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Refining the Global Goal on Adaptation ahead of COP28

ANNA CABRE, OLIVIA FIELDING, and MICHAEL WEISBERG

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Cover Photo: With support from the Global Climate Fund and UN Development Programme (UNDP), more than 3,200 hectares of mangroves have been regenerated in Vietnam, boosting local livelihoods and biodiversity. May 16, 2023. UNDP Vietnam.

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ABOUT THE AUTHOR

ANNA CABRE is a climate and ocean physicist and an independent researcher at the University of Pennsylvania.

OLIVIA FIELDING is the Program Coordinator for Peace, Climate and Sustainable Development at the International Peace Institute.

MICHAEL WEISBERG is the Bess W. Heyman President's Professor and Chair of Philosophy at the University of Pennsylvania and a Non-resident Senior Adviser at the International Peace Institute.

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ABBREVIATIONS

COP	Conference of the Parties
ENSO	El Niño–Southern Oscillation
FAO	Food and Agriculture Organization
GGA	Global Goal on Adaptation
IHR	International Health Regulations
IPCC	Intergovernmental Panel on Climate Change
NOAA	National Oceanic and Atmospheric Administration
SDG	Sustainable Development Goal
UNEP	UN Environment Programme
UNFCCC	UN Framework Convention on Climate Change
WHO	World Health Organization

Executive Summary

As the 2023 UN Climate Change Conference (COP28) approaches, it is increasingly crucial to understand and develop clear actions for not only mitigation but also adaptation. While mitigation has the clear numerical target of limiting warming to 1.5°C above preindustrial levels, adaptation is a complex concept that cannot be captured in a single figure. Ahead of COP28, there is a need for conceptual clarity as to what exactly the Global Goal on Adaptation (GGA) aims to achieve and how it can be globally applicable when adaptation is so often locally implemented.

One way to clarify the GGA is to adopt well-being as the ultimate outcome toward which countries should be working. Well-being is a state where one can pursue one's goals and thrive. This requires having adequate physical health, water, food, and a healthy environment, even as the impacts of climate change worsen. Adaptation actions that further this goal should be assessed by their effects on present and future human and environmental well-being. Whenever possible, these actions should be both transboundary, reaching across national borders and administrative or jurisdictional boundaries, and transformational, addressing the systemic root causes of climate impacts and working toward a more stable, flexible, and equitable future.

Health, water security, food security, and biodiversity—all essential aspects of human and planetary well-being that can spur transformative, transboundary adaptation action—can be considered the central pillars of the GGA:

- **Human health** requires a healthy lifestyle; access to healthy necessities like water, food, and air; and a healthy environment. Human health is intrinsically intertwined with the health of animals and the environment. Climate risks that impact human health include heat waves, extreme weather events, climate-induced epidemics and increased zoonotic and waterborne diseases, and increased air and water pollution. Actions that can be taken to combat these risks include improving early warning (e.g., better detecting and reporting on disease outbreaks), reducing risk (e.g., improving healthcare and sanitation), and putting in place adequate response systems.
- **Water security** requires sanitary water availability, economic water security, ecosystem health, and resilience to water-related disasters. Climate risks that impact water security include increased water scarcity; increased rain and flooding and longer, more intense droughts; sea-level rise and coastal storm surges; and increased contamination of the water supply, including groundwater salinization. Responses to these risks can include improving water storage, enhancing infrastructure to absorb regular and peak floods and droughts, enhancing the resilience of coastal infrastructure, and improving regulations and management to decrease water waste and improve desalinization processes.
- **Food security** requires availability of food, stable access to food and food distribution systems, and adequate utilization (nutritious and safe foods). Climate risks that impact food security include reduced crop yield and loss of livestock, reduced fish biomass, and supply-chain shocks. Actions to combat these risks can include diversifying agricultural practices, expanding sustainable aquaculture, and facilitating local and regional connectivity.
- **Biodiversity** overlaps with and underpins all three of the other pillars. Climate change is anticipated to become the biggest cause of biodiversity loss, with temperature shifts that create unlivable conditions for historically native species; pollution; land-use change and habitat loss or fragmentation; and hunting, overfishing, and resource exploitation. Actions to combat biodiversity loss include minimizing additional stresses or disturbances; reducing ecosystem fragmentation; and integrating biodiversity protection into health, water, and food frameworks.

While each step of the adaptation policy cycle should be robust and well-funded, these are the four areas where progress is most crucial to achieving the GGA. When crafting a framework for transformational adaptation in these four areas, negotiators and technical experts can draw on existing, agreed-upon frameworks and indicators that point the world toward the goal of well-being for people and planet.

Introduction

The United Nations Framework Convention on Climate Change (UNFCCC) was formed in 1992 as the world's preeminent international governance body for addressing climate change. There have been many milestone agreements and protocols adopted under the UNFCCC since then, the most significant being the Paris Agreement of 2015. Today, 195 parties have joined the Paris Agreement.[1] Every year, negotiators from these parties meet for a two-week negotiation session and conference known as the Conference of the Parties (COP) to negotiate different aspects of the Paris Agreement and other elements of the UNFCCC, such as how far we are falling short of the commitments made in Paris and how we can change course to meet them more effectively.

> At the most basic level, the Global Goal on Adaptation should aim to achieve human and planetary well-being even in the face of the adverse impacts of climate change.

Article 7 of the Paris Agreement established the Global Goal on Adaptation (GGA), articulating the goal's high-level aspiration as "enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response."[2] Unlike mitigation, which has the clear numerical target of limiting warming to 1.5°C (or at least well below 2°C), adaptation is a complex concept that cannot be captured in a single figure. The need for further articulation of the GGA led to the launch of the comprehensive two-year Glasgow–Sharm el-Sheikh work program at COP26 in Glasgow. The work completed under this program, in addition to reports from the Adaptation Committee, the UN Environment Programme (UNEP), and the Global Mapping Initiative, has helped identify elements of the goal, as well as the means of assessing collective progress toward it.[3]

At COP27 in Sharm el-Sheikh, GGA negotiators initiated the development of a high-level framework to "guide the achievement of the global goal on adaptation and the review of overall progress in achieving it with a view to reducing the increasing adverse impacts, risks and vulnerabilities associated with climate change, as well as enhance adaptation action and support."[4] The basis of negotiators' proposed framework was the iterative adaptation cycle (see Figure 1), with a view toward ensuring that all countries and regions have robust processes to plan for and implement best adaptation practices. This is one element upon which most negotiators seem to agree.

In the framework written in Decision 7/CMA.4, the steps of the cycle are accompanied by themes based on the chapters of Working Group II's contribution to the Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report (AR6). The framework also includes cross-cutting considerations for holistic adaptation. This framework should not only ensure robust adaptation processes but also enhance the quality of adaptation actions and guide them toward a global goal of well-being for people and planet. It has the potential to provide an overarching guide to help move countries from purely local, incremental adaptation to transformational adaptation that accounts for transboundary risks.

While it is important to have a framework to give more clarity and structure to the GGA, the focus of this paper is on clarifying the high-level goal itself—in other words, toward what end point the framework should guide adaptation processes. What will a state of enhanced adaptive capacity, greater resilience, and reduced vulnerability look like? In what areas is adaptation most crucial to

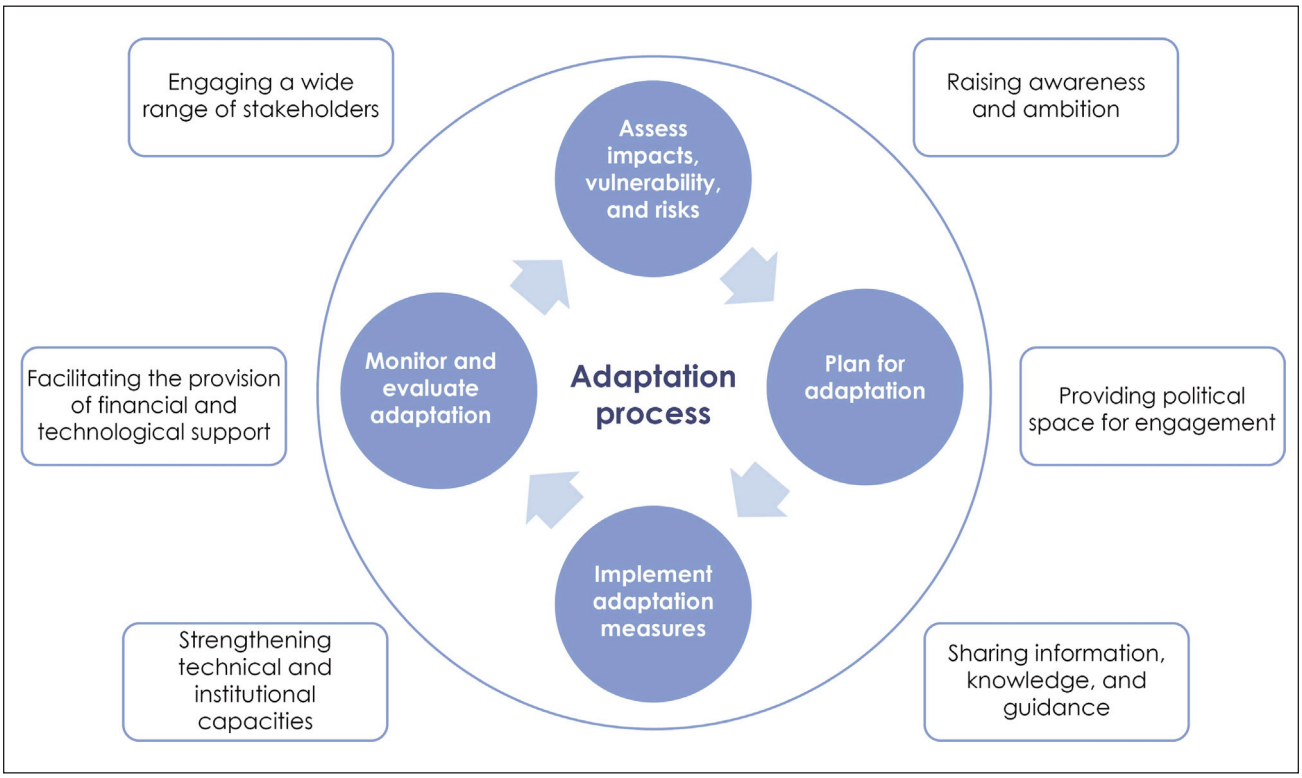
1 UN Treaty Collection, "Status of Treaties," available at https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-d&chapter=27&clang=_en&_gl=1*jjeuth*_ga*MTY0MzQ3Mzc2My4xNTkwNTA0OTg4*_ga_TK9BQL5X7Z*MTY5NzQ4NzE4Ni43Ni4wLjE2OTc0ODcxODYuC4wLjA .

2 United Nations, "Paris Agreement," November 2015, Article 7.1.

3 UNFCCC, "Glasgow–Sharm el-Sheikh Work Programme on the Global Goal on Adaptation," 2021, available at https://unfccc.int/topics/adaptation-and-resilience/workstreams/glasgow-sharm-el-sheikh-WP-GGGA ; UN Adaptation Committee, *Approaches to Reviewing the Overall Progress Made in Achieving the Global Goal on Adaptation: Technical Paper*, UN Doc. AC/2021/TP/GGA, April 9, 2021; UN Environment Programme (UNEP), "Adaptation Gap Report 2022," November 2022; Global Adaptation Mapping Initiative, "Global Adaptation Mapping Initiative: A Collaborative Network for Mapping Global Evidence on Climate Change Adaptation," available at https://globaladaptation.github.io/ .

4 UNFCCC, *Matters Relating to Adaptation: Proposal by the President—Draft Decision -/CMA.4*, UN Doc. FCCC/PA/CMA/2022/L.16, November 19, 2022.

Figure 1. Iterative adaptation cycle within the UN climate regime[5]



ensure human and planetary survival and well-being in the face of climate change? This paper presents non-exhaustive responses to these questions based on analysis of available literature. We argue that at the most basic level, the Global Goal on Adaptation should aim to achieve human and planetary well-being even in the face of the adverse impacts of climate change.

There is no consensus on what constitutes "well-being," so we draw on several definitions. For our overarching definition, we use the capabilities approach, which classifies well-being as a state where one has the capability to pursue one's goals. Achieving this type of well-being requires meeting people's basic needs—including access to clean water, food, and a healthy natural environment—to ensure adequate physical and mental health.[6] Only when these basic, universal needs are met can people pursue their individual goals, economic or otherwise. Ensuring that these basic needs continue to be met, even as the impacts of climate change worsen, reflects a more concrete understanding of what it means to have the "enhanced adaptive capacity, strengthened resilience, and reduced vulnerability" spoken of in Article 7. This will require countries to collectively undertake adaptation actions that are commensurate with transboundary climate change risks to health, water, food security, and the biodiversity that underlies healthy ecosystems. The rest of the paper explores these impact areas.

Transboundary and Transformational Adaptation Actions

First, we must define our key terms: risk, transboundary risk, and transformational adaptation. The IPCC's Sixth Assessment Report defines risk as the "potential for adverse consequences" to "human or ecological systems."[7] In the context of climate change, risk can arise both from potential impacts of climate change and from human

5 UNFCCC, "Introduction: Adaptation and Resilience," available at https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction .

6 IPCC, "IPCC Sixth Assessment Report," 2022, Chapter 7.1.4.

7 IPCC, "The Concept of Risk in the IPCC Sixth Assessment Report: A Summary of Cross–Working Group Discussions—Guidance for IPCC Authors," September 2020.

responses to climate change. According to the IPCC, the three elements of risk related to the adverse impacts of climate change are hazard, vulnerability, and exposure (see Box 1).[8]

These elements all change over time depending on human efforts to mitigate climate change and the resulting climate scenario. Because of this, all three elements contain uncertainty. Adaptation actions also carry the risk of maladaptation, which is when an intended adaptation action ends up creating more risk. Keeping this in mind, we must consider all elements of risk as we articulate the GGA and develop a framework for its implementation, including both physical climate risks and the risks we ourselves might create through maladaptation.

Transboundary and cascading climate risks manifest when the impacts of climate change in one place affect people in another, cascading across both national borders and administrative or jurisdictional boundaries.[9] They also occur when the impacts of adaptation actions affect areas beyond the jurisdictions where they are implemented. One clear example of this is climate-induced migration, which can be caused by any number of climate change impacts and which itself impacts both the place of origin and the destination. Because of these types of risks, even when adaptation is implemented locally, both climate change and our responses to it have transboundary consequences. The Transboundary Climate Risk Report 2023 explores ten such risks, illustrating the transboundary nature of health, water resources, food, and various ecosystem services and functions.[10] In these areas, adaptation can be understood to mean reducing climate-related risks and strengthening resilience across sectors and borders. The report also notes that transboundary climate risks associated with adaptation actions frequently affect global trade, supply routes, and financial pathways. It states that the "transboundary and systemic nature of climate risk cements the need for equity and just resilience as leading principles in approaches to adaptation." As in this paper, the report uses well-being as a central measure.

An increasing number of countries spanning all regions of the world are identifying transboundary climate risks to their water and food security, health systems, and natural ecosystems in both their national adaptation plans and nationally determined contributions.[11] Almost every cycle of the IPCC's Working Group II reports include chapters that focus on these areas, which are crucial to well-being for people and planet regardless of geographic location or political context and are all directly threatened by climate change. Therefore, these ought to be central pillars of the GGA and its framework to guide adaptation actions toward well-being for people and planet. Our collective goal should be to ensure that these pillars are able

Box 1. The IPCC definition of risk

Risk = Hazard x Vulnerability x Exposure

Hazard: the physical climatic driver of the risk

Vulnerability: the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist, and recover from the adverse effects of physical events

Exposure: the presence (location) of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected by physical events and are thereby subject to potential future harm, loss, or damage

8 Allan Lavell et al., "Climate Change: New Dimensions in Disaster Risk, Exposure, Vulnerability, and Resilience," IPCC, 2012.

9 Adaptation without Borders, "Transboundary Climate Risks: An Overview," 2017.

10 Ariadna Anisimov and Alexandre K. Magnan, "The Global Transboundary Climate Risk Report," Adaptation without Borders, 2023.

11 Anika Terton, Jeffrey Qi, and Anne Tadgell, "Transboundary Climate Risks and the National Adaptation Planning Process," International Institute for Sustainable Development, September 2023.

to withstand the adverse impacts of climate change so that people and planet can survive and thrive, both now and in the future.

Negotiators are still defining transformational adaptation within the UNFCCC regime. The IPCC defines it as "adaptation that changes the fundamental attributes of a socio-ecological system in anticipation of climate change and its impacts."[12] We take this definition a step further, defining transformational adaptation as adaptation that addresses systemic root causes of climate risks and works toward a more stable, flexible, and equitable future. Adaptation practices with high transformational potential should be prioritized, building toward the highest degree of well-being, where one has the capability to pursue one's goals and thrive. In some cases, this can include incremental adaptation, or actions that maintain the essence and integrity of a system or process at its current scale. These actions can accrue to result in transformational adaptation.[13] Bringing about the systemic societal shifts required for transformational adaptation requires a forward-looking vision and collective action.

Adaptation practices with high transformational potential should be prioritized, building toward the highest degree of well-being, where one has the capability to pursue one's goals and thrive.

The IPCC argues that improving the efficiency of water management, strengthening food systems, and adopting new biodiversity management systems, among other actions, all have transformational potential and can contribute to improved human and planetary health.[14] While it will not be possible in every case, transformational adaptation should be the "guiding star" for the GGA so that we are truly aiming toward a less vulnerable, more resilient world.

Health

The World Health Organization (WHO) defines health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."[15] Human health depends on internal biological factors, such as the metabolism or microbiome of individuals, and external factors, such as the health of the environment and of animals, exposure to pollution or extreme weather, and socioeconomic conditions, which determine personal factors such as work and diet. Human health exists when we can guarantee the following:

- **A healthy lifestyle:** nutritious diet and adequate socioeconomic conditions
- **Access to healthy necessities:** clean water, sufficient and safe food, and clean air
- **A healthy environment:** sanitation and a low overall risk of contracting disease (including prevention, low exposure, and effective cures)

The concept of "One Health," which was cemented into the international health policy regime in 2008, means that human health is connected to and depends on the health of animals and the environment.[16] Climate change has a significant impact on human health through both direct and indirect pathways. In terms of direct pathways, heat waves increase the risk of cardiovascular disease and death; negatively impact human mental health, life satisfaction, happiness, and cognitive performance; and increase aggression.[17] Increased heat and humidity, as well as erratic weather patterns, also increase the distribution of and exposure to pollutants such as pollen,

12 IPCC, "Global Warming of 1.5°C: An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty," 2018, Annex 1, p. 542.

13 Catrien Termeer, Art Dewulf, and G. Robbert Biesbroek, "Transformational Change: Governance Interventions for Climate Change Adaptation from a Continuous Change Perspective," *Journal of Environmental Planning and Management* 60, no. 4 (2017); J. David Tàbara et al., "Defining Transformative Climate Science to Address High-End Climate Change," *Regional Environmental Change* 19, no. 3 (March 2019).

14 IPCC, "IPCC Sixth Assessment Report: Technical Summary," 2022, TS.D.11, p. 99.

15 World Health Organization (WHO), "Constitution of the World Health Organization," 1946, available at https://www.who.int/about/accountability/governance/constitution .

16 Centers for Disease Control and Prevention (CDC), "One Health: History," June 6, 2022, available at https://www.cdc.gov/onehealth/basics/history/index.html ; WHO, "One Health," September 21, 2017, available at https://www.who.int/news-room/questions-and-answers/item/one-health .

17 Fiona Charlson et al., "Climate Change and Mental Health: A Scoping Review," *International Journal of Environmental Research and Public Health* 18, no. 9 (May 2021).

ozone, dust, and fires, triggering respiratory tract diseases.

In terms of indirect pathways, land degradation; the loss, shift, and invasion of species; changing heat and precipitation patterns; and extreme weather events like flooding and heat waves can all increase the risk of disease outbreaks, epidemics, and antimicrobial resistance.[18] Furthermore, as the human population grows and expands into new geographic areas, and land use changes with deforestation and more intensive livestock farming, transboundary biosecurity risks could increase food insecurity, the spread of zoonotic and waterborne diseases, and antimicrobial resistance.

In low-income countries, the top risk factors to health include child malnutrition, air pollution (both indoor and outdoor), unsafe water, and poor sanitation.[19] These risks will be compounded by the climate-related health impacts enumerated above. Reducing these risks, and therefore the population's vulnerability, will require transforming infrastructure, cities, economies, laws, social norms, and public perceptions across sectors to guarantee the essential conditions for human health, even in the face of climate change. The ideal state for human health would include safe levels of outdoor and indoor air pollution, sanitation services for all, integration of nutrition into health policies, implementation of protective biodiversity and health policies, and universal access to healthcare. It would also include cities and human settlements that are socially and environmentally resilient and plan for seasonal, occasional, and permanent migration when necessary, taking into account the vulnerabilities of different populations.

Protecting global health in the face of the increasingly adverse impacts of climate change will require strengthening the capacity of all countries, particularly developing countries, to conduct early warning, reduce risks, and respond to national and global health impacts.

Protecting global health in the face of the increasingly adverse impacts of climate change will require strengthening the capacity of all countries, particularly developing countries, to conduct early warning, reduce risks, and response to national and global health impacts, as reflected in Sustainable Development Goal (SDG) 3.d.1.[20] These could include adaptation actions like those listed in Table 1.[21]

Coordinated global preparedness for climate-induced epidemics will benefit everyone, but it will look different in different places. In biodiversity hotspots, for example, global health preparedness might mean coordinating biodiversity protection to limit the spread of zoonotic diseases, which will involve changing food production practices.[22] In the context of climate change, the key is to protect and value biodiversity as a form of ecosystem-based adaptation in a way that enhances long-term resilience to future changes and conditions, such as zoonotic spillover, instead of focusing on the short-term delivery of commodities, such as high crop yield.[23] This will require ensuring local participation and adequate compensation for the countries and communities with the most biodiversity to protect. In other places, coordinated early-warning systems for epidemics will be most important, which could involve actions as simple as installing more cell phone towers.

Preparing for climate-induced epidemics will be especially important in a year such as 2023, when El Niño, the warm phase of the El Niño–Southern Oscillation (ENSO), causes increases in temperature, drought, and humidity in many places, heightening the risk of outbreaks of cholera,

18 Jason P. Burnham, "Climate Change and Antibiotic Resistance: A Deadly Combination," *Therapeutic Advances in Infectious Disease* 8 (2021).

19 Saloni Dattani et al., "Causes of Death," Our World in Data, 2023, available at https://ourworldindata.org/causes-of-death .

20 United Nations, "3: Ensure Healthy Lives and Promote Well-Being for All at All Ages," available at https://sdgs.un.org/goals/goal3#targets_and_indicators .

21 Global Health Security Index, "Welcome to the 2021 Global Health Security Index," available at https://www.ghsindex.org .

22 Arthur Wyns, "Global Biodiversity is not Pandemic Proof," *The Lancet* 7, no. 3 (March 2023).

23 Zoonotic spillover refers to the transmission of pathogens from wild animals to humans. Joel Henrique Ellwanger and José Artur Bogo Chies, "Zoonotic Spillover: Understanding Basic Aspects for Better Prevention," *Genetics and Molecular Biology* 44, no. 1 Supple 1 (2021). Ecosystem services refer to the outputs, conditions, or processes of a natural system that directly or indirectly benefit humans or enhance social welfare. Robert J. Johnson, "Ecosystem Services," Britannica, February 16, 2016.

Chikungunya, Zika, and Rift Valley fever.[24] Climate change may be increasing the frequency of El Niño (and its counterpart, La Niña) and amplifying its impacts, such as by intensifying tropical storms.[25] Being able to anticipate ENSO will be essential not only to better predict dangerous heat waves but also to prevent disease outbreaks. Climate change has already worsened outbreaks of cholera and malaria in South Asia and dengue and Chikungunya in the Caribbean and Southeast Asia.

There are many preexisting indicators we can use to measure progress toward ensuring human and ecosystem health (One Health) against the backdrop of a changing climate. Countries can assess their capacity to detect and respond to public health events under the International Health Regulations (IHR), in line with SDG target indicator 3.d.1. Progress on global health is also closely related to poverty (SDG 1), food security (SDG 2), sanitation (SDG 6), and biodiversity (SDG 15 and the Kunming-Montreal Global Biodiversity Framework).[26] Many of these indicators are enumerated in Table 1.

Two ongoing processes will impact these efforts to monitor and respond to climate-related health crises. One is the ongoing process to amend the IHR.[27] At the same time, the Intergovernmental Negotiating Body is drafting and negotiating a WHO convention, agreement, or other international instrument on pandemic prevention, preparedness, and response.[28] Both of these processes could lead to additional indicators for monitoring progress.

Water Security

UN-Water proposes that water security is "the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against waterborne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability."[29] Drawing on available literature, water security exists when we can guarantee:

- **Sanitary water availability:** stable and reliable long-term access to clean, safe water for human use and consumption
- **Economic water security:** equitable and sustainable share of water use at the national and transboundary level, taking into account major cross-sector interdependencies (especially those between water, food, energy, and biodiversity),[30] as well as the allocation of scarce water resources to higher-value uses, which requires understanding and agreement on the value of water[31]
- **Ecosystem health:** protection and restoration of water-related ecosystems (mountains, forests, wetlands, rivers, aquifers, and lakes)
- **Resilience to water-related disasters:** resilience to extreme weather events, such as floods and monsoons, and slow-onset events, such as prolonged droughts and rising sea levels

Climate change affects water security by intensifying the natural water cycle. This means more intense rains, monsoons, and cyclones; longer, more intense droughts; and increased rates of evaporation. These changes increase water scarcity in typically dry places, increase flooding in typically wet places, and cause more frequent, less predictable, and more intense weather events that threaten crops, infrastructure, health, and livelihoods.

Climate change indirectly increases the demand for water, as flooding increases sewage cross-contamination and growing evapotranspiration increases the need for crop irrigation while worsening soil

24 Nat Johnson, "ENSO and Your Health: How the 2015–16 El Niño Led to Early Warnings for Global Disease Outbreaks," National Oceanic and Atmospheric Administration (NOAA), May 30, 2019.

25 NOAA, "How Will Climate Change Change El Niño and La Niña?" November 9, 2020.

26 UNEP, *Decision Adopted by the Conference of the Parties to the Convention on Biological Diversity: 15.4 Kunming-Montreal Global Biodiversity Framework*, UN Doc. CBD/COP/DEC/15/4, December 19, 2022.

27 WHO, "Working Group on Amendments to the International Health Regulations (2005)," available at https://apps.who.int/gb/wgihr/index.html .

28 WHO, "International Negotiating Body," available at https://inb.who.int .

29 UN-Water, "What Is Water Security? Infographic," May 8, 2013, available at https://www.unwater.org/publications/what-water-security-infographic .

30 Middle East Desalination Research Center (MEDRC), "Transboundary Briefings," available at https://www.medrc.org/transboundary-briefings/ .

31 World Bank, "High and Dry: Climate Change, Water, and the Economy," May 2, 2016; UNESCO, "UN World Water Development Report 2021: Valuing Water," 2021.

Table 1. Health risks, actions, and indicators

Risk	Actions	Indicators
Heat waves	• Increase communication to prepare the public for heat waves • Retrofit public buildings • Develop heat-wave forecasts and action plans	• Reduction in the number of deaths associated with extreme heat • Reduction in exposure to warming (Lancet Indicator 1.1.1) • Reduction in exposure of vulnerable populations to heat waves (Lancet Indicator 1.1.2) • Reduction in heat-related mortality (Lancet Indicator 1.1.5) • Reduction in the costs of heat-related mortality (Lancet Indicator 4.1.2)
Extreme weather events	• Implement the Early Warning for All initiative • Strengthen emergency response systems • Make infrastructure more resilient • Increase communication to prepare populations for floods, droughts, and other climate-related events • Implement quick-response systems for floods, droughts, storms, and other climate-related events	• Reduction in the number of deaths, missing persons, and directly affected persons attributed to disasters per 100,000 people (SDG 13.1.1) • Increase in the number of countries that adopt and implement national disaster risk-reduction strategies, in line with the Sendai Framework for Disaster Risk Reduction (SDG 13.1.2) • Increase in the proportion of local governments that adopt and implement local disaster risk-reduction strategies, in line with national disaster risk-reduction strategies (SDG 13.1.3) • Reduction in exposure to wildfire-derived fine particles (PM2.5) (Lancet Indicator 1.2.1) • Reduction in the lethality of extreme weather events (Lancet Indicator 2.3.2)
Climate-induced epidemics and increased zoonotic, foodborne, and waterborne diseases	• Increase laboratory capacity for early detection of epidemics • Put in place early-detection and quick-response systems for epidemics • Improve usage of and access to vaccines and mosquito nets • Increase regulation of the wildlife trade • Manage the introduction of invasive species • Expand research on climate-induced epidemics, new diseases, and forgotten tropical diseases that are likely to spread with changing climatic conditions • Increase international reporting of animal disease outbreaks	• Increase in the total net official development assistance to medical research and basic health sectors (SDG target indicator 3.b.2) • Increase in the proportion of health facilities that have a core set of relevant essential medicines available and affordable on a sustainable basis (SDG target indicator 3.b.3) • Assessment of IHR capacity and health emergency preparedness (SDG target indicator 3.d.1) • Reduction in climate suitability for infectious disease transmission (e.g., transmissibility and number of months suitable for transmission)

Risk	Actions	Indicators
	• Implement universal healthcare • Implement quick-response systems for epidemics and disease outbreaks • Integrate data between the human, animal, and environmental health sectors	• Reduction in the number of people requiring interventions against neglected tropical diseases (SDG 3.3.5)
Increased air and water pollution	• Increase sanitation and "greening" of cities • Increase regulation of waste • Tax air pollution and waste • Increase ventilation and reduce indoor use of high-emitting products	• Reduction in mortality rate attributed to household and ambient air pollution (SDG 3.9.1) • Increase in the use of clean household energy (Lancet Indicator 3.2) • Increase in the percentage of households that primarily rely on zero-emission fuels and technology for cooking in the home • Reduction in mortality from ambient air pollution by sector (Lancet Indicator 3.3) • Increase in sustainable and healthy road transport (Lancet Indicator 3.4) • Reduction in costs of the health impacts of air pollution (Lancet Indicator 4.1.4)

salinization. More demand for water for irrigation then further depletes groundwater, which accelerates saltwater intrusion. Climate change also shifts precipitation patterns, a major risk for populated zones in transitional biomes such as the Sahel, which is located between desert and tropical biomes. At the same time, climate change is causing sea-level rise and more frequent coastal storm surges, which, in addition to submerging inhabited land and damaging infrastructure, contribute to groundwater salinization and the deterioration of coastal ecosystems, with especially severe impacts on small islands and deltas. In high-mountain regions, climate change is melting glaciers, which impacts the flow, seasonality, and storage of water in riverbeds, often far from the origin. Climate-induced prolonged droughts have also increased the intensity and extent of wildfires.

Despite these climate-caused impacts, only a small portion of government budgets is allocated to the financing of water infrastructure.[32] This underfunding, combined with economic development and increasing water use, means we are not keeping up with the global demand for water, which is escalating groundwater depletion, water pollution, and biodiversity loss.

Underfunding, combined with economic development and increasing water use, means we are not keeping up with the global demand for water.

Ensuring global water security will require a sustainable and safe artificial water cycle, including water withdrawal, water use, and water waste treatment; efficient and equitable share of water use; integrated water resource management; reliable access to clean water for all; and resilient water infrastructure. It will require accomplishing all the targets associated with SDG 6—"ensure availability and sustainable management of water

32 MEDRC, "Issue 13: Water Finance," October 2022, available at https://www.medrc.org/transboundary-briefings/ .

and sanitation for all"—against the backdrop of climate change. Sustainable and safe water withdrawal, for example, requires protecting primary water sources from pollution and other human impacts, reducing the need for primary-source freshwater, ensuring that rates of water withdrawal are kept below rates of natural freshwater replenishment (sustainable withdrawal), and increasing secondary-source water from waste treatment plants or rainwater harvesting.

Since 60 percent of the world's freshwater flows come from transboundary waters, guaranteeing stable, renewable freshwater is by definition a transboundary issue.[33] Maintaining the availability of fresh water against the backdrop of climate change is particularly complex in transboundary water basins, as climate change affects the distribution, storage, and replenishment rates of watersheds, rivers, and dams. In transboundary water basins, water management falls to multiple institutions and is susceptible to failed communication and political divisions between states. These challenges are particularly difficult for water-scarce areas or highly contaminated regions, as well as for large cities that depend on water flowing from faraway sources. Moreover, increased efficiency in water use is often accompanied by increased demand, as it drives down prices and increases pressure on water-scarce areas. Further adding to this pressure, transboundary agreements are often focused on surface-water systems and do not align with the groundwater systems that support them.[34]

Studies on transboundary water management often focus on the Himalayan region, which relies heavily on glaciers; the Nile River region, spanning from Ethiopia to Egypt; and the Middle East, which is facing severe water scarcity. However, managing transboundary water is also a concern for islands and other water-importing regions. In many vulnerable small island states, water security is a topic of growing concern, as a significant proportion of the population is being exposed to poor sanitation, waterborne diseases, and frequent water shortages during the dry season.[35] Many of these states' water supplies depend on rainwater and desalinated water. Ensuring the availability of renewable freshwater is becoming more challenging as climate change brings longer periods without rain, greater salinization of groundwater, and more frequent flash floods. Adaptation projects are already underway to target those three domains—rainwater, groundwater, and desalinated water—to ensure water security for everyone in the face of climate change and reduce the need for clean water transport across islands and the expensive importing of clean water (especially where tourism is a key economic driver, as tourists drive up the demand for clean water). It is important to note, however, that not all of these projects are working, and some are even causing maladaptation.

Table 2 lists concrete adaptation actions that can stabilize water availability and improve the management of shared water resources. As in the case of health, there are several preexisting indicators we can use to measure progress toward

Table 2. Water risks, actions, and indicators

Risk	Actions	Indicators
Increased water scarcity	• Increase water storage at all levels (household, urban, national, and transboundary), with evaluation and planning of new dams, reservoirs and desalination plants • Improve knowledge about the quality and quantity of subterranean water resources	• Reduction in the level of water stress, or freshwater withdrawal as a proportion of available freshwater resources (SDG 6.4.2) • Reduction in the ratio of water withdrawal rate to replenishment rate

33 UNEP, "Transboundary Waters Assessment Program (TWAP)," available at https://www.geftwap.org/ .

34 MEDRC, "Transboundary Briefings."

35 UN Media, "SIDS Resilience to Climate Change through Water Security: Towards SDGs and SAMOA Pathway Achievement (UN 2023 Water Conference Side Event)," March 24, 2023, available at https://media.un.org/en/asset/k1g/k1g19jrzxi .

Risk	Actions	Indicators
	• Increase regenerative agricultural practices like drip irrigation that use less water • Implement cooperative management to protect primary freshwater sources and the biodiversity sustaining them • Cooperatively manage aquifer recharge and use • Transfer water between basins to replenish water-scarce basins • Enhance nature-based solutions for water retention, storage, treatment, recycling, and efficient use where possible • Increase water reuse and rainwater harvesting	
Increased rain and flooding and longer, more intense droughts	• Enhance infrastructure and capacity to absorb regular and peak floods and droughts • Enhance nature-based solutions to flooding and storms • Increase permeable pavement and green roofs	• Reduction in the proportion of land affected by flooding • Reduction in mortality caused by hunger and thirst due to drought
Sea-level rise and coastal storm surges	• Enhance resilience of coastal infrastructure, including seawalls and nature-based solutions where possible (after determining the appropriate option)	• Reduction in the number of people that need to relocate due to sea-level rise • Reduction in monetary storm surge damage • Increase in mangrove-restored areas • Increase in coral reef restoration
Increased contamination of water supply, including groundwater salinization	• Increase the number of desalinization plants • Shift the paradigm of wastewater management from "treatment and disposal" to "reuse, recycle, and resource recovery" • Implement strict regulations on water waste for all industries, including food and textiles	• Increase in the proportion of safely treated domestic and industrial wastewater flows (SDG 6.3.1) • Increase in the proportion of bodies of water with good ambient water quality (SDG 6.3.2) • Reduction in the percentage of water loss • Increase in the proportion of treated nonconsumptive water returned to the natural water cycle • Increase in secondary-source water use from wastewater (especially as irrigation for agriculture or in oil and gas wells)

ensuring clean and renewable water availability against the backdrop of a changing climate, also laid out in the table.

Food Security

Food security exists when "all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life."[36] The dimensions of food security include the following:

- **Availability:** sustainable, stable, and resilient food production systems
- **Stable access:** social access, affordability, international exchange of key foods (especially during droughts or crop failures) and resilient food distribution systems
- **Adequate utilization:** nutritious and safe food[37]

The world's current systems of food production are major contributors to anthropogenic climate change, pollution, and biodiversity loss. Food production accounts for 26 percent of global greenhouse gas emissions; uses half of the world's habitable land, causing deforestation; accounts for 70 percent of water withdrawals; and causes 78 percent of eutrophication, or nutrient overloading, causing dead zones in water. Moreover, livestock account for the majority of mammal and bird biomass on Earth, creating linkages between food security, biodiversity, and biosecurity.[38] This means that our current food-production systems are creating a negative feedback loop with our natural environment, as these systems worsen climate change and consequently impede our ability to achieve food security.

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Global access to food is severely affected by the slow-onset impacts of climate change, like sea-level rise and droughts, and extreme events, like heat waves, floods, storms, and storm surges. In agriculture, climate change is causing lower yield for most staple crops, earlier harvests, increased risk of seasonal mismatch with pollination services, increased risk of crop failure, and the shift of agricultural production away from the tropics.[39] Livestock are also vulnerable to increased heat. In fisheries, we are seeing declining fish biomass, disturbed food webs and marine physiology, widespread death of coral reefs, and geographic shifts in marine stocks. These cause shocks throughout the supply chain, from production collapse to increased choking points in transport, and could potentially increase the potential for climate-induced conflict due to growing competition over food resources.[40]

These risks may also lead to global and regional food shocks, especially when combined with preexisting food insecurity; social inequalities; global disruptions such as epidemics, energy shocks, wars, and inflation; and geopolitical power fragmentation. Ensuring access to food for all and at all times requires finding an equilibrium between local and global food systems.[41] This can be achieved by implementing policies that reduce social and economic vulnerability to ensure some level of self-sufficiency in a functioning global food market, as well as effective global systems for short-term aid in case of shocks.

The relevant adaptation actions will vary from place to place, depending on the geographic, economic, and political context of the country and region. For example, countries characterized by large-scale industrial agriculture, monoculture farms, and export dependence are at risk of soil deterioration, droughts, flooding, biodiversity loss, and a resulting reduction in agricultural yields. As such, adaptation efforts in such countries will need to include soil regeneration, agroforestry, bio-

36 Food and Agriculture Organization (FAO), "Report of the World Food Summit," November 1996.

37 Jennifer Clapp et al., "Viewpoint: The Case for a Six-Dimensional Food Security Framework," *Food Policy* 106 (2022).

38 Hanna Ritchie, Pablo Rosado, and Max Roser, "Environmental Impacts of Food," Our World in Data, 2022, available at https://ourworldindata.org/environmental-impacts-of-food .

39 IPCC, "Special Report on Climate Change and Land," 2019, Chapter 5.

40 Ore Koren, "Food, Climate Change, and War in the 21st Century," *Georgetown Journal of International Affairs* (March 2022).

41 Amanda Wood et al., "Reframing the Local-Global Food Systems Debate through a Resilience Lens," *Nature Food* 4 (2023).

diversity protection, land-use optimization, expansion and increased efficiency of irrigation, diversification of crops and export routes, and enhancement of local and niche practices that ensure domestic food security and long-term resilience. Countries characterized by rural agriculture dominated by small farms might achieve transformational adaptation by supporting small landholders, land tenure, and increased agricultural innovation, nested within a global food trade system. Import-dependent countries will need to ensure healthy and diversified food imports and use high-tech solutions to ensure some level of self-sufficiency as climate change impacts worsen and droughts and supply-chain shocks become more severe.[42] Policy coherence with other sectors is also important. For example, policy responses should not increase the resilience of food systems by inadvertently exacerbating water insecurity, or vice versa.

Ensuring food security in the face of climate change will require adapted and resilient global food systems that give rise to better health outcomes and lower emissions. Achieving this will require systemic changes and concrete adaptation actions across the three major domains of availability, access, and utilization.[43] Some of these actions are listed in Table 3. We can measure progress toward food security against the backdrop of adverse climate change impacts using several preexisting indicators, as laid out in the table.

Table 3. Food security risks, actions, and indicators

Risk	Actions	Indicators
Reduced crop yield and loss of livestock and increased erratic or unpredictable production	• Increase small farmers' governance over land • Expand regenerative agricultural practices • Prioritize soil-regeneration techniques • Optimize cycling of nutrients • Diversify seeds, crops, and agricultural practices, including by shifting from monoculture to polyculture, ensuring symbiosis between agriculture and biodiversity, and combining perennial and annual crops depending on needs • Regulate industrialized food systems to avoid food loss due to a high production-to-demand ratio • Enhance innovation in agricultural technology and sustainable agricultural practices • Recover underutilized seeds and crops • Incentivize food self-sufficiency • Transform diets to be healthy for people and the planet by subsidizing lower-emission food products[44] • Increase global cooperation and compensation mechanisms to protect biodiversity within food systems	• Reduction in the proportion of crops used for industrial livestock • Increase in the proportion of crops used for human consumption • Decrease in the proportion of crops used for biofuel • Increase in land holdings for small farmers and Indigenous communities • Increase in the proportion of agricultural area under productive and sustainable agriculture and aquaculture (SDG 2.4.1) • Increase in the use of underutilized (neglected) foods and seeds • Reduction in food loss and food waste indices (SDG 12.3.1)

42 Brent Loken et al., "Solving the Great Food Puzzle: 20 Levers to Scale National Action," World Wildlife Fund, 2022.

43 The Food and Land Use Coalition, "Growing Better: Ten Critical Transitions to Transform Food and Land Use," September 2019.

44 See, for example: Nordic Council of Ministers, "Nordic Nutrition Recommendations 2023: Integrating Environmental Aspects," 2023.

Risk	Actions	Indicators
Reduced fish biomass	• Increase small fisheries' access to fish stocks and their involvement in designing protected areas • Increase regulation and monitoring to stop overfishing • Pay fishermen for ecosystem services • Expand sustainable aquaculture	• Increase in the proportion of fish stocks within biologically sustainable levels (SDG 14.4.1) • Increase in the volume of protected marine areas
Supply-chain shocks	• Implement the Early Warning for All initiative and link to the global food network • Increase the reciprocity of the global food trade by reducing inequality in international exports and imports and diversifying export and import countries and transport routes • Create more multinational grain-stock partnerships to prevent food shocks • Improve infrastructure for food storage and distribution • Ensure that effective global systems for short-term aid are in place by improving the global network of grain-storage facilities • Facilitate local and regional connectivity, especially for sustainable niche foods and where overdependence on global trade creates vulnerabilities • Increase connections between small farms and fisheries and nearby cities • Finance the distribution capacity of small farms and fisheries • Increase transboundary cooperation and financing to protect key agricultural commodity exports (maize, wheat, sugar, etc.) and global trade • Develop systems for efficiently transferring food from storage facilities to populations in need • Reduce food loss and waste	• Reduction in the variability and volatility of food price anomalies (SDG 2.c.1) • Increase in coverage of early-warning systems (UN Global Set 137) • Reduction in direct economic loss attributed to disasters in relation to global gross domestic product (SDG 1.5.2) • Increase in the number of countries that adopt and implement national disaster risk reduction strategies, in line with the Sendai Framework for Disaster Risk Reduction (SDG 1.5.3) • Increase in storage infrastructure • Increase in diversity of transport routes, types, and access • Reduction in the percentage of total exports and imports accounted for by the top export and import country, meaning more diversity in exporters and importers • Increase in traceability throughout the supply chain

Biodiversity

The GGA's biodiversity pillar is slightly different than the others. We use it to encapsulate many aspects of planetary health, and it overlaps with the other three pillars. A high level of biodiversity means a large variety of life, which is essential to ensuring healthy and stable ecosystems and human well-being. Biodiversity refers to ecosystem diversity (within a region), species diversity (within an ecosystem), genetic diversity (within one species), and functional diversity (varying roles of species within ecosystems). In this paper, the theme of biodiversity encompasses several chapters in Working Group II's contribution to the IPCC's Sixth Assessment Report, including terrestrial and freshwater ecosystems, oceans and coastal ecosystems, mountains, deserts, polar regions, small islands, tropical forests, the Mediterranean region, and other hotspots of biodiversity.[45] The framework as it was written in Decision 7/CMA.4 used these chapter headings of the AR6 as the themes for the GGA framework. We simply refer to "biodiversity" to consolidate these chapter headings into a truly global category.

Stable biodiversity underpins the other three pillars of the GGA because healthy ecosystems provide services to health, food security, and water security.

Stable biodiversity underpins the other three pillars of the GGA because healthy ecosystems provide services to health, food security, and water security. A biodiverse planet benefits our health directly by providing medicine, filtering water and air, and improving general mental well-being, among other things. Stable biodiversity increases food security and, indirectly, human health by providing the natural resources for food and food production, nutrition, soil regeneration, agricultural resilience, microclimate regulation, flood control, waste filtering, photosynthesis, pollination, and genetic diversity. Biodiversity improves water security and, indirectly, food and health by sustaining the water cycle, providing water resources, and cleaning water. Biodiversity also has economic and noneconomic value, including cultural value. Furthermore, when we protect biodiversity, we mitigate climate change by reducing land-use change and enhancing natural carbon storage.

Our planet is experiencing biodiversity loss at an unprecedented rate, and climate change is anticipated to become the biggest cause of biodiversity loss as temperatures continue to rise.[46] The IPCC notes that without urgent and deep emissions reductions, some species and ecosystems, especially those in polar and tropical areas, will face temperatures beyond their historical experience in the coming decades, putting unique and threatened ecosystems at high risk in the very near future. Climate change impacts on biodiversity are worsened by other human-caused impacts, such as land-use change, pollution, habitat loss and fragmentation, hunting, overfishing, overexploitation of natural resources, water extraction, and the introduction of invasive species, including pests and diseases. Climate change and biodiversity loss are considered core planetary boundaries, as they cause long-term changes to the earth system that may be irreversible, as in the cases of "points of no return" for climate change or species extinction.[47] The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services argues that "a sustainable society requires both a stabilized climate and healthy ecosystems…. Satisfactorily resolving either issue requires consideration of the other."[48]

Hence, adaptation on all fronts—health, water, food, and beyond—is most successful when it supports biodiversity and ecosystem functions and services.[49] The GGA should prioritize protecting

45 Hans-Otto Pörtner et al., eds., *Climate Change 2022: Impacts, Adaptation and Vulnerability—Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, UK: Cambridge University Press, 2022).

46 Eduardo Sonnewend Brondizio et al., "Global Assessment Report on Biodiversity and Ecosystem Services," Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), May 4, 2019; Daisy Dunne, "Explainer: Can Climate Change and Biodiversity Loss Be Tackled Together?" Carbon Brief, June 16, 2022.

47 David I. Armstrong McKay et al., "Exceeding 1.5°C Global Warming Could Trigger Multiple Climate Tipping Points," *Science* 377, no. 6611 (September 2022); Brondizio et al., "Global Assessment Report on Biodiversity and Ecosystem Services."

48 Hans-Otto Pörtner et al., "IPBES-IPCC Co-Sponsored Workshop: Biodiversity and Climate Change—Workshop Report," IPBES and IPCC, June 24, 2021.

49 Mark New et al., "Decision-Making Options for Managing Risk," in *Climate Change 2022: Impacts, Adaptation and Vulnerability—Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.*

and valuing biodiversity in a way that:

- Prioritizes ecosystem-based adaptation methods, such as protecting and enhancing mangroves, over technological or man-made adaptation, such as building seawalls, especially where ecosystems still have the natural capacity to adjust;
- Aims toward multiple objectives at once to maximize mutual benefits across multiple dimensions and to address synergies and tradeoffs between biodiversity loss and climate change while also considering their societal impacts; and
- Designs adaptation goals that complement the Convention on Biological Diversity, keeping in mind the Kunming-Montreal Global Biodiversity Framework 2030 targets.[50]

The Kunming-Montreal Global Biodiversity Framework, adopted at the UN Biodiversity Conference in Montreal in 2022, is the most up-to-date framework for protecting biodiversity. The framework's vision is to achieve a world in which humans live in harmony with nature and biodiversity is valued by 2050. Its mission for the period up to 2030 is "to take urgent action across society to conserve and sustainably use biodiversity and ensure the fair and equitable sharing of benefits from the use of genetic resources, to put biodiversity on a path to recovery by 2030 for the benefit of the planet and people."[51] Targets 2 (effective restoration of 30 percent of degraded ecosystems by 2030) and 3 (effective conservation and management of 30 percent of land and 30 percent of oceans by 2030) are particularly relevant for the GGA.[52] These targets also relate to SDG 15 (protect, restore, and promote sustainable use of terrestrial ecosystems; sustainably manage forests; combat desertification; halt and reverse land degradation; and halt biodiversity loss).

This new biodiversity framework is consistent with a sharing-the-planet agenda whereby humans and nature can live and thrive together.[53] The framework dedicates Targets 9 through 13 to "meeting people's needs through sustainable use and benefit-sharing," reflecting the understanding that when restoring and sustainably managing ecosystems, planners must take into account all the interests, benefits, and tradeoffs at play. They should put local communities and Indigenous peoples at the center of planning while simultaneously considering the transboundary risks and other affected communities. Finally, Targets 14 through 23 are dedicated to "tools and solutions for implementation and mainstreaming." This should inform the GGA framework wherever possible so that countries can draw on existing indicators instead of reinventing the wheel.

There are also many other existing metrics and indicators that can help measure progress toward protecting biodiversity against the backdrop of adverse climate change impacts. Some of these key indicators are laid out in Table 4.

50 Hans-Otto Pörtner et al., "Overcoming the Coupled Climate and Biodiversity Crises and their Societal Impacts," *Science* 380, no. 6642 (April 2023); Convention on Biological Diversity, "Kunming-Montreal Global Biodiversity Framework: 2030 Targets (with Guidance Notes)," September 21, 2023, available at https://www.cbd.int/gbf/targets/ .

51 UNEP, *Kunming-Montreal Global Biodiversity Framework: Draft Decision Submitted by the President*, UN Doc. CBD/COP/15/L.25, December 18, 2022.

52 Ibid.

53 Marco Immovilli and Marcel T.J. Kok, "Narratives for the 'Half Earth' and 'Sharing the Planet' Scenarios: A Literature Review," PBL Netherlands Environmental Assessment Agency, August 2020.

Table 4. Biodiversity risks, actions, and indicators

Risk	Actions	Indicators
Temperature shifts that create unlivable conditions for historically native species	• Reduce greenhouse gas emissions • Protect small-scale refugia where microclimate conditions can allow species to persist[54] • Increase corridors between ecosystems to allow for the safe movement of species	• Reduction in the number of species that are threatened, endangered, or going extinct each year
Pollution	• Increase regulation on waste (e.g., tax pollution and waste) • Increase technological innovation to reduce and contain waste • Improve nutrient cycling and use • Work toward eliminating plastic pollution	• Reduction in levels of air and water pollution • Improved air quality index (AQI) • Increase in the proportion of bodies of water with good ambient water quality (SDG 6.3.2)
Land-use change and habitat loss or fragmentation	• Reduce ecosystem fragmentation by increasing the extent, connectivity, and heterogeneity of natural habitats • Conserve stable forests even when they are not under immediate threat of deforestation, which will require developing financial and policy mechanisms to protect forests in the long term[55] • Increase compensation to countries and communities to protect biodiversity hotspots • Increase agroforestry	• Reduction in levels of air and water pollution • Improved air quality index (AQI) • Increase in the proportion of bodies of water with good ambient water quality (SDG 6.3.2)
Hunting, overfishing, and resource over-exploitation	• Increase regulation on fishing and hunting • Stop subsidizing extractive practices • Increase penalties on illegal fishing and hunting • Create job opportunities for populations that rely on illegal fishing and hunting	• Reduction in illegal fishing and wildlife trade • Reduction in subsidies for overexploited resources

54 IPCC, "Fact Sheet—Biodiversity: Climate Change Impacts and Risks," November 2022.

55 Sophia Simon et al., "Options for Conserving Stable Forests," World Bank, September 2021.

Conclusion

At COP28, the Glasgow–Sharm el-Sheikh Work Programme on the GGA will conclude, and negotiators will hopefully adopt an ambitious framework on the GGA. However, there is a need for conceptual clarity as to what exactly the GGA aims to achieve and how it can be globally applicable when adaptation is so often locally implemented.

One way to bring conceptual clarity to the GGA is to adopt well-being as the ultimate outcome toward which countries should be working. Well-being is a state where one can pursue one's goals and thrive. This requires having adequate physical health, water, food, and a healthy environment. Adaptation actions that further this goal should be assessed by their effects on present and future human and planetary well-being.

Health, water, food security, and biodiversity are all essential aspects of human and planetary well-being that can spur transformative adaptation action. They are all transboundary issues and applicable in every country on earth, regardless of geographic location or political context. Furthermore, the IPCC tells us that they are all severely threatened by climate change. While each step of the adaptation policy cycle should be robust and well-funded, these are the impact areas most crucial to the planet and its inhabitants. Robust processes and outcomes in these areas are thus essential to achieving the GGA.

When it comes to measuring progress toward these outcomes, the GGA does not need to reinvent the wheel. When crafting a framework for transformational adaptation in these four areas, negotiators and technical experts can draw on existing, agreed-upon frameworks and indicators that point the world toward the goal of well-being for people and planet.

In practice, implementing the GGA framework will require sufficient means of implementation, particularly for developing countries, and recognition of the colonial legacies that have contributed to current circumstances in many parts of the world today. The actions listed in each table will be impossible for many developing countries, especially small island developing states and least developed countries, to carry out without significant financial, technological, and capacity-building aid from developed countries. Unfortunately, this is a sensitive issue that will likely have to be solved at a high political level rather than among the technical negotiators of the GGA. Despite this political sensitivity, any successful GGA framework must take these things into account to achieve the sort of outcomes described in this analysis.

Agreeing on the importance of health, water, food security, and biodiversity to well-being for people and planet, understanding the science behind how climate change will impact them, and investigating and implementing the most effective adaptation actions available will encourage global cooperation on dealing with transboundary climate change risks. Only by taking these actions do we have a chance to truly enhance adaptive capacity, strengthen resilience, and reduce vulnerability.

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IPI
INTERNATIONAL PEACE INSTITUTE

777 United Nations Plaza
New York, NY 10017-3521
USA
TEL +1-212-687-4300
FAX +1-212-983-8246

51-52 Harbour House
Bahrain Financial Harbour
P.O. Box 1467
Manama, Bahrain
TEL +973-1721-1344