, addressing environmental challenges necessitates cooperation—from community-level resource management to global climate action—thereby promoting trust and social cohesion [22,23]. These challenges, as well as the responses to them, may have a dual effect on peace and sustainability. For instance, environmental and natural disasters that have become more frequent and severe in the past decades could undermine peace by delaying peace negotiations; they could also resolve or postpone conflict by displacing and demobilizing combatants [24,25].

The ontological and epistemological debates surrounding the Anthropocene could also inform a rethinking of the assumptions behind peace and sustainability. For one, it challenges the traditional state-centric and militarist approaches to peace and security. Militarism, which entrenches state-centrism, not only fails to address a wide range of peace and security issues but also contributes to the conditions that led to the Anthropocene [26]. Nuclear proliferation is justified on the basis of short-term state interests, despite the long-term devastating impacts of nuclear fallout on ecosystems and human health. Global military expenditures continue to rise despite the need to fund other global challenges, such as climate adaptation, while military-industrial complexes remain exempt from global commitments to reduce greenhouse gas emissions [27].

The critical discourse on the Anthropocene also helps reveal the problematic design of the global economy. The socio-ecological factors that led to the Anthropocene reflect the commodification of nature for capital accumulation [28], alongside the global expansion of industrialization through (neo)colonialism. This capitalist model encourages the overconsumption and accumulation of finite resources for the purpose of prosperity, human development, and consequently, peace. Unlimited growth and capital accumulation are economically desired, despite being environmentally harmful. They also deepen structural inequalities—or systemic, governmental, and administrative barriers to equity for various sectors of society—and reify historical injustices that become more pronounced in times of catastrophes,[#] as we saw during the COVID-19 pandemic. Replacing a consumption-driven economy with more sustainable economic models will not only reduce structural inequalities but also increase access to means of survival and well-being amidst environmental challenges [26]. Despite the problematic connotations of the term, the Anthropocene serves as a reminder of human-nonhuman nature entanglement, i.e., environmental destruction for anthropocentric purposes will ultimately threaten human survival.

The question is no longer about how existing structures and mechanisms can address global environmental challenges in the Anthropocene but more about how these challenges can transform governance. As such, the Anthropocene is a valuable contextual backdrop for rethinking how we govern peace and sustainability. First, what alternative security frameworks are more aligned with the challenges in the Anthropocene? Rather than states and national interests as the objects of security, in his conceptualization of ecological security, McDonald argues the most vulnerable across time, space, and species must be the focus of the climate security discourse [29]. This call echoes Dryzek and Pickering's concept of formative agents, including the most vulnerable and nonhumans, who have the moral agency to shape the norms and discourses in the Anthropocene [30]. Peace in the Anthropocene, therefore, must consider what peace means for nontraditional objects and subjects of security. Second, what are more ecologically aligned alternatives to a growth-centric economy? One of the reasons for failing to deliver socio-ecological sustainability is that the growth imperative is firmly entrenched in global politics [31]. Political structures must welcome alternative measures of wealth and progress. Existing work on decentralized, localized, and care economies [32,33], for example, may engage with the critical discourse on the Anthropocene to infuse their call for radical economic transformations with the ostensible urgency to survive ongoing ecological crises. Sustainability in the Anthropocene, therefore, begs the question of when these transformations will happen.

2. Disasters
Tobias Ide

Disasters play a key role in the peace-sustainability nexus. In 2023 alone, disasters like droughts, earthquakes, floods, and storms affected around 93 million people throughout the world, over 86,000 of which died from their direct impacts. Disasters also caused economic damage of US$ 203 billion and forced 26 million people to leave their homes involuntarily [34,35]. Furthermore, disasters have massive environmental impacts, for instance, the 2011 tsunami that destroyed industrial facilities and a nuclear reactor along the coast of Japan, resulting in massive contamination. Consequentially, disasters have considerable impacts on sustainable human development and positive peace.

Indirectly, disasters also tend to undermine negative peace. Droughts contribute to farmer-herder and pastoralist conflicts across the Sahel, specifically in locations with already tense intergroup relations and a high disaster vulnerability [36]. Earthquakes and storms have provided recruitment opportunities to rebel groups, weakened state institutions, and thus contributed to the escalation of civil wars in countries as diverse as Egypt, India, and the Philippines [24]. More recent work indicates, however, that under certain circumstances, disasters can also contribute to peace. This is either because groups with tense relations cooperate in the face of a shared challenge or because the disaster undermines their ability to wage violence (e.g., because bases and infrastructure are destroyed). The 2004 Indian Ocean tsunami, for example, contributed to a lasting peace agreement in Aceh, Indonesia [24,25]. So far, however, only limited knowledge is available on a potential disaster-peace nexus.

Disasters are likely to get more frequent and more intense in the future because they interact with several other key sustainability challenges. In this context, it is important to remember that disasters result from the interaction of extreme natural conditions (hazards) with societal vulnerabilities—both of which are on the rise. Climate change increases the risk of extreme weather events like heat waves, dry spells, or heavy rainfalls that can turn into disasters. Due to rapid urbanization, more people and economic assets are located in exposed areas, such as low-lying coastlines. Furthermore, because of continuously high levels of poverty, many households lack the ability to prepare for and deal with disasters [37].

[#] We consider structural inequalities as inequalities embedded in social, economic, and political institutions, and therefore systemic. Echoing Galtung's conceptualization of violence and peace, these inequalities result in structural violence or avoidable and indirect harm to people's ability and opportunity to meet their fundamental needs [9]. Such forms of violence may stem from a history of oppression and discrimination and are perpetuated across generations.

Several issue areas are crucial to better understand the role of disasters in the peace-sustainability nexus. To start with, identifying the causes of disaster risks will better inform scientific and policy debates. Attribution research in the physical sciences has come a long way in identifying climate change's impact on extreme weather events, even though critical knowledge gaps remain [38]. Assessing such impacts more precisely will facilitate anticipatory measures and benefit debates about climate impacts on conflict and migration. Complementing these insights, critical social scientists have shown how decision-makers tend to blame climate change for their own policy failures. For instance, droughts in the Middle East have been attributed to a lack of rainfall rather than to groundwater overuse and subsidies for crops that are too water-intensive for the local climate [39]. In extreme cases, elites have used disaster vulnerability narratives to re-settle farmers and fishers from tsunami-prone coastlines, only to quickly allocate the land to luxury tourism hotels [40]. Critically investigating the social drivers of disaster risks (including mal-responses to disasters) will further benefit peace and sustainability.

Gender is another emerging topic in disaster research that requires further attention. An impressive body of work has demonstrated how women are unequally affected by disasters due to increased risks of sexual violence in emergency shelters and higher female workloads in post-disaster settings, among others [41]. Less is known about the specific disaster vulnerabilities faced by men (e.g., due to social expectations of them taking higher risks) and by non-binary people (e.g., because emergency shelters are organized around binary gender categories) [42]. The gendered dimensions of the disaster-conflict nexus also require further study to address peace and sustainability challenges simultaneously [43].

3. Migration
Vally Koubi

Climate change, characterized by increased storms, floods, droughts, and rising sea levels, is expected to increase migration, especially among vulnerable populations [44]. The World Bank's Groundswell report projects that if current trends in emission and development continue, climate-related impacts could compel 216 million people across six regions of the world to relocate within their countries by 2050 [45]. In response, interdisciplinary research over the past decade—from geography and economics to climate and environmental science, climate adaptation, and political science—has largely focused on establishing the connection between environmental/climatic change and migration. Yet, there has been comparatively little investigation into how environmental migration might influence peace and sustainability, either by fostering resilience or posing new challenges.

Environmental migration can have substantial effects on the intertwined areas of peace and sustainability [46]. For individuals and communities facing worsening environmental conditions, migration often acts as a critical coping strategy [47]. By moving away from vulnerable areas, people can diversify their incomes and increase resilience, while also reducing environmental pressures on overburdened regions, potentially allowing ecosystems to recover and enhancing long-term sustainability. Additionally, migrants often send remittances back to their home communities, helping to diversify livelihoods, stabilize local economies, and alleviate poverty [48]. These financial flows support sustainable development efforts, enhancing peace by promoting economic stability and improved living standards.

The relationship between peace and sustainability is complex [49], and the positive impacts of environmental migration are not guaranteed. In receiving regions, a sudden influx of migrants can strain resources, intensify job competition, and increase demand on housing, healthcare, and education systems [50]. Many migrants also end up settling in environmentally vulnerable areas, where they face unfamiliar risks such as urban crime [51] and may experience discrimination, all of which can heighten their sense of marginalization that can fuel grievance [52]. Without proper management, these pressures can lead to socio-economic inequalities, social and ethnic tensions, and even unrest, threatening peace and hindering sustainable development [53,54]. In migrants' home regions, large-scale departures can lead to labor shortages, reduced economic activity, and a shrinking tax base, limiting investment in essential public goods and services [55]. This can intensify local vulnerabilities and weaken social cohesion, further straining peace and stability. Moreover, those left behind—often the most vulnerable, lacking human and financial capital to migrate [56,57]—may face worsening environmental and economic conditions, making them more susceptible to environmental hazards and economic hardship, and posing additional challenges for peace and sustainability.

While migration can help to address environmental and economic challenges, potentially supporting peace and sustainability, it also carries risks that may threaten these goals. Thus, thorough research is crucial to fully understand both the positive and negative impacts of migration driven by environmental and climatic changes. This research should rely on empirical evidence and longitudinal data tracking migration flows and patterns, with careful distinction between internal and international migration, rural-to-rural and rural-to-urban movements, and permanent versus temporary relocation. These distinctions are critical for capturing the diverse experiences of migrants and non-migrants alike, as well as the varied impacts on both origin and destination communities.

Additionally, integrating interdisciplinary approaches that account for social, political, economic, and environmental factors is crucial for fully understanding the complexities of (im)mobility and its broader implications for the peace-sustainability nexus. Such a holistic approach can shape policies and interventions that not only address immediate migration challenges but also foster long-term resilience and stability. By examining and managing the intricate connections between environmental migration, peace, and sustainability, we can develop more effective strategies to support vulnerable populations and promote sustainable development. This comprehensive understanding is essential to ensure that environmental migration serves as a positive force for peace and sustainability, rather than drivers of instability and conflict.

4. Oceans
Cullen Hendrix

The world's oceans provide invaluable ecosystem services by producing oxygen, acting as a carbon sink, and absorbing most of the heat generated by global warming, while facilitating 80 % global trade, and providing food and livelihood security for over a billion people. Yet the world's oceans have often been sidelined in discussions of climate security and resilience. And while academic discussions of climate security have been dominated by scholars from the Global North, this oversight extends to the developing world as well. A 2021 survey of over 7000 public, private sector, and civil society leaders from 141 developing countries and semi-autonomous territories found SDG 14 (Life Below Water), which addresses conservation of marine resources and ecosystems, was the bottom priority for each stakeholder group [58]. This needs to change. The world's oceans are at or near a variety of critical tipping points related both to climate change and attempts to mitigate it.

Against rising global demand for fish, 90 % of the world's marine fish stocks are fully exploited, overexploited, or depleted [59]. The negative impacts of fisheries collapses would be felt hardest in the developing world, where over a quarter of all animal protein consumed is fish-based and 97 % of fisherfolk live [60]. In addition to these challenges, global fisheries are also on the move, with commercially important fish stocks migrating in search of more habitable ocean environments, resulting in large losses in maximum catch potential concentrated in tropical countries' exclusive economic zones (EEZs) [61]. These circumstances will embolden fishing fleets to follow migrating stocks into the high seas or into other countries' EEZs, cause countries to assert contentious

claims to disputed islands, or create artificial islands, potentially sparking broader geopolitical conflict [62,63].

The Atlantic meridional overturning circulation (AMOC) plays a critical role in regulating the climates of North America and Europe and monsoon patterns in the tropics. AMOC is a system of ocean currents that move warmer, saltier water from the tropics to the North Atlantic Ocean, returning cooler, less saline water to the tropics. AMOC is showing signs of slowing and becoming more variable due to increasing ocean temperatures and lower concentration levels of salinity due to melting ice sheets and changing currents. Some simulation-based analyses point to a collapse by mid-century under business-as-usual emissions scenarios [64], with historic collapses having preceded previous abrupt climate shifts [65]. This event would be unprecedented in the modern era, and points to a critical gap in our understanding of rapid climate regime shifts that are not amenable to standard empirical analysis.

As part of efforts to mitigate climate change, deep sea mining is being offered as a solution to supply concerns about metals—including nickel, copper, cobalt, manganese, and rare-earth elements—that underpin renewable energy and transport systems. In 2024, Norway became the first country to open its EEZ for mining activity, and the International Seabed Authority authorized contracts for exploration to 16 different entities in the Pacific Ocean's Clarion-Clipperton Zone. Opening the high seas to mining activities has the potential to disrupt ocean ecosystems that are, to date, poorly understood [66].

Failing to address these and other challenges will threaten not just our global climate but also prospects for peace. Studies show an increasing frequency of fisheries-related conflicts at sea between sovereign states and their militaries [67], including in ocean regions, like the East and South China Seas and the Gulf of Aden, with significant underlying geopolitical tensions [68,69]. Climate change also opens the polar oceans to commercial and militarized activity, increasing their economic and strategic significance for major powers and other high-absolute latitude countries. Identifying the hard and human security implications of these developments is crucial for advancing our understanding of the peace-sustainability nexus.

In addition to these pressing concerns, the oceans are a particularly crucial case for theories of global governance. The high seas constitute a global commons governed by a framework established by the UN Convention on the Law of the Sea (including the International Seabed Authority) and a patchwork of multilateral regional fisheries management organizations (RFMOs) that vary widely in their assessed capacity to provide effective fisheries management under climate change [70,71]. Future research may consider how the health of our oceans can be secured through collective action against a dynamic backdrop of changing ocean conditions and increasing geopolitical fragmentation.

5. Water

Katherine Alfredo

"Water is life" is a common refrain in many societies. Water is an everyday necessity—hydration, sanitation, cooking—yet while water is everywhere, provisions of potable water is not. There are two key areas in water sustainability that need more attention to eventually achieve Sustainable Development Goal 6 and ensure the availability and sustainable management of water for all. First, the use of infrastructure as a development marker is misguided and we need a better way to measure "access" to potable water. Second, we need to think about the impact of conflict on the sustainability of potable water provisions.

A key area of future research is to improve our benchmarking to move beyond simple infrastructure accounting. Despite decades of large-scale investment in water treatment technologies worldwide [72], about 2 billion people still lack access to safe drinking water. The traditional assumption that potable water provision can be achieved by simply advancing technological complexity somewhere in the delivery chain ignores the fact that new infrastructure is developed in a dynamic social and environmental context. While tabulating water infrastructure is an easy approach to evaluating access, water infrastructure does not unequivocally equal access. We must account for technology operation and management to achieve sustainable and efficient operation. Rates of failure of water technologies (at around 20 %) are notable even for basic communal hand pumps [73,74]; however, the rate increases to over 75 % for technologies designed to treat contaminated water [75,76]. In the absence of regular upkeep, these technologies cannot provide safe water, resulting in health and mortality impacts in the affected communities. In rural areas of India, where decentralized water treatment plants are eventually handed over to communities to own and operate, it was found that 90 % of a study's community-level water treatment systems failed within 18 months of the system being transferred from a private company to community management [75]. The failure of water systems is most critical in rural areas because it is often hidden in remote locations and unaccounted for in terms of infrastructure failure. According to the UN, almost half of the world's population live in rural areas (mostly in Asia and Africa) and are served by some form of decentralized water infrastructure [77]. When technology fails in these communities, residents revert to the available unsafe sources of water, but they are still counted as having access within most development metrics. These indices are misleading and do not account for an infrastructure's long-term success.

Another key area of research is to understand how and why people make certain water source selections and decisions to improve resilience through adaptive management. Water infrastructure exists in a complicated social landscape, and managing water infrastructure at the community level requires more than just technical knowledge and resources [74,75,78]. New infrastructure is never built in a social void, and thus the new "hard infrastructure" must adjust to local community norms and practices [79]. Installed technologies contend with many unaccounted-for stressors that threaten resilience and long-term sustainability. Most development assistance (and research) focuses on the process associated with immediate integration into a community—technology operation, willingness to pay, social engagement. However, these limited considerations ignore how dynamic social and environmental factors—climate variability, environmental resource constraints, local conflict—act as stressors on environmental and social systems, which may trigger tipping points ("shocks") associated with the water infrastructure.

For example, changing rainfall patterns may result in decreased groundwater infiltration which can lead to increased geogenic contaminants, a direct stress on the technology's efficiency and long-term resilience. These same changing rainfall patterns can also lead to crop failures [80] and heat-related health issues [81], which can impact a community's long-term ability to maintain a communally owned water technology. Even when maintained, water infrastructure can become a casualty of local conflict. Prejudices have led to unequal access. Redlining in many US cities have created unbounded communities, still lacking piped potable water despite being located within major city centers [82,83]. And in other areas of the world, racial [83] and socio-economic standing [84] can continue to restrict access to marginalized communities even after a potable source is installed. Conflict on a larger scale can then more broadly disrupt access. Water has historically been a weapon of conflict—intentional poisoning of water sources, intentional explosions of dams, or simply a casualty of conflict. It is estimated that even for medium-sized conflicts, 1.8 % of a local population can be deprived of access to potable water as a result [85].

These two complications produce real tests of infrastructure resilience and *effective* access, but are largely ignored due to the typical technology integration, management, and accountability structure of the water development field and how the development indices are scored. Future research may consider how to account for long-term infrastructure success and accountability to improve our scorecards and our water access and quality data. With improved data, we can begin to better understand the social pressures impacting water technology access and provisions to address the concerns of the most disadvantaged and marginalized within our society.

6. Heritage
John Lee Candelaria

Cultural heritage occupies a complex role in conflict dynamics, acting as both a source of tension and a catalyst for peace. Frequently targeted to assert dominance or erase adversarial symbols [86], heritage can also become a contested resource that exacerbates tensions [87]. However, these same cultural elements hold significant potential for peacebuilding. When leveraged effectively, heritage sites can offer symbolic reparations, providing space for intergroup dialogue, fostering social cohesion, rebuilding trust, and supporting reconciliation through communal healing and conflict transformation [88].

Cultural heritage has also been increasingly recognized as integral to sustainable development, though its role has often been overlooked [89]. While heritage is explicitly mentioned under SDG 11 (Sustainable Cities and Communities), its relevance extends to other goals, including SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), and SDG 16 (Peace, Justice, and Strong Institutions). Effective cultural heritage management has the potential to drive sustainable urban regeneration, stimulate local economies, and strengthen social cohesion [90]. These connections underscore the importance of developing innovative strategies that link heritage preservation with sustainable development practices.

Exploring the link between peace and sustainability through the lens of cultural heritage provides a deeper understanding of how social cohesion—a vital component of peaceful and sustainable societies—functions. Social cohesion, characterized by trust, mutual respect, and a sense of belonging among diverse groups, is essential for managing natural resources effectively, equitably distributing environmental benefits, and fostering collective action [91]. It also enhances resilience to social and environmental shocks and is crucial for long-term sustainability. Moreover, cultural heritage further grounds the concept of sustainability, which often suffers from ambiguity due to its multiple interpretations across different perspectives, values, and contexts [92]. By linking sustainability to cultural heritage, the concept becomes more tangible and meaningful to communities, emphasizing the preservation of the environment along with the values, traditions, and practices that define a society. This connection logically contributes to positive peace by fostering a holistic view of sustainability that integrates cultural, social, and environmental dimensions.

Shifting the focus of cultural heritage—from its role in conflict to its potential in fostering peace—reveals its capacity to drive what Galtung [10] called "cultural peace," a state where cultural elements actively promote nonviolence, cooperation, and harmony. Recognizing the peacebuilding potential of cultural heritage, particularly in local contexts, allows for a departure from top-down, standardized approaches to peacebuilding, and advocates for more context-specific strategies sensitive to each community's unique cultural dynamics [93].

To advance the peace-sustainability nexus through cultural heritage, future research should adopt an interdisciplinary approach, drawing insights from anthropology, peace studies, environmental science, and cultural studies, among others. This approach would enable a more comprehensive understanding of the complex interconnections across these fields. While existing research primarily focuses on cultural heritage's role in post-conflict reconstruction [94], future studies should examine how sustainable practices in rebuilding tangible cultural heritage contribute to long-term peace and sustainability in these areas. Additionally, exploring the roles of intangible cultural heritage—such as traditions, languages, and rituals—in fostering peace and sustainability within multi-ethnic societies is essential. Such exploration could reveal how intangible cultural heritage supports social cohesion and sustainable development in culturally diverse settings. Lastly, research must investigate how cultural heritage initiatives can be effectively integrated into the global sustainable development agenda, particularly the SDGs, to amplify their impact, especially in post-conflict and developing regions. While Giliberto and Labadi offer a foundation for this inquiry [89], further exploration is necessary to fully grasp cultural heritage's potential in advancing global goals such as social equity, environmental protection, and economic resilience.

Exploring these inquiries will significantly deepen our understanding of the intricate link between peace and sustainability. First, it will illuminate the enduring influence of cultural heritage, transcending the immediate realm of post-conflict rebuilding efforts. Second, it will bridge the divide between tangible and intangible heritage, underscoring their roles in fostering social cohesion. Finally, it will critically examine how cultural heritage can be integrated into the global sustainable development agenda, positioning heritage as an essential component in attaining comprehensive and equitable development outcomes.

7. Cities
Ayyoob Sharifi

Cities, as the primary habitat for the world's population and epicenters of innovation and economic growth, play a crucial role in advancing sustainability and addressing global challenges like climate change. The concept of 'urban resilience'—a city's capacity to plan for, withstand, recover from, and adapt to various stresses and shocks—can in most cases reinforce peace, sustainability, and their nexus in cities [95]. When properly implemented, urban resilience strategies can create a virtuous cycle that promotes both peace and sustainability. By enhancing a city's ability to manage risks proactively, urban planners can mitigate potential conflicts arising from resource scarcity, environmental degradation, or social inequalities. For instance, investing in sustainable infrastructure and equitable resource distribution can reduce competition for basic necessities, fostering social cohesion and stability. Moreover, resilient cities are better equipped to handle climate-related challenges, reducing the likelihood of environmental disasters that could lead to social unrest and resource conflicts, as evidenced during recent crises such as the COVID-19 pandemic [96].

The absence of proper planning and management in urban areas can transform large concentrations of people and assets into hotbeds of vulnerability. This can severely undermine both peace and sustainability efforts. When cities lack the ability to manage risks effectively, the potential for conflict among urban residents and stakeholders increases dramatically. Competition for dwindling resources or safe living spaces can escalate tensions, leading to social unrest and, in extreme cases, violence [97]. This breakdown in social order not only threatens peace but also diverts attention and resources away from long-term sustainability goals. Furthermore, inadequate risk management often results in a reactive approach to crises, demanding costly emergency measures that strain city budgets. These financial burdens can leave limited resources for investing in sustainable development initiatives, creating a vicious cycle where short-term crisis management perpetually overshadows long-term sustainability efforts.

The key to leveraging urban resilience as a positive force lies in effective disaster risk management. By implementing comprehensive strategies that anticipate and mitigate various urban risks, cities can create synergistic benefits that enhance both peace and sustainability. In addition, it is essential to provide necessary measures and infrastructures for more effective risk communication. This requires not only optimized use of early-warning systems and mapping tools, but also effective engagement of various stakeholders during various stages of disaster risk management. Such proactive approaches can reduce the likelihood of conflicts arising from resource scarcity or environmental degradation. They can also facilitate optimized management of resources for sustainable development initiatives. However, it is crucial to recognize that resilience is not inherently positive and can, in fact, undermine long-term peace and sustainability if not carefully managed. A city can be resilient without being sustainable, particularly when planners and policymakers prioritize short-term actions and 'low-hanging fruits' over a long-term vision. This narrow-minded approach, often driven by economic or political pressures to please constituencies, can lead to increased vulnera-

bility in the long run. An illustrative example of this phenomenon is the use of energy-intensive approaches to address increasing heating and cooling demands in cities. While these methods may provide immediate relief, they create undesirable feedback loops that further lock cities and their residents into intensified climate change. Such actions may appear resilient in the short term but ultimately exacerbate the very problems they aim to solve, potentially leading to resource conflicts and social unrest [98,99].

The conceptualization of urban resilience from a social-ecological-technological perspective is a recent research trend that can contribute to developing resilient cities that also provide co-benefits for peace and sustainability. This perspective requires recognizing the complex and dynamic interactions between multiple social, ecological, and technological dimensions that influence urban planning and development. It is conducive to achieving desirable resilience by maximizing co-benefits and minimizing trade-offs in the long run [99].

As this is an emerging field, further research is needed to advance our understanding of how urban resilience interacts with peace and sustainability. First, how can we effectively measure and balance short-term resilience against long-term sustainability in urban planning? Answering this will help address the core tension between immediate resilience and long-term sustainability, and provide urban planners and policymakers with concrete metrics and methodologies to evaluate their strategies. By identifying innovative approaches to integrate peace and sustainability into resilience planning, even under resource constraints, we can help cities avoid the pitfalls of pursuing resilience at the expense of long-term peace and sustainability. One condition to balance the often-competing priorities should be ensuring that positive peace will be maintained in cities. In other words, the indicators of positive peace should be considered when determining thresholds and tipping points to balance short-term resilience against long-term sustainability.

Second, what are the specific mechanisms by which urban resilience strategies impact social cohesion and conflict prevention in cities? This question focuses on the direct links between resilience measures and social dynamics within urban environments. Answering it will address the interlinkages between the social dimension and other ecological and technological dimensions. Understanding these mechanisms would shed light on how different resilience strategies affect the social fabric of cities, which is crucial for maintaining peace. By identifying which resilience measures promote social cohesion and which might inadvertently create or exacerbate divisions, we can design more effective policies that simultaneously enhance a city's ability to withstand shocks while also fostering a peaceful, inclusive urban environment.

8. Food

Ali Kharrazi

Food systems—encompassing how, where, by what means, and with what inputs food is grown and consumed—are deeply connected to the peace-sustainability nexus. Meeting the global demand for food equitably and sustainably requires robust resource governance to ensure the responsible use of critical inputs and ecosystem services, such as water, soil, fertilizers, and carbon capture. Mismanagement of these resources threatens not only environmental stability but also undermines social cohesion, linking food systems directly to broader challenges in peace and sustainability [8]. Compounding this complexity, modern food systems are increasingly reliant on international trade, both for staple crops like wheat, soy, and corn, and for essential inputs, such as fertilizers, pesticides, and energy [100,101]. While global supply chains have successfully fed billions over decades, their fragility amplifies risks when shocks like market fluctuations, financial instability, wars, or pandemics occur. Developing countries, which often lack the infrastructure and financial resilience to absorb these disruptions, are disproportionately affected, leading to heightened food insecurity and exacerbating inequalities [102]. When considering food system security as an indirect driver of conflict and fragility, this imbalance underscores how food systems—heavily reliant on global trade, susceptible to market shocks, and increasingly impacted by climate change—can become fragile, undermining both peace and sustainability, particularly in contexts of global inequity.

Recent research trends in food systems have expanded beyond the traditional dimensions of availability, access, utilization, and stability to include two critical additions: agency and sustainability [103,104]. This shift reflects a growing recognition of the social and environmental complexities that underpin food systems. Agency emphasizes empowerment and the ability of individuals and communities to have a voice in how food systems are shaped, reinforcing the connection between food security and human rights. Sustainability, on the other hand, highlights the importance of resource management and environmental stewardship to ensure the long-term viability of food systems. The inclusion of agency and sustainability in food systems research has deepened its interdisciplinary nature, engaging fields such as environmental economics, sociology, psychology, nutrition, agriculture, and resource management. This diversification reflects the complexity of food systems, where social empowerment, environmental sustainability, and economic stability intersect. Current research is focused on developing methodologies that better account and quantify for these interdependencies, aiming to address systemic challenges. This involves moving beyond theoretical models to design interventions that are context-specific, equitable, and scalable.

Food systems are increasingly seen as platforms for empowerment and tools for addressing global inequities. A circular economy approach emphasizes reducing dependency on imports, minimizing waste, and strengthening local production cycles. Advances in natural capital accounting and payment for ecosystem services are enabling more accurate valuation of environmental contributions, incentivizing sustainable practices, and fostering transitions that address socio-economic impacts. In parallel, practical strategies, such as transboundary water-sharing agreements and linking energy, water, and food systems are emerging to tackle resource challenges in a climate-impacted world [105]. These examples demonstrate that addressing structural vulnerabilities in food systems is essential for reducing conflict and fostering sustainable development.

An essential step in strengthening food systems is promoting adaptation measures that address climate-related shocks—such as rising temperatures, floods, and droughts. While developing new, more resilient crop varieties is crucial, it is equally important to clarify what 'resilience' means and for whom [106,107]. For instance, smallholder farmers may define resilience in terms of immediate livelihoods, while policymakers focus on longer-term market stability. In both cases, farmer capacity—shaped by access to formal and nonformal education [108], financial resources, and institutional support—ultimately determines how effectively adaptation measures are implemented [109]. Policies that support environmental literacy, facilitate affordable credit, and offer incentives for climate-smart agriculture can substantially enhance resilience at multiple levels.

Future research should focus on three key areas to strengthen the peace-sustainability nexus in food systems. First, it should investigate how robust resource governance can address mismanagement of critical inputs such as water, soil, and fertilizers, mitigating risks of conflict and ensuring environmental stability. Second, it should examine how agency—through empowering individuals and communities to influence food systems—can reduce inequalities and enhance social cohesion, particularly in fragile regions. Finally, research should assess the impact of incorporating sustainability metrics, such as natural capital accounting and payment for ecosystem services, into global food trade policies to reduce disparities and stabilize economies. These directions address structural vulnerabilities in food systems, supporting sustainable development and peacebuilding.

Future research should address three critical questions to explore how food systems can serve as a policy tool for the peace-sustainability nexus. First, how can resource governance ensure the responsible use

of critical inputs, such as water, soil, and fertilizers, to prevent mismanagement that undermines both environmental stability and social cohesion? Answering this would provide actionable insights into reducing resource-driven tensions and safeguarding ecosystem services. Second, how does agency—empowering individuals and communities to participate in food system decisions—strengthen food security and human rights, particularly in fragile regions where inequalities are stark? Understanding this dynamic would illuminate the role of social empowerment in addressing structural vulnerabilities. Finally, what are the effects of integrating sustainability metrics, such as natural capital accounting and payment for ecosystem services, into global food trade policies to manage the fragility of supply chains and reduce food insecurity in developing countries? Addressing these questions would improve understanding of how food systems can be leveraged to address key challenges and actively contribute to the peace-sustainability nexus.

9. Geoengineering
Simon Dalby

The basic premise of sustainability at the global scale is that climate conditions must be maintained at roughly what has been known throughout human history [110]. Stability offers at least rough predictions as to what agricultural conditions will be in any year, and large-scale agriculture is essential to feed a global population in the billions. Failure to do so will likely cause catastrophes in certain societies, with spillover effects leading to the possibility of conflict. While climate stability obviously does not guarantee peace, the potential for major disruptions to generate conflict and possibly major wars looms. The nightmare scenario is rapid disruptions should a key earth system tipping point, such as the cessation of the Atlantic meridional ocean circulation, be crossed [111].

The term geoengineering, used to cover atmospheric carbon dioxide removal (CDR), as well as solar radiation management (SRM), stretches the term so much that it covers a multitude of climate interventions. But, given that the sheer scale of human actions is now making the whole earth system an increasingly artificial entity, the overall use of the term makes sense [112]. Consistency and clarity on the terminology would be useful, especially when academic research is taken into the policy arena, but that seems unlikely any time soon. This matters because CDR at least attempts to tackle the causes of climate disruption whereas stratospheric aerosol injection, the most controversial SRM method currently being debated, merely promises to mask some of the worst impacts [113].

Four key issues emerge from the current discussion on geoengineering. First is how suites of technological innovation might work effectively together; focusing on one technology in isolation from others does not lead to either useful insights or helpful policy suggestions. Second is the frequently overlooked question of what interventions will work best where. Nicaraguan policymakers concerned with making an immediate difference in their country are unlikely to want to work on refreezing the Arctic; Nepali scientists will have higher immediate priorities than coral reef restoration to serve as carbon sinks. Third is the question of ocean responses to global warming; the anomalously warm ocean surface temperatures in 2023 and 2024 suggest that oceans, which absorb most of the heat and, at least until recently, much of the carbon dioxide generated by combustion, have focused attention on the possibilities of marine cloud brightening technologies to try to reduce ocean heating directly. Fourth is the obvious but crucial point that, within an increasingly artificial ecosphere, the technical aspects of geoengineering projects cannot be isolated from the social dimensions, and research must link these to effectively grapple with the complexity of shaping the future of the earth system [114].

Research on geoengineering—if it is focused on the key theme in ecological security thinking [29], the need to foster ecological fecundity, and hence resilience in the face of changes that are already “baked in” to the earth system—will have to tackle matters in terms of how these play out in specific biomes. All of this is made more complicated as climate change makes environmental predictions more difficult; accelerating climate disruptions might make measures redundant or ineffective; forest carbon sinks depend on rainfall and growing conditions that allow specific species of trees to flourish. Should these conditions change in the future, a likely prospect, then very different species mixes might be appropriate; sorting out likely adaptation strategies in advance is a key research need.

Hence, at the heart of carbon reduction end of the geoengineering discussion must be examinations of best practices for rewilding, regenerative agriculture, and forestry practices designed to make ecosystems both carbon sinks and ones that are adaptable given the uncertainties of how climate change will play out in coming decades. What gets grown where is a matter of political economy, and as climate adaptation measures often morph into corporate and government extractive activities, questions of who decides on land use priorities and property rights is a further topic for any serious discussion of biological modes of CDR. Crucially, research is needed on how these notions can be effectively transferred to oceanic spaces—the key to the long-term thriving of life in the earth system. These questions suggest clearly that the research agenda linking sustainability to peace must grapple with innovations in governance that can facilitate regenerating ecologies in specific places while simultaneously making them flexible enough to accommodate shifting climate patterns. To be effective, however, the global dimension of all this needs attention too; saving a forest in one jurisdiction is not much help if deforestation is simply shifted to another jurisdiction with less effective regulation [115].

Neither CDR nor SRM offers much hope of long-term climate stability unless the use of fossil fuels is rapidly reduced; then and only then will these technologies offer some useful options for effectively tackling climate impacts. But if warming continues, even if dramatic cuts in the use of fossil fuels come in the next couple of decades, then the unavoidable conclusion is that some form of SRM to cool things is going to be needed. In tackling this agenda, it might be useful to learn from previous innovations in global governance, where technical and societal concerns are meshed in common initiatives [116].

10. Gender
Úrsula Oswald-Spring

Multiple theories on peace and security, specifically in International Relations, were developed mostly by Western men, such as negative, positive, structural, environmental, cosmopolitan, and cultural peace. But these approaches do not explain the root causes of violence, domination, and exploitation of humans and nature. Betty Reardon understood that war and destruction were related to the patriarchy in families, countries, governments, and enterprises, where dominant men exercise violence, exploitation, and dominance [117]. They have produced resource wars, global climate change, and the sixth extinction of biodiversity. Crutzen called the present history of Earth in today’s late capitalism, the Anthropocene, without explaining who this destructive Anthropos is [118].

It is important to uncover the origins and the ongoing destructive extraction of natural resources and the exploitation of people in the Global South by a few neocolonial powers and multinational enterprises. This phase of the Earth’s history is called the Patriacene [119]. The origin of the existing violence is related to the destruction thousands of years ago of the maternal clans, later the purchase of women and slaves by private propriety, the conquest of neighboring states, militarization and wars, neoliberal globalization, and the extraction of natural resources mostly by men. This patriarchal dominance, consolidated by conquests and wars, has threatened the survival of nature and humankind, producing poverty, discrimination of women and Indigenous people, and the powerful destructive history of Earth [119].

An engendered sustainable peace represents an alternative to patriarchal violence, with a systemic analysis of socio-environmental deterioration by negotiating emerging conflicts on resources, sweatshops, and

forced migration [120]. This integrated engendered sustainable peace from the top down and bottom up proposes concrete actions against ongoing wars and environmental destruction. Engendered sustainable peace recognizes female unpaid work and care inside the household. It is oriented to overcome exploitation, violence, hunger, and misery, especially among women and Indigenous people, by recovering societal integration and a care economy. This alternative approach includes protection, solidarity, sorority of vulnerable people, and sustainability for humanity and Mother Earth. It promotes a culturally diverse and sustainable world, where 5 % of Indigenous communities protect 80 % of the remaining biodiversity [121]. Engendered sustainable peace represents a paradigm shift to the dominant patriarchal worldview and political dominance of undemocratic governments. It takes from the Aymara Indigenous people their philosophy of living well [122] and from Bhutan's happiness index [123], putting quality, care, justice, peace, and social integration at the center by promoting the best life for everybody.

Future research may be interested in the following questions crucial for advancing an engendered sustainable peace. Why are women actively involved in peace-building, especially when their husbands and male youths are linked to illegal activities? How can an integrated approach among indigenous communities, organized women, and civil society promote an engendered peace with happiness, including wellbeing for everybody? Answering these questions must start in a decentralized way within small communities and social groups, where equity and environmental restoration also include preventive peacebuilding.

11. Justice
Joshua Fisher

Changes in our interconnected social and environmental systems have begun to intensify, notably in terms of biodiversity, our climate system, and social polarization around the world. The resulting destabilization we are currently facing signals deepening crises for peace and sustainability on global and local levels. Such crises carry heavy costs that are experienced uniquely by different actors based on structural, cultural, and social dynamics. Because of this, actors react to destabilization and system breakdowns in unique ways. Some may try to slow or reverse the breakdown, while others might try to steer it to advance a certain policy or social outcome. Other actors may work to mitigate the adverse effects of the breakdown, while others prepare for an eventual restoration of the system following destabilization. Such a diversity of reactions can inadvertently lead to uncoordinated, countervailing responses or ineffective adaptation strategies, and such reactive responses can generate conflicts across political, social, and geographical divides.

Many of the concurrent breakdowns we are experiencing involve concentric interests and actors, and many are nested at multiple social and spatial scales. We can understand complex interactions across scales through the lens of a social-ecological systems paradigm, which describes how change and disturbance cascade across interconnected human and natural systems [124]. Under this framing, breakdown is an important and inevitable process for a system that has become maladapted to its current social or ecological context. Only by passing through breakdown can a system regenerate in ways that are better adapted to diverse social needs and better able to promote environmental integrity.

Considering that breakdown is a natural part of system evolution, new theoretical and empirical work suggests that rather than trying to stop or reverse a breakdown, it is more effective for stakeholders to work collaboratively to navigate cycles of breakdown and facilitate the regeneration of social and environmental systems [125]. There are many examples of the use of such regenerative practices to promote sustainability. The breakdown of soil health has spawned the development of regenerative agricultural practices that integrate traditional knowledge and modern technologies to improve soils. Regenerative land management likewise works to regenerate ecosystem function in degraded lands. With this in mind, there is a continued need to better understand the mechanisms that enable stakeholders who have experienced conflict, polarization, and injustice to regenerate the social capital needed to move collectively and collaboratively toward a regenerative environmental system.

Effective environmental governance requires collaborative adaptive management [126], and regenerating social capital, or the social networks and social connectivity that build resilience into social systems, has been shown to be a key mechanism for enabling effective and constructive collective action [125]. Crucial to that are the roles of distributive, procedural, and retributive justice as heuristic guides for stakeholders to regenerate that capital. However, our existing notions of justice are not well adapted to navigate intersectional issues of climate, ecosystem integrity, social cohesion, and conflict. Too often, they reify existing social, economic, political, and gender disparities, and in doing so, open pathways to new or renewed conflicts.

Certain notions of justice have been advanced to reconcile these limitations, such as transitional justice and restorative justice. While these have rich traditions, they invoke an idea of a return to or restoration of pre-disturbance states and are not well suited to assist stakeholders adapt to new contexts. It is here that merging the concepts of justice with the principles of regeneration could play a critical role in advancing peace and sustainability. Such work would provide a framework that could enable societies at multiple scales to unlock our collective potential to design collaborative, adaptive institutions that enable stakeholders who have experienced social and environmental breakdowns to regenerate social bonds as well as regenerating ecosystem functioning and environmental integrity. Such a theory would expand the notion of regenerative justice beyond only humans [127] to incorporate climate, geophysical, and ecological processes. Importantly, it would provide a heuristic guide to help societies diagnose institutional deficiencies, navigate conflict constructively, and regenerate institutional architectures to be better adapted to new post-breakdown realities. It would also consider the downstream impacts of decisions across geographic, identity, and generational dimensions. Key questions in this regard include: (1) What are the essential components of a theory of regenerative justice? (2) What are the linkages and pathways for regenerating social and ecological integrity following disturbances? (3) During the regenerative process, how do we ensure that structural injustices and unsustainable social and economic practices are not recreated leading to renewed conflict? (4) Can regenerative justice provide meaningful heuristic guidance for the emerging field of environmental peacebuilding?

12. Plurality
Joyashree Roy

Plurality, particularly in advancing sustainable peace and development, aims to capture complex and interconnected contexts, perspectives, and systems. A pluralistic approach, contrary to a solitarist approach, helps situate people in a multifaceted and diverse world of complex relations and belongingness. Following similar logic, the multiple crises occurring within the broad domains of socio-political, economic, and environmental systems should also be analyzed through their causal entanglement, interconnectedness, and cascading effects rather than crisis-by-crisis, siloed reasoning. Just to give an example, to ignore everything such as an unfinished development agenda, inequity, biodiversity loss, war, and so on, and to focus only on the current state of climate change is to obliterate the complex reality of climatic impacts. We have seen how such a "climate-first" approach has pushed the political position of Non-Annex I countries for a long time to assert their position on non-committal climate action. They put forward the historical past to establish evidence of their contribution—which is negligible compared to Annex I countries of today—to cumulative emissions since 1870, leading to shrinking global carbon budgets for the rest of the world. On the other hand, and with a similarly problematic approach, Annex I countries pick up on their current triumphs in innovation-led actions toward decarbonization to help reduce their territorial emissions [128].

As the world, nations, societies, and communities become polarized, plurality gets lost when framing the complex interconnection among escalating global crises and reasoning becomes influenced by national interests, and collective action gets lost. As Amartya Sen wrote, "a singular classification can make the world thoroughly inflammable…" and "prospects of peace….lie in the recognition of plurality" [129]. Singular classifications of contemporary crises by climate crisis or the rising cost of living or democratic backsliding narrow down reasoning and lead to a siloed structure in policymaking, ignoring the plurality and complex relations among crises. This narrow focus in reasoning leads to various binary identities, such as between believers and deniers of climate change, Annex I and Non-Annex I countries, climate resilient and climate anxious, historically high emitters and anticipated high emitters, rich and poor, status consumers and subsistence consumers, and democracy and autocracy, among other binaries. This gives rise to a volatile societal situation, leading to wrong policy priorities without scientific reasoning of complex relations and the need for the adoption of simultaneous actions through the multiple sensitive intervention points. To build preventive strategies to avoid conflicts and help build a peaceful human society that can live in harmony with other life forms, scientific pluralistic reasoning is needed to develop methods and tools to understand complex relations and design inclusive actions.

The SDG framework, although not perfect [130], in some sense provides a plural approach to address multiple sensitive points across various systems for managing progress in a world with diverse priorities across nations, social groups, and economies. Multiple researchers have looked into the interconnectedness among various SDGs, breaking away from the idea of taking ownership of SDGs as singular issues and siloed thinking [131]. Sustainability studies, political economy, and economics, among other disciplines, have provided scientific insights but not much progress has been made in implementing plurality in approaches at the action level. Hence, if we accept the SDG framework that is determined by an inclusive process as the best the world could politically negotiate, it can provide a plural framework for soft power diplomacy by juxtaposing climate action and peace [132]. Literature on polycrisis is also attempting to provide an analytical framework [133]. Both climate change and lack of peace create global externality, imposing huge cost burdens on all in a world with scarce financial resources. Inequality is a major barrier to peace, as violence is more prevalent in unequal societies. There are competing discourses in the literature about sustainable consumption and ideal ways of living. The rational consumption, social consumption, degrowth approaches to consumption, and just consumption and well-living are some of the approaches that attempt to bridge the gap between incremental, rational, individualized approaches to sustainable consumption and more nuanced conceptions of meaningful, interconnected, peaceful ways of living [134].

As we accept the hypotheses that maintaining plurality can promote peace in society, and/or juxtaposing climate action and peace can enhance global cooperation, then as a scientific community, individually or collaborative, we need to find answers to two important questions. First, how can societies design their economic, political, and social institutions/rules/norms to encourage plurality in practice? And second, how can human intelligence learn and interact with nature's intelligence and co-create a regenerative future for all to support plurality and challenge polarization? It is also important to understand whether this action can deliver eco-modern justice [135], by building productively and focusing on need-based solutions to avoid the miniaturization of other human beings into mere users of technology, which is another form of polarization. With scientific studies like these happening across the world in a short time, a meta-analysis/assessment would provide necessary key messages on pathways for peaceful living and how they vary from the "wellbeing for all" approach and economic growth measured by single metric GDP. It is also necessary to assess whether such pathways overlap with net-zero goals by mid-century, how they converge or diverge from sustainable development, and how priorities must be configured to deliver peace.

Conclusion

Defining and articulating the peace-sustainability nexus continues to be a challenge for academics and practitioners. As research agendas continue to build knowledge in each area, the nexus may well evolve into an emerging field and discipline or could remain transversal across more traditional fields of study. Similarly, policies addressing any singular area must also delineate potential consequences outside of their narrow canonical focus. The research agendas in this forum demonstrate that the peace-sustainability nexus is multifaceted and includes a diverse set of themes operating from micro-level to global scales. While we do recognize that the policy implications of the research agendas presented above do not always operate at the same scales, research into policy responses and impacts can inform modes of political intervention to facilitate effective regulations.

This forum highlights several important questions that scholars of the peace-sustainability nexus must begin to address. Of particular importance are questions such as how the peace-sustainability nexus is unique from or complementary to other fields of study. When focusing on holistic or integrated conceptualizations of peace and sustainability, what are the methods, mechanisms, and pathways that enable societies to move toward policies and institutional designs that promote peace and sustainability? What role can emerging technologies and methods play in better elucidating the peace-sustainability nexus? And finally, in the academic knowledge ecosystem, what is the niche of the peace-sustainability nexus in terms of the functions and information it contributes to the wider ecosystem? We hope that the research agendas presented here prompt new questions as challenges and solutions to peace and sustainability continue to evolve.

The pursuit of scientific and theoretical development of the nexus is critical for enabling societies to adapt to the rapidly changing social and environmental context of the planet, and our hope is that the research agendas outlined in this forum can inform meaningful action to advance a more peaceful and sustainable world. Each of the agendas, similar to the sustainable development goals, are connected and cannot be resolved by one discipline alone. The tension that exists between these focus areas is not one to be ignored but should be the focus of future pursuits.

CRediT authorship contribution statement

Dahlia Simangan: Writing – review & editing, Writing – original draft, Conceptualization. **Joshua Fisher:** Writing – review & editing, Writing – original draft. **Tobias Ide:** Writing – original draft, Conceptualization. **Vally Koubi:** Writing – review & editing, Writing – original draft. **Ayyoob Sharifi:** Writing – review & editing, Writing – original draft. **Katherine Alfredo:** Writing – original draft. **John Lee Candelaria:** Writing – original draft. **Simon Dalby:** Writing – original draft. **Cullen Hendrix:** Writing – original draft. **Ali Kharrazi:** Writing – original draft. **Úrsula Oswald-Spring:** Writing – original draft. **Joyashree Roy:** Writing – original draft.

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