

Human Health, Land Use, and Climate in a Changing World

Climate and Forests 2030

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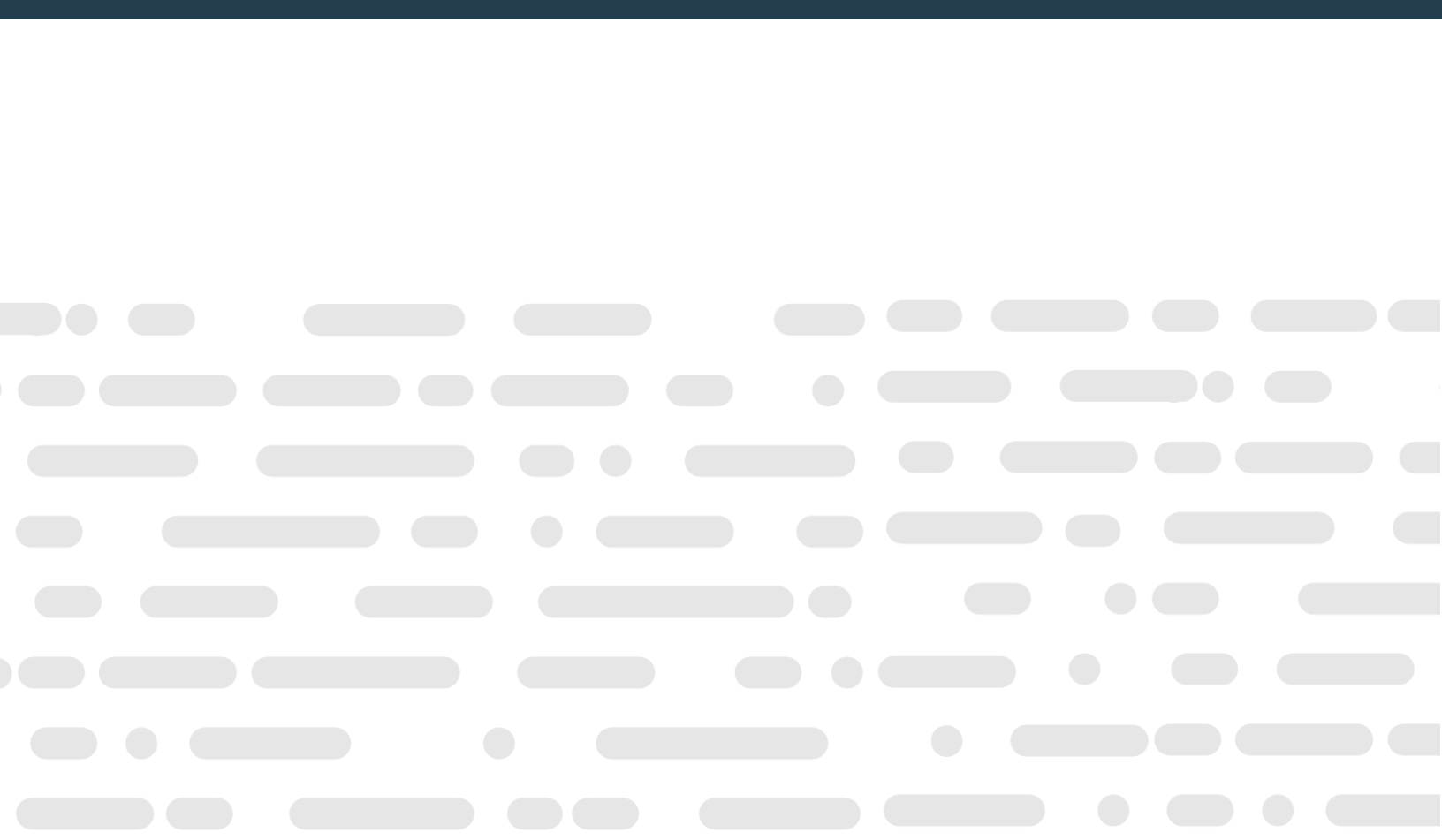
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Background

The Climate and Land Use Alliance (CLUA), with the support of Meridian Institute, is exploring the integration of climate and land use with justice, equity, health, and economic recovery through Climate and Forests 2030: Resources for Funders. This focus is intended to inspire innovation and investment in integrated work on forests, rights, and sustainable land use and will inform a new strategic plan for CLUA for the period 2021 to 2030.

To inform the thinking, CLUA commissioned a series of “thought pieces” to provide diverse inputs into developing a more integrated approach for forests and land use. These are meant to stimulate discussion and debate and are not intended to reflect the views of CLUA, its member foundations, or Meridian Institute. The views expressed in this paper are those of the authors. They have been informed by commentary and input by a range of other experts.

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Abstract

Rapidly-increasing human pressures on nature, if not vigorously mitigated, will result in irreversible damage to ecosystems and their services, and large reductions in human health and well-being. The current Covid-19 pandemic is just one example of the fragile relationship between environment, society, economy, and human health. Changes in climate and land already affect large vulnerable population groups, including – but not exclusively – poor communities living off the land, children, older people, and those with poor health status. Promises of a global transformation in all spheres of sustainability (social, economic, and environmental) need to be followed by clear actions at all levels of society. Civil society, local and national governments, the private sector, scientists, and international agencies play a key role in implementing change through research networks to strengthen the evidence base and assessments to inform policy and identify the best options for action to protect people and planet. Tools and mechanisms required include implementing monitoring and surveillance programs, developing and implementing local and national action plans, and educating and communicating to communities to promote change. Given the mounting evidence of the perils we face, there are no excuses for inaction. Transformative actions need proactive approaches supported by political commitment, community engagement, and appropriate funding, within a framework of social justice and equity.



Climate change, land use, and health are closely interlinked

Humanity finds itself at a unique and decisive point in time to protect health and the environment.

Science, technological advances, and economic prosperity are providing health, well-being, and a quality of life never before attained, but at the same time environmental deterioration is occurring at an unprecedented pace, along with increasing global inequalities in sharing prosperity (Whitmee *et al.* 2015). Population growth and consumption patterns coupled with unsustainable land and water use are adding enormous stress on ecosystems (IPCC 2019). Climate change brings additional pressures to this already delicate balance (e.g., through increased temperatures leading to drought; or changes in precipitation leading to flooding or water scarcity). Land use and land degradation contribute about one quarter of the world's greenhouse gas (GHG) emissions (Johnson *et al.* 2017); in turn climate change is a driver for desertification, land degradation, and drought. Both land degradation and climate change, driven by unsustainable economic development and increasing consumption, are contributing to increasing overall vulnerability for millions of people. Both are drivers for impaired health. The Covid-19 pandemic is the most recent manifestation of the fragile relationship between environment, society, the economy and human health (hereafter referred to as "health").

Nature's contributions to people include ecosystem services supporting human health and well-being.

The tight connections between land, land use, health, and well-being have always accompanied humanity, although they have not always been well understood. Ecosystem services are the benefits, direct and indirect, which ecosystems provide to people (Duraiappah & Naeem 2005). The services that support life and human well-being include food and water, fuel and fibre, the regulation of climate and diseases, and cultural and spiritual services (Corvalan *et al.* 2005; Reid *et al.* 2005). All these services promote physical and mental health. Around 25 centuries ago, Hippocrates noted that to investigate medicine properly one should consider the seasons, the winds, the quality of the waters, and the land where people live ("the ground, whether it be naked and deficient in water, or wooded and well-watered") (Hippocrates 1881), hinting at the important

connection between land-based and water-based ecosystems. Today it is no different, except that it is we who are very rapidly changing the quality of the waters and the land.

Human health cannot continue to improve while the planet is depleted.

The planet is being overloaded with environmental pressures including loss of biological diversity and habitat, desertification, and climate change, among others. Pressures on land are large and growing. Over 1.3 billion people (17% of world population) live on degrading agricultural lands, increasing the vulnerability of the poor, women, and children (Johnson *et al.* 2017). Despite the clear links between climate change, land use, and ecosystem degradation and adverse health outcomes, in global terms health continues to improve when measured as averages in life expectancy or infant mortality. Unfortunately, environmental degradation is starting to undermine decades of gains in improved health status and well-being, and this is particularly the case with poor and vulnerable populations (Whitmee *et al.* 2015). Humanity is reaching the point of convergence between global environmental emergencies and health emergencies, where we cannot continue damaging the planet and expect health to continue improving. Recent assessments note that while more ecosystem services (including food, water, and energy sources) are being provided to more people, the changes imposed on these systems result in their impaired ability to continue providing such services (IPBES 2019; IPCC 2019), and eventually, therefore, negatively impact health and well-being.

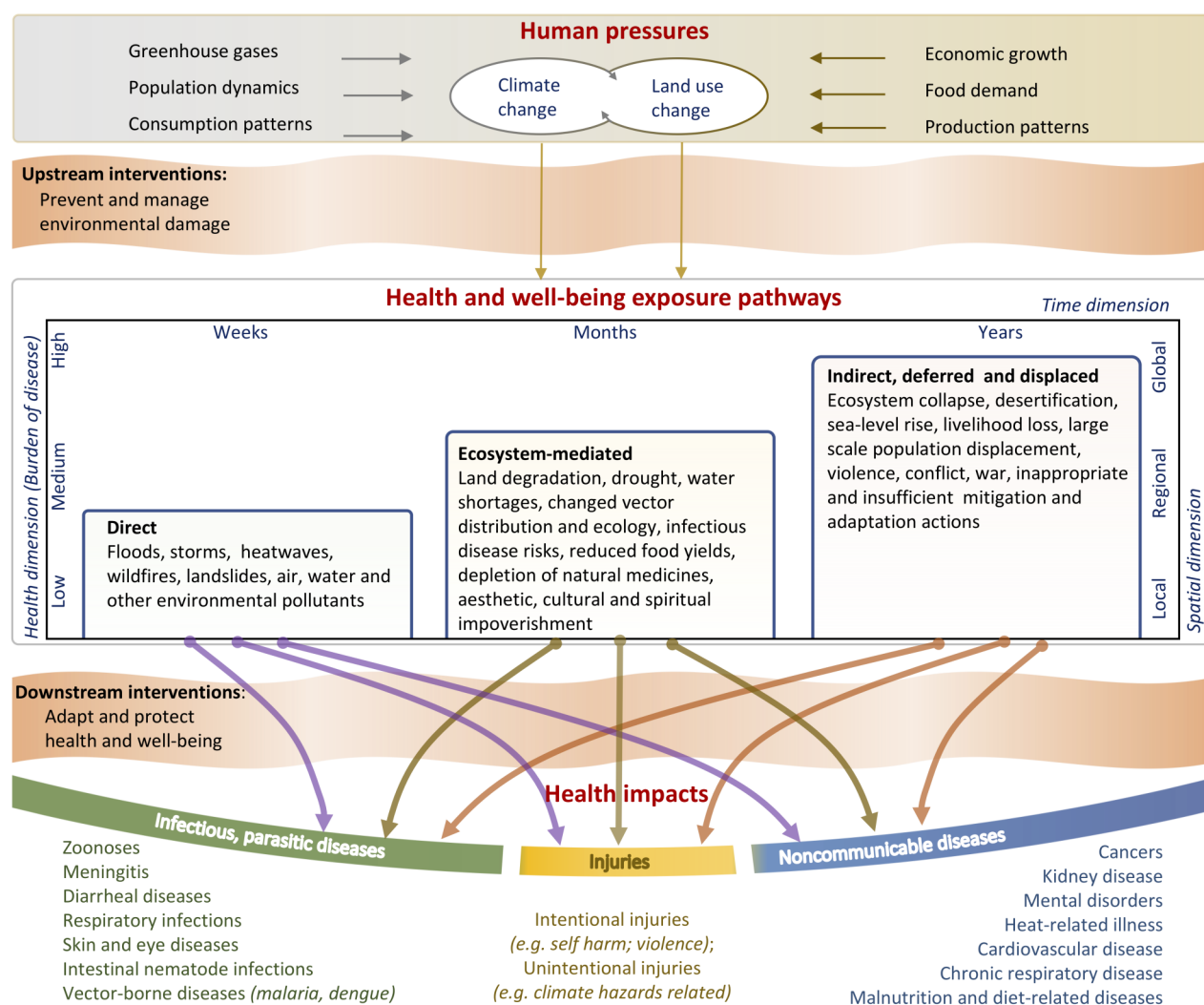
Health impacts are large, complex, and multiple.

The World Health Organization (WHO) estimates that 23% of all deaths (nearly 13 million) can be attributed to environmental factors which could be managed through existing interventions. The fraction is higher in children at 26% (Prüss-Üstün *et al.* 2016). Wealthier countries have high rates of noncommunicable disease (NCD), but in some low-income countries, infectious diseases overlap with NCDs (Bygbjerg 2012; Smith & Ezzati 2005). Over 8 million deaths are from environmentally preventable NCDs, and a large fraction can be attributed to air pollution from the combustion of fossil fuels, which also contributes to climate change (Burnett *et al.* 2018; Prüss-Üstün *et al.* 2016). In turn, climate change is projected to cause 250,000 excess deaths per year starting in 2030 due to heat exposure in older people, diarrhoea, malaria, and childhood undernutrition (Hales *et al.* 2014),

although this estimate is very conservative. Food production has become the largest human pressure on the planet and yet 820 million have insufficient food, and for many more their diet is unhealthy (Willett *et al.* 2019). Ecosystems provide freshwater, yet 1 in 3 persons globally do not have access to safe drinking water (WHO 2019a). There are no estimates of the burden of disease from unsustainable land use practices.

A conceptual framework of the causal pathways, from pressures on the global environment to specific health outcomes, shows the complexity of the problems we face. Human pressures on the global environment result in global and local environmental changes. These lead to different exposure pathways, which in turn result in health impacts (e.g., infectious and parasitic diseases, injuries, and noncommunicable diseases; Figure 1).

FIGURE 1: Conceptual framework – Human pressure on the environment, exposure pathways, and examples of health impacts



Source: Based on Butler *et al.* 2005; Corvalan *et al.* 2005; Lo *et al.* 2019; Sena & Ebi 2021)

- *Direct health and well-being exposure pathways* (left box in Figure 1) are often of short duration, of local concern, and of comparatively low health impact (e.g., increased temperatures may lead to heatwaves and wildfires and increased air pollution in a given location, resulting in increased incidence of respiratory diseases).
- *Ecosystem-mediated exposure pathways* (center box in Figure 1) imply that some changes occur in the environment before health impacts appear, and the exposures can be regional in scope, result in higher health impacts than direct pathways, and of longer duration (e.g., changes in temperature, precipitation, and deforestation may lead to changes in vector habitat, leading to outbreaks of a vector-borne disease, such as malaria. Infectious diseases like Ebola and Covid-19 are also examples of this pathway).
- Of greatest concern are *exposure pathways that are indirect, deferred (in time) and displaced (in space)* – the right box in Figure 1. They can be global in scope, of very long duration (some possibly irreversible), and have very high cumulative health impacts (e.g., increased temperatures and severe land degradation may lead to increased areas of desertification, causing population displacement and malnutrition) (Corvalan *et al.* 2005; Whitmee *et al.* 2015). They are also the most difficult to characterize and quantify. Moreover, multiple simultaneous threats could lead us to rapidly reach tipping points with unpredictable, non-linear effects in ecosystem services (Whitmee *et al.* 2015).

These pathways often overlap and are mediated by the levels of vulnerability and of socio-economic inequalities present. Upstream interventions (to prevent environmental damage) are more effective than downstream interventions (to adapt and protect health), although both are needed. Upstream interventions require the coordinated efforts of multiple sectors, and their aim is to stop or reduce exposures. Downstream interventions aim to reduce the health impacts (or treat the resulting diseases). The health impacts (lower part of Figure 1) show the main disease categories, listing some of the most important specific diseases and injuries (Sena & Ebi 2021).

Weakened health systems perpetuate the problem. In many low- and middle-income countries, health systems struggle to provide health under harsh conditions.

In many settings, health care facilities are precarious and understaffed. Worldwide, 1 in 4 health facilities lack water services; 1 in 3 do not have access to hand hygiene; 1 in 10 do not have sanitation services; 1 in 3 do not segregate waste safely (WHO & UNICEF 2020); and a large fraction lacks reliable energy services. This needs special attention to ensure that better access to water and energy services is achieved following environmental sustainability principles (Corvalan *et al.* 2020). Climate change and land use change accentuate this weakness by changing the pattern of diseases, bringing new health problems that health facilities may not be prepared to respond to. For example, local food insecurity can change the nutritional status of populations; or changes in the geographical range of vectors or rodents can change the pattern of zoonotic and vector-borne diseases. Mental health conditions (depression, stress, suicide) may increase due to social changes, such as unemployment, forced migration, violence, and conflict. Strengthening health systems must include a better understanding by health leaders of the links between land use, climate change, and health, so as to identify areas of action and advocacy with relevant sectors. Lack of overall health system resilience has been identified with regards to infectious disease control (Kruk *et al.* 2015) and with regards to climate change (WHO 2015a). The current Covid-19 pandemic further underscored the weaknesses (including inequalities in access to health care) of health systems everywhere.

Public health benefits to societies from climate-smart land use

We can have a healthy planet with healthy people.

WHO defines *public health* as “the art and science of preventing disease, prolonging life and promoting health through the organized efforts of society” (WHO Regional Office for Europe, 1988). *Health* is defined in the Constitution of the World Health Organization as a state of complete physical, mental, and social well-being, and not merely the

absence of disease or infirmity (WHO 1946); while *planetary health* is defined as the health of human civilization and the state of the natural system on which it depends (Whitmee *et al.* 2015). These two definitions were formulated 70 years apart, and much changed in this period. The time of the WHO definition was around the start of the so-called great acceleration which is proposed as the start period of the Anthropocene, where many human activities began rapid acceleration in socio-economic and Earth systems trends, including energy and water use, tropical forest loss, increase in domesticated land, increase in CO₂ emissions, and loss of biodiversity, among several other rapid changes (Steffen *et al.* 2015), resulting in over-exploitation of natural resources and loss of vital ecosystem services. While human health benefitted from these changes, we are reaching the point when improved gains in health are limited due to the loss of ecosystem services. A healthy planet can only support healthy people while people protect the planet. Physical, mental, and social well-being implies living in harmony with nature, where healthy people have an intrinsic need to protect nature. That need is currently hidden behind an unfounded need for societal and personal economic growth, but there is increasing awareness of our planetary boundaries.

We must better integrate health in intergovernmental global assessments. With few exceptions, human health is not fully integrated in global assessments. This is a missed opportunity. Health has been integrated in the assessments of the Intergovernmental Panel on Climate Change (IPCC); and health was an active contributor to the Millennium Ecosystem Assessment (MA). However, only a decade ago, the health sector in countries had minimal participation in matters related to climate change, loss of biological diversity, or desertification (the three areas covered by the Rio Conventions (Patz *et al.* 2012)). The sector was mostly absent from global discussions. Although at the global level there have been initiatives between WHO and the Convention on Biological Diversity (CBD) (Romanelli *et al.* 2014; WHO & CBD 2015) and the United Nations Framework Convention on Climate Change (UNFCCC) (WHO 2019b), this has not translated to national action by governments. This is changing, and health is becoming an increasingly-active participant in and contributor to discussions and

agreements. The health sector is also becoming active in reducing its own carbon emissions, with National Health Service England (NHS) being the first health system to take action to become “Net Zero” (NHS 2020).

The coronavirus disease Covid-19 is not the first nor the last pandemic of the 21st Century.

The new millennium began with outbreaks of novel diseases, as epidemics and pandemics. Ebola, severe acute respiratory syndrome (SARS), the H1N1 influenza pandemic, and the Middle East respiratory syndrome (MERS) were the precursors to Covid-19. Such diseases have pointed to the vulnerabilities in health systems and failures in the protection of nature; they all took the world by surprise; and they all are the result of animal to human (zoonotic) transmission. Climate and land use have contributed to the spread of disease-carrying vectors worldwide, moving into new geographical areas. Over 700,000 deaths a year are caused by vector-borne diseases. This translates to 17% of the global burden of communicable diseases, with 80% of the world’s population at risk of one or more vector-borne diseases. Major outbreaks of malaria, dengue, yellow fever, Zika virus disease, and chikungunya have occurred since 2014 (WHO 2020a). Zika virus disease, for example, was first identified in Africa in monkeys in 1947, and in humans in 1952. Rare sporadic infections in humans did not cause great concerns, but a large outbreak began in 2013 in the Pacific and 2015 in the Americas. In all, it reached 86 countries (WHO 2018b). There are over 200 known types of zoonoses and they make up a large percentage of new and existing diseases (WHO 2020c). Pandemic surveillance programmes need to understand the patterns of viral diversity in wildlife, how human-driven environmental changes contribute to their emergence, as well as the biophysical and social-behavioural determinants of cross species transmissions. Unfortunately, such analytical tools are not well developed (Olival *et al.* 2017). As stated in a recent UNEP report, pandemics like Covid-19 are predictable because they are the outcome of how people trade and consume animals, source and grow food, and in the process, alter the environment (UNEP & ILRI 2020). In other words, we know that new zoonotic epidemics and pandemics will emerge, but we cannot determine how, when, the mechanism for emergence, nor the magnitude of the event.

Looking back from 2030 on how we improved health by protecting nature

If we place ourselves in the year 2030, we may see the following scenario:

Advances in several areas were lost or delayed in 2020 due to the Covid-19 pandemic. However, this was the stimulus needed to begin a great transformation across the environmental, social, and economic dimensions of development. Similar to the year 2020 when people were more aware of the importance of responding to the climate change emergency, people became aware of the planetary emergency involving ecosystems, water, energy, air, land, food, and their implications for life on Earth — not just human health and well-being — and demanded change. The private sector supported this call and was critical to advance the global environmental agenda. Increased global solidarity helped many low-income countries in their recovery.

By 2030, many Sustainable Development Goals (SDGs) health targets were achieved because of action on climate change and ecosystems, including forestry and agriculture.

- Ending preventable deaths of newborns and children under 5 years of age (SDG 3.2) was achieved partly because of better access to clean water from restored ecosystems (SDG 6.6); and from reduced air pollution from elimination of biomass as a source of energy among the poor (SDG 7.1).
- Ending the epidemics of malaria and neglected tropical diseases (SDG 3.3) was aided by a better understanding of human encroachment in, and protection of, forests and pristine lands (SDG 15.1 and 15.2).
- Promoting mental health and well-being (SDG 3.4) was assisted by better understanding of the links between nature, including disaster reduction actions, access to forests, green spaces, and mental health, as was the reduction in substance abuse (SDG 3.5).
- Deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination (SDG 3.9) were substantially reduced by better understanding of the impact they also have on nature.
- Ending hunger (SDG 2.1) and all forms of malnutrition (SDG 2.2) were achieved through better management of the land and implementing resilient agricultural practices while increasing productivity (SDG 2.4) and restoring degraded land and soil (SDG 15.3).
- The eradication of extreme poverty (SDG 1.1), achieving social, economic, and political inclusion of all persons (SDG 10.2) and the integration of climate change into national policies (SDG 13.2) contributed directly and indirectly to improving health.

In all, nature-based solutions (i.e., cost-effective solutions inspired and supported by nature, and which provide social, environmental, and economic benefit) (European Commission 2020) helped achieve health-related SDGs.

Justice and equity issues overlap with climate and land use change, ultimately affecting public health

Inequities are health risk factors — the social determinants of health. These are the conditions in which people are born, grow, work, live, and age, and are the result of factors such as politics, culture, values, beliefs, gender, race, distribution of power,

and the economy: “a toxic combination of poor social policies, unfair economic arrangements, and bad politics” (WHO 2008). The unequal distribution of health among population groups or individuals is socially-produced and spread worldwide, even within high-income countries (Rudolph *et al.* 2015; Solar & Irwin 2010). The social gradient (where those with the lowest socioeconomic position have the worst health status) is also present in health and environment associations. For example, an environmental burden of disease study shows very large differences among countries depending on income levels. Age

standardized death per one hundred thousand attributable to the environment shows that the 10 countries with highest rates (over 300) are low-income countries, whereas the 10 countries with the lowest death rates (under 45) are all high-income countries (Prüss-Ustün *et al.* 2017). By responding to social injustice and inequities, governments are working towards better health.

Health outcomes show significant differences for different population groups depending on several social mediating factors.

Not all population groups are equally exposed to environmental changes, in land use or the climate. While wealthy countries and people are affected, they can buffer the impacts of these changes in their lives and their health. This is not the case for people who live on and depend on the land for survival. As is the case with other environmental pressures (e.g., air pollution; water and soil chemical contamination), the groups that are often the least responsible for the problem are the ones that suffer the highest consequences. Indigenous Peoples, who have traditionally been the custodians and protectors of the land, are particularly affected by climate and other global environmental changes. Even with current political and societal awareness, global mandates and agreements, and civil society and donor community actions, the problem of health disparities persists.

Changes in land and climate leave many groups at higher risk to poor health outcomes.

People cannot live without the support of ecosystem services; and some population groups are particularly at risk. For example: lactating women and children need access to nutritious food and safe water; people in rural or remote communities can be completely dependent on the land for survival and may have no access to public health services; older people and persons with chronic diseases may be at higher risk from air pollution, heat stress, and lack of food access; agricultural workers and their families may be exposed to heat and dehydration, agricultural pesticides, and air pollution from burning of agricultural fields, and suffer the impacts of drought, water scarcity, and food insecurity; people living in poverty often have poor health status, and face increased risks of infectious diseases from water and vectors, while also experiencing malnutrition. If pressures on ecosystems are not mitigated, these risks will increase and include new population groups. As stated by Mary Robinson, the former president of

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the Republic of Ireland, climate justice “insists on a shift from a discourse on greenhouse gases and melting ice caps into a civil rights movement with the people and communities most vulnerable to climate impacts at its heart” (UN 2019).

Every effort must be made to integrate equity and justice in the path to 2030.

The United Nations Conference on Sustainable Development (Rio+20) recognized that a state of physical, mental, and social well-being is necessary to achieve the goals of sustainable development (UNGA 2012). On the other hand, sustainable development influences people’s ability to pursue a state of physical, mental, and social well-being. The UN 2030 Agenda for Sustainable Development calls for transformative decisions for a sustainable, equitable, and resilient world that can offer health and human rights to everyone, without leaving anyone behind. The SDGs are a call for action by all countries for peace and prosperity for people and the planet. Actions on climate change mitigation and adaptation jointly with sustainable land use management and restoration can make important contributions to achieving other SDGs.

Healthy ecosystems (those that perform their various functions well, and where equilibrium is maintained (WHO & CBD 2015) are needed to ensure healthy communities and societies and are essential to reducing poverty in all its forms and to improve access to drinking water, food security, and nutrition. Progress towards all SDGs involve promoting social justice, reducing inequalities, increasing socioeconomic stability, reducing conflict and forced migration, instigating the principle of equity for the most vulnerable population groups and countries, and improving human development. Likewise, ensuring universal health coverage (SDG 3.8) and universal access to health are not only fundamental to promoting and protecting human health, but also to promoting equity and social justice (Sena & Ebi 2021).

Transformative actions are needed to accelerate positive trends and mitigate negative trends during this critical 2021-2030 period

The last decade brought the promise of a different and better future, but global and country level responses are not being implemented fast enough.

The *Future We Want*, the outcome report of the 2012 Rio+20 Conference, placed health as a precondition for, an outcome of, and indicator of all three dimensions of sustainable development (social, economic, environmental) (UNGA 2012). In 2015, Agenda 2030, the Sendai Framework for Disaster Risk Reduction, and the Paris Climate Agreement offered the promise of a transformed world. The SDGs provide a framework to guide transformative actions and include targets on climate action, life on land, and good health and well-being to be accomplished by 2030 or earlier.

Despite global planning and these seminal, unprecedented agreements, climate change hazards have worsened, affecting both land and people through large scale wildfires, droughts and floods, and in low-lying coastal areas, land salinization from sea-level rise. Since 2010, there have been almost 1,900 separate flood and drought events causing over 76 thousand deaths, 1.4 billion affected persons, and 500 billion USD in damages (CRED/EM-DAT 2021). World leaders agree on the urgency to act in speeches and global agreements, but the responses are far too slow for a rapidly changing world. The disparity between speech and action frustrates scientists, civil society, young people, and donor communities. Health should be a centerpiece of discussions and action plans; and yet, important issues such as building the resilience of the health sector are woefully underfunded. Of the multilateral climate finance, only around 0.5% has been allocated to health projects (WHO 2018a). Funding alone, though, will not be sufficient without complete political commitment to act.

The Covid-19 pandemic is both a consequence of human actions (and inactions) and an opportunity for transformation. The pandemic is also a wake-up call and a reminder of the importance of nature in our

lives (UN 2021). Had the SDGs been proposed after the Covid-19 pandemic, we may have had some very different and valuable targets. For starters there could have been a stronger SDG 3.d target to “Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks” (UN/DESA 2021) that could have specifically included a One Health approach for the control of zoonoses and combating antimicrobial resistance. In parallel, SDG 15 (life on land) could have a target linking ecosystem disruption and wildlife trafficking with public health. Nevertheless, there is a renewed opportunity to link Covid-19 recovery actions with the expected transformation towards a sustainable world.

Several key initiatives were launched in 2020 aimed at accelerating change. Important initiatives were launched in 2020 in response to the Covid-19 pandemic with positive transformative implications for nature and for health:

1. A Manifesto for a Healthy Recovery. Launched by WHO in response to the Covid-19 pandemic, it notes both the lack of universal health coverage — even in some rich countries — and large inequalities driven by socioeconomic status, gender, and minority status, in the spread of the infection, loss of livelihoods, and death. Among the prescriptions for a healthy and green recovery, the first is to protect and preserve the source of human health — nature. It calls for essential services for health care facilities (water, sanitation, and clean energy) and a quick global energy transition, which would also help in reducing deaths, considering that 1 of 8 deaths are related to air pollution. Promoting healthy and sustainable food systems would help to reduce global GHG emissions from land clearing, noting that land use change is the single largest environmental driver for new disease outbreaks. The manifesto also calls for building healthy and livable cities and, importantly, to stop using taxpayer’s money to fund pollution, of which about 400 billion USD per year is spent in subsidies for fossil fuels (WHO 2020b) — although the total global estimate for subsidies is over 5 trillion USD, or 6.5% of gross domestic product (GDP) in 2015 (Coady *et al.* 2017).

2. Race to Zero (R2Z). The United Nations Framework Convention on Climate Change (UNFCCC) Race to Zero (R2Z) campaign calls for healthy, resilient, and zero carbon recovery, with the

participation of the health sector. In a recent event, Prime Minister of Fiji, Frank Bainamarama, stated: "Covid-19 is our wake-up call. We've been offered a glimpse into the not-so-distant future, one where the compromised health of humanity and our planet alike make every day a fight for survival. But unlike the pandemic, we see this life-threatening catastrophe coming and we have the chance to act now before it's too late" (UNFCCC 2020).

3. Building Back Better and Covid-19. The pandemic threatens to derail progress towards the SDGs, reversing decades of progress in reducing poverty, hunger, and inequalities. Building Back Better is a global United Nations response, a unique opportunity to transform economies and ultimately create more equitable societies. Action is needed on many fronts including building stronger and equity-focused health systems (UN 2020a).

Listening to a million voices, we hear the call for environmental protection and access to healthcare.

The [UN75](#) initiative is a global conversation about our common challenges (UN 2020b). In an online survey (with over 1.3 million responses as of this writing), we learn what people wish for in the next 25 years. The three most voted for responses include more environmental protection, more respect for human rights, and better access to health care. Asked about the global trends most likely to affect the future, the highest votes were for climate change and environmental issues and risks related to health. UN75 also held over 1,000 dialogues in 80 countries. On Covid-19 the main priority of participants is better access to health care, water and sanitation, education, and having greater solidarity with places hardest hit by the pandemic (UNDP 2020). Health and the environment are on everyone's mind, and this demands action.

Build resilience of health systems while empowering the sector to act.

Resilience in health systems is the capacity of health actors, institutions, and populations to prepare for and respond to a crisis in an effective manner — maintaining core functions and staying informed during a crisis so as to be ready to reorganize if conditions require it (Kruk *et al.* 2015). The Ebola outbreak of 2014 and the Covid-19 pandemic have shown how health systems from low- to high-income countries need to strengthen resilience to respond to health crises. Climate-resilient health systems are defined as those capable

of anticipating, responding to, coping with, recovering from, and adapting to climate-related shocks and stress, so as to bring about sustained improvements in population health, despite an unstable climate (WHO 2015a). Transformative actions to accelerate positive trends include building health systems that are resilient in every aspect: not just able to respond to global changes, but to proactively engage in mitigating negative trends. Empowering the health sector requires communication, sensibilization, participation, and capacity-building — in other words, strong human and financial resources to act.

Governments, civil society, scientists, private sector, international agencies, and individuals have a role in implementing change. Protection of essential ecosystem services must be ensured and sustained through actions on climate change and land use issues. SDG target 16.7 calls to "ensure responsive, inclusive, participatory and representative decision-making at all levels" (UN/DESA 2021). This means commitment and engagement of all of society to help create healthy environments and offer the opportunity for a healthy life for everyone. Scientists serve a key role in informing policies. Governments and international agencies should provide and facilitate the political frameworks to operate. The private sector has a responsibility to ensure ecologically-sustainable approaches at all levels from production to consumption of goods and services. Civil society plays a key role in advocating for equity and justice in their communities, as does the engagement and participation of communities in reducing their own vulnerabilities. And each individual has a role in building healthy environments, from their dwellings to their neighborhood, for themselves and their families.

We must avoid the high cost of doing nothing.

Current global commitments in particular on climate change action by countries are insufficient. The longer it takes to respond, the more costly it becomes. The huge investment to fight the Covid-19 pandemic and to avoid global economic collapse indicates that funding is not the issue. It is political commitment at the highest levels that is lacking. In spite of all the accumulated knowledge, climate change and ecosystem destruction have not received the attention they deserve. We can see, in the short term, the impacts of the pandemic. We lack the longer-term vision to understand that the impacts of

global environmental changes will unfortunately be worse, unless we act now. There is increasing evidence that doing nothing is expensive (Dobson *et al.* 2020) and that transitioning the economy away from fossil fuels would have a good return on investment (Coady *et al.* 2017). Investment in prevention, such as reducing deforestation (which has the additional benefit of reducing losses of biodiversity and habitat), would require investments of 22 to 31 billion USD per year, a small fraction of the at least 5 trillion USD in lost GDP in 2020 (Dobson *et al.* 2020).

There are major risks and uncertainties that need urgent attention

Responding to health risks from unsustainable land use and climate change is urgent. Can leaders respond with the urgency and scale that are needed? With lessons learned from 2020 about interconnectedness, can they begin to see the integrated solutions that are required? The WHO calls climate change the biggest threat to health in the 21st Century (WHO 2015b). The challenges posed by the complex interaction between climate change and unsustainable land use, and the need to reverse ecosystem degradation — all while responding to increasing demand for natural resources and services due to continued population growth and economic development — involve managing risks to ecosystem service delivery (e.g., water and food security), as well as socioeconomic factors (e.g., poverty and forced migration) which contribute to health inequalities (Sena & Ebi 2021).

Water and food security are basic human rights. Water is indispensable to the provision of services such as energy and food production and to socioeconomic development, and provides direct human health benefits. Exposure pathways include growth of pathogens (including abundance of vectors which carry them) due to increased temperatures; contaminant concentration in ground and surface water due to reduced water levels and stream flows; industrial pollutants that can contaminate water systems, including industrial agricultural chemicals; high level of salinity in water; damage of water-infrastructure supply; and overall, ecosystem service

mismanagement (Landrigan *et al.* 2018; WHO 2017). Water contamination or inappropriate storage is related to infectious diseases (e.g., diarrhoeal diseases), changes in vector-borne diseases (e.g., dengue), noncommunicable diseases (e.g., undernutrition, cardiovascular diseases, cancers); while reduced access to water may lead to conflict and violence and to food insecurity (WHO 2017).

Food production is the major driver of land use change; it is also responsible for a large fraction of GHG emissions (Haines & Ebi 2019). While food systems are increasing in productivity — which is important to feeding a growing world population and prevent risk of famine in many parts of the world — large scale production is undermining long-term sustainability. Food production also results in high demand for freshwater (accounting for 70% of all freshwater withdrawals), is responsible for 80% of deforestation, and impacts soil quality (Johnson *et al.* 2017), thus putting enormous pressure on land- and water-based ecosystems. Current models of food production also require intensive use of fertilizers and pesticides, monoculture systems, and genetically modified crops. The direct negative effects of soil quality status through erosion, degradation, contamination, and salinization influence agricultural production — thus impairing food security, livelihoods, and human health and well-being (Pierzynski & Brajendra 2017). Loss of soil productivity can cause lack of food nutrients, lack of food production, food insecurity, and high food prices. All these factors impact malnutrition (including nutrient deficiency, undernutrition, and obesity), contributing to premature deaths and worsening some health conditions, including both chronic and infectious diseases. The accelerating demand for livestock products (including poultry) has resulted in increased pressure on land and water systems, while also increasing risks of infections in humans (Corvalan *et al.* 2005).

Poverty and migration may increase as a result of water and food insecurity. The world population is expected to increase from 7.8 billion (a three-fold increase since 1950) to 8.5 billion in 2030 and to 9.7 billion in 2050, with much of the rate of growth occurring in low-income countries (UN/DESA 2019). There is currently uncertainty regarding how to produce healthy and nutritional food without further stressing the land and water systems. Populations are not equally vulnerable, and risks are not equally

distributed (Sena & Ebi 2021). The magnitude of the impacts caused by climate change and the loss of ecosystems affect mostly poor people in low- and middle-income countries, exacerbating poverty and inequalities. In addition, poverty and income inequality can be intensified amongst people who live on fragile lands or who are dependent on subsistence agriculture. These areas, which already have a higher overall proportion of rural poverty, may only offer land of low productivity. These environmental vulnerabilities, when coupled with social, economic, and political challenges, can produce a vicious cycle of poverty and environmental degradation which can further increase socioeconomic instability and result in violence, conflict, and forced migration, which in turn adds further threats to human health (Neumann *et al.* 2015; Verner 2010). Poverty incorporates in its characterization limited or lack of access to resources (land and technology), opportunity to access markets, and participation in decision-making processes (Sanz *et al.* 2017). Poverty, land degradation, and migration processes are interconnected (McLeman 2017). People who migrate can experience additional vulnerabilities such as conflict, violence, and discrimination in the places they migrate to, amplifying the inequities and social injustice they try to escape from (FAO 2018). Migration and conflict can lead to land use changes elsewhere, so it is a vicious circle (IPCC 2019).

Making decision in times of uncertainty is hard, but we must make every effort to adapt to what we cannot prevent, and prevent what we cannot adapt to. One of the many lessons learned from the Covid-19 pandemic is that while we are good at building scenarios and identifying risks, we are not so good at the basic principle of prevention and preparedness and continue to focus, instead, on post-event management. While knowing for years that a pandemic was imminent, even the most advanced health systems were caught unawares, and many have been close to collapsing. Therefore, while we may not have been able to prevent its emergence, we could have been able to contain it. A better approach is to reduce the drivers of pandemic risk, and therefore prevent their emergence (IPBES 2020). Climate change and ecosystem degradation follow a similar pattern. Environmental contamination is often local and reversible; however, environmental changes result in permanent loss of natural resources and ecosystems, which are global and irreversible (McMichael *et al.* 2008). Both are preventable.

One of the many lessons learned from the Covid-19 pandemic is that while we are good at building scenarios and identifying risks, we are not so good at the basic principle of prevention and preparedness and continue to focus, instead, on post-event management.

Uncertainties exist in every process and they must be part of planning. They are not an excuse for inaction; as that would result in increased ill health and injustice and inequity for the most vulnerable people. Science can help in providing the most up-to-date evidence on the consequences of inaction in this area.

How to be part of the transition

Reducing risks by integrating actions on public health, land use, and climate change into decision-making processes

Building resilience to environmental changes and emerging health threats and emergencies is urgent to reduce health risks and this requires both resources and enabling mechanisms. Actions to inform decision-making include:

1. Research networks: Establishing collaborative and multidisciplinary networks across sectors, levels, and stakeholders to build and communicate knowledge about the complex interactions between land use change and climate change, their causal pathways, and their health impacts mediated by social and economic determinants (Sanz *et al.* 2017; Sena & Ebi 2021). Research would support strengthening the evidence base and advancing knowledge and understanding regarding the interaction between changing environmental conditions (for instance from unsustainable land use leading to desertification, land degradation, and drought) and health inequalities and inequities, considering as a priority all vulnerable population groups (IPCC 2019). This would help identify the best options for action to protect people and planet, in particular those that provide the highest co-benefits, using the latest technologies for data collection and analysis. Examples of networks include Planetary Health (Whitmee *et al.* 2015) and

One Health (Amuasi *et al.* 2020). *Implementation: Actions by scientists and academic institutions in partnerships with government sectors, civil society, and local communities.*

2. Assessments: Assessing the health risks and health system needs and costs associated with current and future environmental, land use, and climate changes, particularly over the long term, and also estimating the costs and savings from protecting health from these challenges (Ebi *et al.* 2013; Fox *et al.* 2019). This places the emphasis on risk reduction management, focusing on prevention and preparedness. *Implementation: Assessments by international agencies, national and local governments, and scientists.*

3. Policy: Integrating biodiversity, water and land use management, drought and land degradation, food security, climate change, and disaster risk reduction into national health planning and the development of national and international guidelines to manage the transition to sustainable land use with social justice and equity. This includes upscaling approaches on adaptation and mitigation to integrate measures of land use management and climate change issues across sectors, levels, and stakeholder groups, making it a consideration in policy in all related areas and sectors (e.g., water, energy, agriculture, forestry, environment, social development, poverty, health) (Sanz *et al.* 2017). Similarly, integrate health in other areas in the context of Health in All Policies (WHO 2014). Lack of complete information from assessments should not be interpreted as an excuse for inaction. *Implementation: Multiple sectors of national and local government, civil society, private sector and international agencies.*

4. Monitoring and surveillance: Promoting surveillance programs (and strategies to improve surveillance capacity) of health impacts related to environmental change risks, including for pandemics. This includes improving access to data and information to facilitate the evaluation and monitoring of the human health impacts in the context of climate, environmental, and land use change hazards, exposures, and vulnerabilities at the individual and population levels to provide policy-makers tools for action (Fox *et al.* 2019). Knowledge co-creation and sharing with users and science-based communication with communities would help inform concrete actions on the ground (Pattanayak &

Haines 2017). *Implementation: National and local governments in partnership with civil society, non-governmental organizations, and the private sector.*

5. Action plans: Developing evidence-based mitigation and adaptation plans and strategies that address the health impacts of changes in climate and land, prioritizing equitable actions to vulnerable people and socioeconomic affected regions. This implies strengthened collaboration between health, environment, and other sectors to build platforms for data exchange, linkage, and analyses. This would directly support SDG target 3.d to “strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks.” *Implementation: Multiple sectors of national and local government, in consultation with civil society, local communities, and the private sector.*

6. Education and communication: Implementing health education and communication strategies about risk factors for human health related to land use changes and climate change to increase community awareness, engagement, participation, and empowerment – considering local needs, gender differences, educational gaps, socioeconomic status, cultural behaviors, and social inequities and inequalities (Sena & Ebi 2021). *Implementation: Educators and communicators from civil society, non-governmental organizations, and national and local governments.*

Realizing the vision – the role of the philanthropic and donor communities

Health, climate, and land use change are seen as separate agendas, seldom addressed as one. Donors have an opportunity to help link these areas for the joint benefit of natural systems and human well-being:

1. Fund environmental common goods for health.

This includes environmental policies and interventions with significant impacts on health, and which require financing from governments or donors to avoid market failures. Examples include interventions to preserve biodiversity and carbon sinks; ecologically sustainable food systems which promote food security and healthy diets; clean energy and transport systems that reduce greenhouse gas emissions, promote equity of

access, active transportation, and improve air quality; and land use policies that protect water sources and natural mechanisms of buffering and recycling. Costing estimates indicate that many interventions are either not expensive or potentially cost saving (Lo *et al.* 2019).

2. The health sector has a part to play but is underfunded for this role. While many interventions are needed outside the health sector, much can be achieved within the sector itself. A central role of the health system is research and advocacy to inform other sectors on actions needed to protect health. For example, there are estimates of the global disease burden from all environmental risks combined, and estimates specific for climate change, but not for ecosystems or desertification, land degradation, and drought, noting that burden of disease assessments allow estimating the magnitude of the problem and the identification of areas for interventions. Health could also lead efforts, involving several health determining sectors, towards an improved understanding of the causal pathway to allow for the identification of upstream interventions (Figure 1) that protect both health and environment.

3. Follow the science for evidence-based philanthropy. Often research and interventions are influenced by fund allocations. This works well when the donor has been informed by science on what is needed, and the donor agrees. But it is not always the case. Donors may not have the best or the correct advice, or they may have a different agenda, and research and interventions may not be directed towards where the need is greatest. In this case, researchers or non-governmental organizations may find themselves adapting their work and interest to comply with a donor call for funding submissions. For example, while the high environmental burden of disease is known, insufficient funds are allocated for health action; and health is insufficiently included in the work of other sectors. Importantly, health sector actors need to be trained and educated as both scientists and advocates in the health, climate and land change use nexus.

4. Support local action and change. Much can be accomplished at the local level by supporting local leaders and communities for local solutions. This would include strategies that respond to crosscutting priorities including gender, minorities, and Indigenous populations; building partnerships with a broad set of

actors; obtaining regional, national, and international support when requested; building local level health resilience; and helping implement nature-based solutions.

5. Implement transformative actions that help eliminate the toxic policies that go against nature and the ability of people to protect the land and themselves. This implies funding projects that promote demonstrated change, integrating both social and environmental determinants of health. This involves social movements with appropriate social media tools to advocate for transformative actions and proactively mitigate negative trends.

6. Build on the momentum created by the pandemic. Support local civil society action derived from initiatives such as the UN's [Building Back Better](#) and the [WHO Manifesto for a Healthy Recovery](#), helping refocus people's actions on the large-scale emergency of planetary health and demanding political commitment to protect nature.

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