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Perspective

Nature's contributions to social determinants of mental health and the role of conservation

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SUMMARY

Little is known about the impending mental health impacts of the global nature crisis. Existing evidence largely overlooks how nature sustains the economic and material dimensions of people's lives that support their mental health. Moreover, this evidence poorly represents the context-dependent experiences of billions living in the rural Global South. Here, we offer a framework illustrating how nature's essential contributions to people underpin multiple social determinants of mental health. We explore how the loss of those contributions (e.g., fisheries collapse) may exacerbate social determinants (e.g., poverty) of poor mental health. We examine how biodiversity conservation may affect mental health by altering the flow of nature's contributions, regulating access to those contributions, generating direct impacts through projects, and tackling the underlying drivers of nature loss (illustrated in an empirically based scenario analysis in Uganda). A better understanding can guide policy and practice to simultaneously tackle nature loss while protecting and enhancing mental health globally.

WHERE IS NATURE LOSS IN GLOBAL MENTAL HEALTH DISCOURSE?

Humanity faces the triple challenge of reversing the loss of nature, keeping global temperatures within safe limits, and supporting the health and well-being of a growing population.[1] These challenges are substantial and deeply interconnected, with seven of the eight "safe and just Earth system boundaries" currently exceeded.[2] People have significantly altered 75% of the global land surface, while half of all coral reef cover and 85% of wetlands have been lost, and 25% of assessed plant and animal species are threatened with extinction.[3] Global temperatures are likely to rise well over 2°C by 2100 unless strong mitigation policies are adopted.[4–6] At the same time, progression toward the United Nations Sustainable Development Goals (SDG) has been inadequate, with progress to 85% of the 169 SDG targets for 2030 either off track or regressing.[7] Looking ahead, the widespread degradation of Earth's natural systems threatens to undermine multiple dimensions of human health and well-being.[8]

Central to the triple challenge is the need to maintain and improve people's lives within a safe, functional, and productive biosphere. Mental health is a central pillar of human well-being[9] and a necessary condition for the health of all (Box 1).[10] Mental disorders collectively are a leading threat to health, ranked as the seventh top cause of disease burden globally in 2019 (measured in disability-adjusted life years).[11,12] The Global Burden of Disease estimates that common mental disorders contributed 15% of total years lived with disability in 2019,[13] with this number increasing by a quarter during the COVID-19 pandemic.[14] Despite this substantial burden, mental health has been neglected within public health policy and spending.[15] For instance, only around 2% of government health spending was on mental health across assessed countries in 2020,[16] with Global South nations being notably underserved by mental healthcare services.[16–19] Recognizing this neglect, the director-general of the World Health Organization, Dr. Tedros Adhanom Ghebreyesus, has affirmed the Organization's commitment to "transforming the environments that influence our mental health." In doing so, the World Health Organization has called for "whole of society" approaches—which cut across all sectors—to promote and protect mental health globally.[20]

A growing body of research examines the impacts of climate change on mental health, including considering people's direct experiences of higher temperatures and extreme weather events and the associated disruption of social determinants of health.[26–28] For instance, Berry et al.[29] outline multiple mechanisms by which drought can alter lives in ways harmful to mental

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Box 1. Definitions of key terms related to mental health and nature

BIODIVERSITY

The "variability among living organisms from all sources […] and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."[21]

CONSERVATION

"Actions that are intended to establish, improve or maintain good relations with nature."[22]

MENTAL DISORDER

"Disturbances of thought, emotion, behavior, and relationships with others that lead to substantial suffering and functional impairment in one or more major life activities, as identified in the major classification systems such as the WHO International Classification of Diseases and the Diagnostic and Statistical Manual of Mental Disorders."[23,24]

MENTAL HEALTH

"The capacity of thought, emotion, and behavior that enables every individual to realise their own potential in relation to their developmental stage, to cope with the normal stresses of life, to study or work productively and fruitfully, and to contribute to their community."[23,24]

NATURE

"The nonhuman world […], with particular emphasis on living organisms, their diversity, their interactions among themselves and with their abiotic environment."[3] This definition includes features co-produced through the interaction between humans and other organisms, such as agroecological systems.[3]

NATURE'S CONTRIBUTIONS TO PEOPLE

"All the contributions that humanity obtains from nature. Ecosystem goods and services, considered separately or in bundles, are included in this category. Within other knowledge systems, nature's gifts and similar concepts refer to the benefits of nature from which people derive good quality of life."[3]

SOCIAL DETERMINANTS OF MENTAL HEALTH

The social and economic conditions that have a direct influence on the mental health of people across the life course.[23,25]

health, such as disrupting social relations. In light of this emerging evidence, institutions such as the World Health Organization[30] and the American Psychological Association[31] have highlighted the serious mental health threats posed by climate change. These calls are influencing climate policy. For instance, mental health was mentioned 428 times in the Intergovernmental Panel on Climate Change Sixth Assessment Report.[32]

In contrast, there is little awareness and patchy evidence of the potential mental health consequences of global nature loss,[33–35] particularly how nature sustains the socioeconomic fabric of people's lives and livelihoods that underpins their mental health.[3] This paucity of evidence is illustrated in The Lancet Commission on Global Mental Health and Sustainable Development report, which highlights the risks of climate change but not the global nature crisis.[23] We are unaware of any high-profile calls for action to understand and tackle the potential mental health consequences of nature loss equivalent to those relating to climate change. At best, neglecting mental health when responding to the nature crisis could lead to missed opportunities to advance progress toward these two interconnected global challenges. At worst, this neglect could worsen the global burden of poor mental health and deepen health inequalities.

Here, we explore potentially significant but largely overlooked links between nature, its loss and conservation, and mental health. Crucially, we offer a framework emphasizing how nature's essential material contributions to people[3] underpin multiple social determinants of mental health[25] (Figure 1). We begin by outlining key existing evidence and then introduce our framework. We examine the consequences of losing nature's contributions and assess how conservation responses might foster or harm mental health. Ultimately, we urge health researchers, practitioners, policymakers, and funding bodies to recognize how nature fundamentally underpins mental health and to support efforts toward its conservation. Moreover, we challenge the conservation movement to better understand its beneficial and detrimental roles in mental health and choose strategies that contribute to better public health outcomes. We believe that these steps will help advance progress toward the coupled goals of reversing nature loss and nurturing good mental health for all.

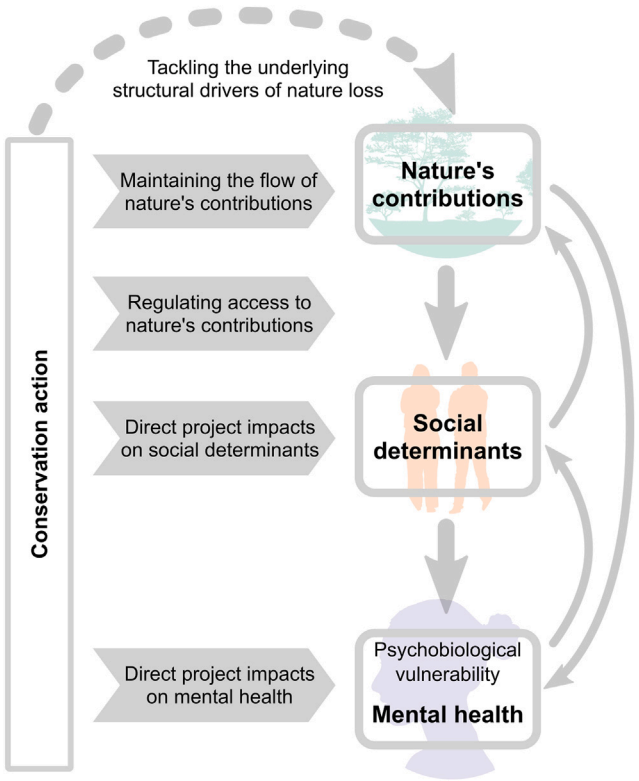


Figure 1. The nature's contributions to social determinants of mental health framework

A conceptual framework illustrating ways that nature's contributions to people (green)[3] might influence social determinants (orange) of mental health (purple).[23] We refer to this combined framework as nature's contributions to social determinants of mental health framework. Nature conservation might support or undermine mental health globally by maintaining the flow of nature's contributions; by regulating access to those contributions; through direct project impacts on social determinants and mental health (gray text boxes); and by tackling the underlying drivers of nature loss (dashed arrow). Other linkages include nature's direct contributions to mental health (e.g., through green-space exposure) and feedback processes between mental health, social determinants, and the state of nature (thin solid arrows).

EVIDENCE AND GAPS LINKING NATURE AND MENTAL HEALTH

A large body of empirical research explores the beneficial relationships between nature and mental health. One increasingly well-studied and important linkage is the psychological benefits of green and blue space exposure.[36–39] For example, one study among 16,307 respondents in 18 countries found that the frequency of visits to green and blue spaces was positively associated with self-reported mental health and negatively associated with "mental distress."[40] Additionally, evidence suggests natural areas also play more indirect roles in mental health, for example, by providing opportunities for exercise and improved physical health,[41,42] with well-evidenced mental health benefits.[43,44] Equally, urban green spaces might mitigate other environmental stressors such as noise, air pollution, and heat,[45–47] potentially resulting in mental health benefits.[48,49] Multiple frameworks have been proposed to explain these observed relationships, including the Biophilia hypothesis, stress reduction theory, attention restoration theory, the ecosystem service cascade model, and the nature-based biopsychosocial resilience framework.[50–52]

Another set of increasingly well-understood and important linkages relates to people's experiences of eco-anxiety, climate anxiety, solastalgia (the "pain experienced when there is recognition that the place where one resides and that one loves is under immediate assault"[53]), ecological grief, and related concepts.[26,54–57] These concepts broadly relate to negative psychological reactions to thinking about and witnessing—directly or indirectly through media and discourse—nature loss and climate change. For example, in a recent study among 10,000 young people (aged 16–25) in ten countries, 59% said they were very or extremely worried about climate change.[58] Other research explores how environmental change can alter place-based relationships and lifestyles in ways that affect mental health.[59] For instance, studies describe how climate change has disrupted Canadian Inuit communities' cultural identity, wild-harvesting practices, and other activities, subsequently threatening their mental health.[60–63] Similarly, Gobster et al.[64] interviewed 17 landowners with strong place-based connections to forests in the Great Lakes of the United States, who experienced solastalgia arising from rapid landscape changes.

However, evidence is lacking on the myriad other ways in which nature affects people's lives and livelihoods that could impact their mental health. Specifically, there is limited understanding of or discourse about how nature's material contributions (like food, materials, and clean water[3,65]) affect the social determinants of poor mental health (including demographic, social, cultural, and economic drivers).[25,33] These material contributions are particularly vital in low-income settings in the Global South[66] (Figure 2). Once again, climate change research is more advanced in this respect. For example, in a narrative review, Lawrance et al.[67] state that climate change "acts as a risk amplifier by disrupting the conditions known to support good mental health, including socioeconomic, cultural and environmental conditions, and living and working conditions."

Furthermore, most of this existing evidence comes from urban Global North contexts, with some important exceptions (e.g., Tomita et al.,[68] Nawrath et al.[69]). For example, only 18 of the 276 studies on the mental health benefits of green-space exposure reviewed by Collins et al.[36] were done in Global South countries. More generally, we found no spatially explicit systematic reviews linking nature and mental health beyond those related to green spaces, and even the terms "green space" and "blue space" appear to reflect Anglo-European conceptualizations of nature.[70]

As such, this existing evidence is unlikely to reflect people's diverse and context-dependent relationships with nature in many parts of the world, including among the three billion people living in the rural Global South.[71] Evidence from the Global North generally focuses on desirable connections between nature and mental health (e.g., Bratman et al.,[50] though exceptions include studies on perceived urban crime[72]). However, relationships between nature and mental health can be highly context dependent and, at times, detrimental. For example, encounters with some wildlife can be psychologically traumatic,[73] with human-wildlife conflict disproportionately concentrated in Sub-Saharan Africa and South Asia.[74] Similarly, it is unclear if the same psychological benefits that urban dwellers tend to gain from spending time in green spaces are experienced by those continually immersed

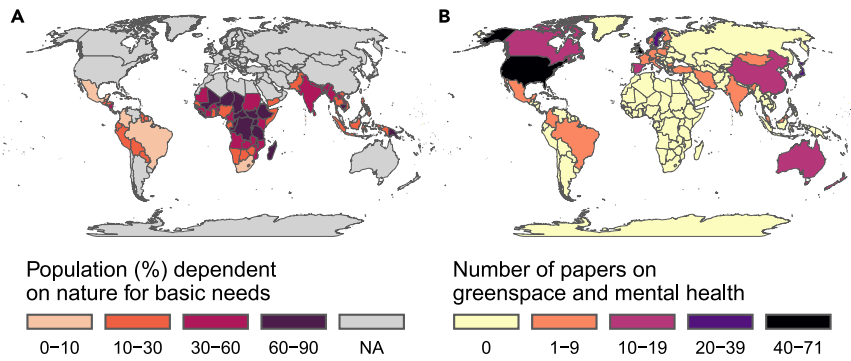


Figure 2. Dependence on nature's contributions to meet basic needs and the number of greenspace and mental health articles

(A) The percentage of the population in assessed countries dependent on nature's contributions to meet basic needs around energy, water, housing and livelihood occupations, adapted from Fedele et al.[66] ("NA" indicates non-assessed countries).

(B) The number of papers linking green spaces and mental health, adapted from Collins et al.[36]

in more natural rural landscapes. Moreover, many residents in the rural Global South are exposed to the rapid loss of nature[75]—with potentially wide-ranging implications for mental health—while often being under-served by mental healthcare services.[16] Overlooking these diverse relationships and promoting policies based on geographically biased evidence risks worsening global mental health inequalities.

LINKING NATURE'S CONTRIBUTIONS TO PEOPLE WITH SOCIAL DETERMINANTS OF MENTAL HEALTH

We draw on two well-established bodies of evidence—which to date have not been systematically connected—to offer a more holistic understanding of the links between nature and mental health. We refer to this as the nature's contributions to social determinants of mental health framework.

The first body of evidence relates to nature's contributions, the benefits and costs produced through interactions between people and nature that underpin diverse aspects of people's lives.[76] The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) identifies 18 categories of nature's contributions to people.[3] These include material and non-material contributions, such as food, materials, medicines, or artistic inspiration. For example, over 2 billion people rely on wood fuel for energy,[77] while over 4.5 billion people face higher water pollution due to losses in nature's contributions under future land use and climate change scenarios.[78] Animals pollinate over 75% of globally important food crops,[79] with the loss of all animal pollinators projected to lead to a 3%–8% decline in total agricultural productivity.[80] Aquatic foods provide essential nutrients for millions globally[81] and are among the most nutrient-rich animal-source foods.[81]

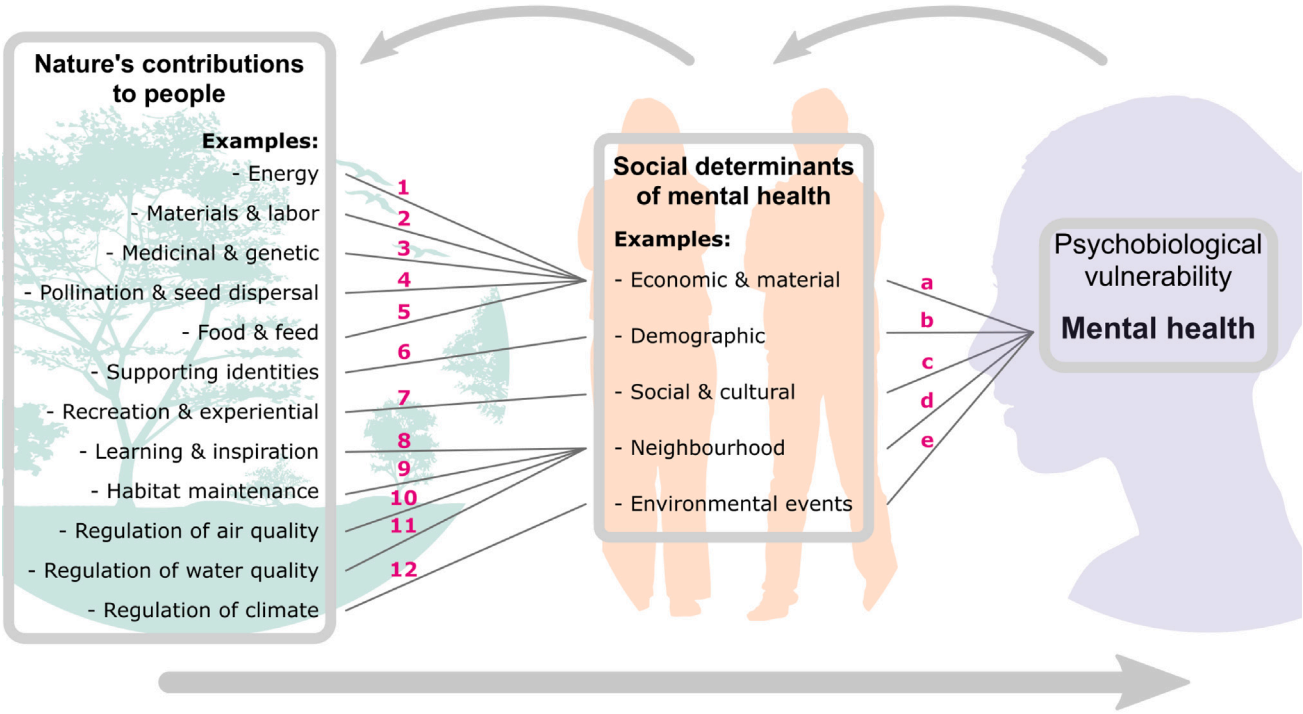
The second body of evidence comes from public health research documenting social determinants of mental health. Multiple factors influence an individual's risk of poor mental health, including the interaction between external stressors and psychosocial, biological, and genetic vulnerabilities.[23] These stressors can emerge from the external conditions and context of people's lives—the social determinants of mental health.[25] Social determinants of mental health include income, employment, social and economic status, education, food security, housing, discrimination, and many contextual factors that significantly influence mental health outcomes.[25,82–85] For example, socioeconomic status—encompassing living conditions, education, and incomes and wealth—has been consistently shown to be a powerful social determinant of poor mental health across the Global North[86] and South.[87,88] Moreover, wealth and income also mediate other social determinants, such as food security,[89] safe housing,[90] and healthcare.[85] Crucially, these risk factors are not randomly distributed among people but emerge from fundamentally inequitable and unjust economic and social systems.[85,91]

Many of nature's contributions to people will likely influence social determinants of mental health (Figure 3). For instance, the contribution of forests to food security may support mental health[92,93]; natural spaces can be valuable socialization spaces, with social support having well-evidenced psychological benefits[94,95]; and pollinators play important roles in agroecological systems, maintaining peoples' livelihoods and thus mental health.[79] Substantial evidence describes both nature's contributions and social determinants of mental health but in isolation from each other.[3,25] Limited research systematically connects these two bodies of theory and evidence (but see Sandifer et al.,[51] who reviewed evidence connecting "ecosystem services" to multiple dimensions of human health). Future research could map out plausible mechanisms linking these domains and systematically review evidence supporting each step in the causal chain. These reviews could draw inspiration from approaches used in climate change and mental health research. For example, researchers might look to Berry et al.[29] and Burrows et al.,[96] who consolidate evidence of multiple pathways linking climate change and mental health.

Furthermore, linkages between nature's contributions and the social determinants of mental health may be bi-directional, potentially giving rise to reinforcing or dampening feedback processes.[97] For example, Ridley et al.[98] reviewed causal evidence of the relationship between poverty and common mental disorders, finding that poverty triggers mental disorders while mental disorders exacerbate poverty. Equally, many social determinants, such as economic status or food security, influence interactions with nature. For instance, Kuiper et al.[99] found that low household wealth was associated with increased illegal elephant killing across 30 African countries between 2002 and 2020. In such cases, the state of nature and the state of people's mental health may bi-directionally entwine.

THE LOSS OF NATURE'S CONTRIBUTIONS

While nature's contributions might support social determinants of mental health, nature loss may exacerbate the global burden



Examples: Nature's contributions to people

1. Firewood as a source of energy for heating and cooking, contributing to living standards.
2. Wild grasses providing building materials, supporting housing conditions.
3. Harvest and sale of medicinal plants providing income for Indigenous peoples.
4. Insect pollinators supporting farmers' employment and incomes.
5. Wild foods supporting livelihoods and incomes.
6. Wild capture fish markets providing income and employment for women with limited alternatives.
7. Group outdoor activities in woodlands facilitating social support.
8. Enhanced learning and educational outcomes through school trips to coral reefs.
9. Green spaces reducing urban heat stress.
10. Urban forests acting as a barrier to pollution.
11. Wetlands ameliorating environmental pollutants and diseases that cause physical illness.
12. Coastal mangroves mitigating climate change and the risk of severe weather events.

Examples: Social determinants of mental health

a. Livelihood, food, energy, and housing security fostering good mental health.
b. Women with financial security being less vulnerable to gender-based violence.
c. Social support, capital, and participation promoting good mental health.
d. Safe, secure, and adequate housing and a good built environment supporting mental health.
e. Mitigating harm, violence, displacement, and conflict that cause psychological trauma.

Examples: Linking nature's contributions & mental health

2.+a. Wild grasses used to create homes, with secure housing fostering good mental health.
4.+a. Pollinators underpinning global food systems that support livelihoods and food security and thus mental health.
6.+c. Fish markets providing financial security for women thus making them less vulnerable to trauma from gender-based violence.
7.+c. British woodlands as recreational spaces facilitating social support, helping nurture mental health.
11.+d. Wetlands removing environmental pollutants, improving physical health outcomes and reducing potential mental health co-morbidities.

Figure 3. Hypothetical examples illustrating nature's contributions to social determinants of mental health

A conceptual framework illustrating ways that nature's contributions to people (green)[3] might influence social determinants (orange) of mental health (purple),[23] illustrated with hypothetical examples (pink characters). Other linkages include feedback processes between mental health, social determinants, and the state of nature (arrows).

of poor mental health. Land use change, overexploitation, climate change, pollution, and invasive species are the greatest threats to nature globally.[100,101] These direct threats emerge from indirect sociocultural, political, economic, demographic, and other drivers.[102] These threats have contributed to unprecedented rates of nature loss worldwide. For instance, average vertebrate species extinction rates are 8–100 times higher than background levels,[103] with around 25% of assessed animal and plant species threatened with extinction.[104] Around 7% of intact forests were lost between 2000 and 2013,[105] and over half of assessed wetlands have been lost since 1700.[106]

These losses have resulted in a widespread weakening of nature's capacity to benefit people. IPBES estimated that nature's capacity to support 14 of the 18 categories of contribution is

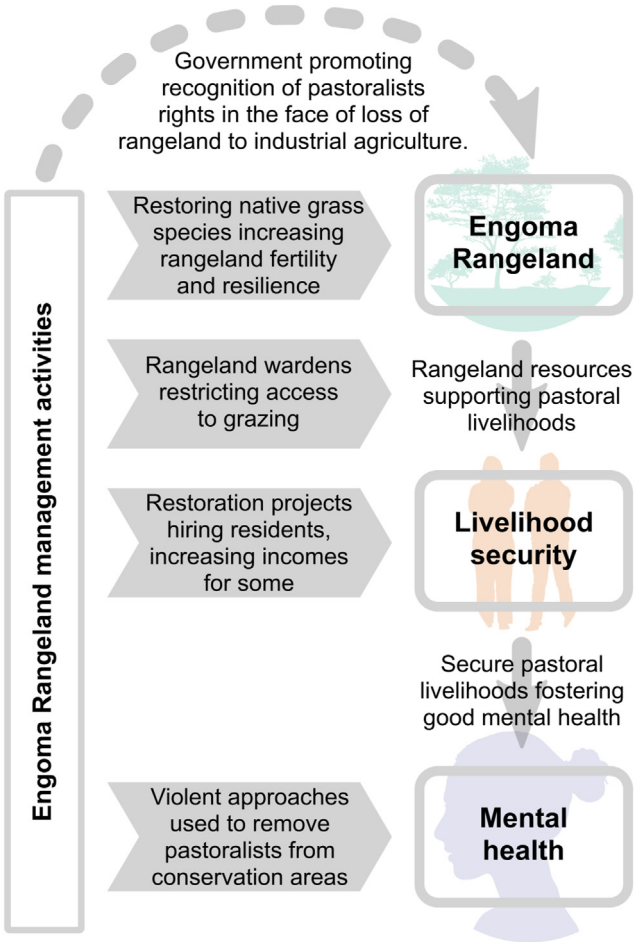


Figure 4. Hypothetical examples of how conservation actions may influence mental health

A hypothetical example illustrating how conservation actions (e.g., rangeland management activities) may influence mental health indirectly (e.g., maintaining the flow of nature's contributions to people, regulating access to those contributions, or addressing underlying structural drivers of nature loss) and directly (e.g., through project activities that directly affect social determinants or mental health).

declining,[3] potentially impacting the social determinants of mental health. For instance, the well-evidenced psychological benefits of nature exposure might decline as the abundance, quality, or accessibility of natural areas diminish,[107] though robust evidence of this is limited.[34,108] Our framework indicates myriad other possible linkages that have not been explored. For example, industrial agricultural expansion in northern Myanmar appears to have driven deforestation and the subsequent loss of construction materials, food, and income-generating products important to residents.[109] Housing, food, and livelihood security are recognized social determinants of mental health,[25] so their loss may have threatened the mental health of affected Burmese residents. In a wider example, the loss of animal pollinators and soil biodiversity threatens global food systems,[79,110] with potential cascading impacts across multiple social determinants of mental health for people worldwide.

However, nature loss may not inevitably lead to worse mental health outcomes; the processes threatening ecosystems might improve other aspects of people's lives. For instance, shifting farming is the largest driver of forest loss in Africa[111] but provides essential food and income for millions on the continent.[112] Economic development driven by natural resource exploitation might bolster many social determinants of mental health, such as income, employment, education, and health opportunities (though these gains may reverse as humanity further exceeds planetary boundaries).[8] This point underscores the importance of building a holistic understanding of the interconnections between nature, loss drivers, and mental health, particularly in developing economies.

Despite the severity of global nature loss and its projected impacts on people, there are no estimates of its mental health repercussions at the local, regional, or global scale. This scarcity of evidence might partly stem from the challenges in assessing causal links between nature loss and mental health. In the context of climate change, Burrows et al.[96] distinguish between sudden-onset events (such as acute flooding) and slow-onset conditions (like chronic droughts), finding comparatively limited evidence of the mental health impacts of the latter. They suggest that this disparity may be because chronic climate conditions are harder to conceptualize and measure than acute disasters. For instance, the mental health ramifications of a single hurricane event might be easier to isolate than the gradual and complex effects of climatic changes on food production systems. Echoing this, nature loss and its cascading impacts on social determinants are seldom discrete events. Instead, these changes may be incremental and unfold in dynamic socioecological systems (where people may adapt to and derive benefits from nature loss), making it hard to attribute long-term health effects to changes in nature.

Randomized experimental interventions might be unfeasible and unethical in this context, particularly when taking population-based approaches to mental health. However, cohort studies are commonly used in epidemiology to understand how risk and protective factors alter the likelihood of developing a disease or condition.[113] Such approaches are rare in research on nature but could be used to explore how nature loss, and the processes driving it, impacts people's lives and mental health over time.

When cohort studies are impractical, simulation-based modeling that merges existing evidence with credible assumptions can provide plausible predictions of mental health outcomes. This research might be strengthened through the use of life-course theory, a powerful approach for explaining how experiences and contextual factors can have cumulative impacts on individuals' health across their lives.[114] Furthermore, conceptions of mental health and nature vary across cultures and groups. In some places, the health of human and non-human nature is seen as intrinsically intertwined, including at a spiritual level.[28,60–63] Cross-cultural research should be sensitive to these differences and seek to understand contextually specific and place-based relationships between nature loss and mental health.

THE DIRECT AND INDIRECT ROLES OF CONSERVATION

We propose four mechanisms by which nature conservation actions might affect mental health: (1) maintaining the flow of nature's contributions, (2) regulating access to those contributions,

(3) the direct impacts from project activities, and (4) the effects of tackling the underlying drivers of nature loss (Figure 1). These mechanisms may apply across a wide range of conservation contexts, as illustrated in a hypothetical example of a rangeland management intervention (Figure 4).

Maintaining the flow of nature's contributions

Failure to conserve nature will lead to the loss of fundamental processes and systems that support the lives and livelihoods of all people.[3] Conservation actions that effectively maintain the flow of nature's contributions may, therefore, support social determinants of mental health. For example, forest conservation may help maintain the supply of diverse and nutritious wild foods and incomes to supplement diets,[115] thus alleviating food insecurity, a well-established mental health risk factor.[25,88,89] As a specific example, the Budongo Forest Reserve in Uganda appeared to offer a safety net function for residents, easing poverty and food insecurity and the consequent risk of psychological distress.[33] In another example, Buckley et al.[116] estimated a USD $6 trillion annual contribution of global economic value from improved mental health for visitors to protected natural areas. Further research is needed to understand if and how conservation actions maintain the flow of nature's contributions to mental health. Coupled social and ecological processes often transpire over long time frames, presenting a barrier to experimental interventions. However, many retrospective studies use match-pair (e.g., Wauchope et al.,[117] Sze et al.[118]) and synthetic control (e.g., Fox and Swearingen[119]) approaches to evaluate if conservation has led to better outcomes than a counterfactual. Such methods could be extended to examine if conservation has mitigated the impacts of nature loss on mental health. This type of analysis is currently limited by the lack of high-resolution, large-scale, spatially explicit mental health data in much of the Global South. Global mental health researchers could help fill this gap by collecting and sharing spatial information—taking steps to ensure anonymity—alongside their epidemiological data. Moreover, psychiatric epidemiologists should take seriously the threats presented by nature loss and the potential role of conservation efforts as a public health intervention.

Regulating access to nature's contributions

Wildlife overexploitation is a leading driver of nature loss globally.[100,101] Many conservation actions seek to tackle this overexploitation, such as through protected areas that exclude people or via hunting and fishing restrictions. Thus, some of the same actions to maintain nature's capacity to benefit people might also prevent access to those benefits. For example, restricting residents' access to the Budongo Forest Reserve in Uganda may worsen food insecurity and poverty among forest-dependent households and thus their risk of depression (Box 2). However, conservation actions can also play roles in securing Indigenous peoples' and local communities' access to nature's contributions. For example, rights-based approaches promote the recognition of local communities' stewardship and control of their territories and resources.[120] In some cases, this recognition can help guard against environmental degradation driven by other actors, such as extractive industries, while protecting access to resources underpinning the material, cultural, and spiritual aspects of local people's lives.[121]

There may be complex long-term or intergenerational trade-offs relating to mental health; conservation actions must balance people's immediate needs with nature's long-term capacity to deliver benefits. For example, the collapse of Atlantic Cod fish stocks led to fishery closures, which appeared to be a significant and chronic source of distress among affected fishers.[134] However, this closure may have accelerated the recovery of fish stocks, helping secure the livelihoods and mental health of fisheries into the future. Further causal evidence is needed to isolate the impact of the fisheries closure, but the range of associated costs and benefits of restricting access may only become apparent after the fact. Development studies and other disciplines have established numerous retrospective impact evaluation tools, including outcome harvesting, process monitoring, and "most significant change."[135] Outcome harvesting collects evidence of changes over time and then works backward to evaluate the contribution of different factors, including interventions, to those changes.[136] The approach is participatory and iterative, utilizes both qualitative and quantitative evidence, and emphasizes learning for adaptive management. This approach is useful for studying complex systems and identifying unintended outcomes, so it might be particularly suitable for understanding the mental health impacts of restricting access to nature.

Direct impacts from conservation project activities

Conservation projects can also directly impact people's lives, both desirably and detrimentally. For example, Kebersamaan Untuk Lautan is a nascent payment for an ecosystem services scheme in Indonesia, where small-scale fishers are compensated for releasing sharks caught as by-catch.[137] This incentive-based scheme has widespread support as an additional source of income among fishermen while potentially offering a cost-effective means of protecting marine megafauna populations.[137] Further research could uncover whether this income stream supports secure livelihoods and, in turn, fishermen's mental health. In other examples, well-designed nature-based tourism can support local economic development (e.g., Hill et al.[138]), while forest restoration can create employment opportunities (e.g., Brancalion et al.[139]), potentially enhancing mental health. Yet, some forms of conservation are likely to directly threaten mental health, particularly when they involve violence, displacement, and human rights abuses, which are well documented.[140,141] For example, people evicted from a wildlife sanctuary in India had significantly greater premature telomere shortening (associated with life stress) than a non-displaced comparator group.[142] Multiple high-profile cases link protected area management to human rights abuses, including physical violence (e.g., Bocarejo and Ojeda,[143] Verweijen[144]). Traumatic and violent events, as the victims of these abuses may have experienced, can be powerful drivers of poor mental health.[88,145] In-depth, long-term qualitative research may be particularly suitable for exploring these cases.

Mental health risks linked to conservation are not confined to residents of an affected area. Conservation professionals can face diverse workplace challenges linked to poor mental health.[146,147] For example, researchers have documented growing rates of post-traumatic stress disorder among frontline rangers working in Kruger National Park, South Africa.[148]

Box 2. Applying the nature's contributions to social determinants of mental health framework to areas adjacent to the Budongo Forest Reserve in Uganda

The Budongo landscape is a mosaic of subsistence and contract sugarcane farming, bordering the Budongo and Rwensama Forest Reserves in western Uganda (Figure 5). These forest reserves are an important source of legally and illegally harvested resources for residents.[122] Over 90% of 165 respondents to scenario-based interviews believed that hypothetical conservation actions restricting forest access would increase economic poverty and food insecurity among forest-dependent households.[35] Semi-structured interviews among 45 residents indicated that food insecurity and poverty were major reported causes of "thinking too much," an idiom suggesting psychological distress.[33]

We re-analyzed survey data collected with 695 residents systematically sampled from 11 communities bordering the Budongo and Rwensama Forest Reserves from March to May 2021, previously published by Pienkowski et al.[35] Respondents completed the eight-item patient health questionnaire (PHQ-8),[123] the Food Insecurity Experience Scale,[124] an asset index previously trailed in western Uganda,[125] and instruments measuring forest dependence and relative land size, among other questions.[35] The PHQ-9 (which includes one item related to suicidality that we removed due to poor performance in piloting, thus arriving at the PHQ-8[35]) has been validated among some sub-populations but not the general population in Uganda.[126] Respondents with PHQ-8 scores of 10 or higher crossed the screening threshold for current depressive disorders.[127] Item response theory models were used to construct latent variables for food insecurity, economic poverty, forest dependence, and relative land size, extracting ten datasets of plausible values. A logistic regression with a stochastic partial differential equation to account for spatial dependencies was fit to the ten datasets,[128] controlling for covariates such as gender, age, social support, and physical health, followed by Bayesian model averaging.[129] We compared the number of cases crossing screening thresholds with those predicted from two hypothetical scenarios representing different conservation strategies. One scenario denoted the restriction of forest access, where we increased food insecurity and economic poverty scores by 25% among the top third of forest-dependent respondents. Another scenario represented a pro-poor agroforestry scheme inside the forest reserves, where we reduced economic poverty scores by 30% among residents in the bottom third of relative land size scores. We extrapolated these scores to the total adult population (N = 76,532) estimated to be living within 3.4 km (the maximum distance in our sample) of the Budongo and Rwensama Forest Reserves, based on data from CIESIN[130] and UNEP-WCMC & IUCN.[11] Existing spatial modeling suggests that communities surrounding the forest reserves have socioeconomic and health profiles similar to those within our sample.[131] A spatially dislocated anonymized version of the analysis is available at https://github.com/Pienkowski/Uganda_case_study.

One standard deviation increases in food insecurity and economic poverty scores were associated with a 1.41 (95% credibility interval [CI]: 1.13–1.74) and a 1.48 (95% CI: 1.19–1.81) odd increase in crossing the screening threshold for current depressive disorder. In the first scenario, restricting forest access was predicted to result in 4,625–9,470 more residents crossing the screening threshold, representing a mean increase of 20.8% across the ten plausible value datasets. In the second scenario, introducing a pro-poor agroforestry scheme was predicted to result in 4,515–8,479 fewer residents crossing screening thresholds, indicating a 17.6% mean reduction.

Mental health care services in Uganda are poorly resourced and understaffed, with approximately one trained psychiatrist per one million people.[132] Common mental disorders are prevalent, with nearly a third of the population estimated to have depression.[133] Uganda's National Forestry Authority is mandated to sustainably manage forests, including for the benefit of local communities. Our hypothetical but plausible scenarios illustrate opportunities to simultaneously progress coupled biodiversity and public health goals in Uganda.

Conservation professionals who care deeply about nature may experience acute ecological grief and anxiety.[149–151] Future research could explore how this emotional toll interacts with the poor working conditions experienced by some conservationists. It could also explore how occupational impacts on conservationists' mental health reduce their abilities to safeguard nature.[147]

Feedback processes may exist where good mental health leads to better conservation outcomes.[67] Davies et al.[34] suggest that experiencing nature might foster interest and concern and thus action to protect nature. Though this evidence is limited, one study found that participants who watched a nature video harvested more sustainably in a fishing-themed game than those who watched an architectural video.[152]

Effects of tackling the underlying drivers of nature loss

Reversing global nature loss will require not only direct conservation action but fundamental shifts toward more sustainable production and consumption.[153] Indeed, the need for fundamental changes to the political, economic, and social systems that shape our relationship with the rest of nature is a core planetary health principle.[154] Equally, the need for a "just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities" is well established in climate change discourse and policy.[155] A just transition is also needed when reversing the global loss of nature to protect workers' mental health. However, it appears that few studies systematically examine how such changes in the name of nature conservation might influence the mental health of populations globally. These impacts are likely to be diverse and complex. For example, shifts in food systems advocated for by the EAT-Lancet Commission might reduce pressures on nature and the climate,[156] potentially indirectly supporting mental health through the pathways discussed above. However, shifts away from meat consumption might harm farmers' livelihoods,[157] which is especially concerning given the apparent prevalence of poor mental health within this occupational group.[158] Mapping out how different sustainability



Figure 5. The Budongo landscape in western Uganda is a mosaic of subsistence and contact farming, bordering the Budongo and Rwensama Forest Reserves, which are important sources of food and income for forest-dependent households

strategies might influence social determinants of mental health among different occupational groups could help ensure a just transition.

Moreover, there is growing recognition of the need to move beyond examining individual-level determinants of mental health and toward understanding complex "macro-social" factors whose effects are not easily tested experimentally.[23,83] Engaging with the critical social sciences, including political ecology and social epidemiology, may be particularly important here. These disciplines draw on various research traditions to interrogate the status quo in conservation and public health, so they may provide crucial insights into these macro-social factors.

POLICY IMPLICATIONS AT THE MENTAL HEALTH AND NATURE INTERFACE

The triple challenge is the focus of three main overlapping global policy frameworks. In 2022, Parties to the Convention on Biological Diversity agreed on the Kunming-Montreal global biodiversity framework,[159] with the vision of "sustaining a healthy planet and delivering benefits essential for all people." In December 2023, Parties to the United Nations Framework Convention on Climate Change met to advance progress toward the Paris Agreement, aiming to limit global warming to below 1.5°C above pre-industrial levels.[155] Accompanying this, the United Nations 2030 Agenda for Sustainable Development includes 17 goals, including ending poverty (SDG 1) and hunger (SDG 2) and ensuring good health for all (SDG 3).[160]

Attempting to tackle any one element of the triple challenge in isolation risks compromising the others. Instead, decision-makers should explicitly evaluate and account for the trade-offs and co-benefits between proposed solutions. Reflecting this, the Kunming-Montreal global biodiversity framework and World Health Organization's World Mental Health Report: Transforming Mental Health for All both call for "whole of government" and "whole of society" approaches.[20,159] These approaches emphasize the need for policy responses that consider multiple societal objectives in tandem and where all sectors consider their role in meeting global priorities. A more holistic understanding of the links between nature and mental health could guide policy and action that simultaneously advances progress in these areas in several ways.

First, the global health movement and allied decision-makers should examine and join calls to protect nature's contributions to the mental health of all. Collins et al.[161] identified six key challenges in global mental health research; the first was to identify root causes, risks, and protective factors of poor mental health. The projected loss of nature[3] is likely to be an increasingly significant root cause of poor mental health without coordinated efforts to reverse these trends. A more holistic understanding would better account for the health impacts of losing nature and the value of retaining it. Such evidence can help advocate for protecting life on land and below water (SDGs 14 and 15) to support human health (SDG 3). In this respect, the global public health movement should join calls for action to reverse the loss of nature as part of preventative healthcare. Furthermore, accounting for the breadth of nature's contributions to people can help mainstream nature into policy, planning, and national budget decisions. At a national level, population-level mental health indicators could be combined with natural capital accounting to track coupled changes in each. Businesses may also play an important role. For instance, processes that ensure people are no worse off—and ideally better off—when development projects alter nature and its contributions have been proposed.[162,163] These processes should account for impacts on mental health, using locally relevant conceptions of health and illness. On a global scale, a global action plan for biodiversity and health has been proposed to help mainstream biodiversity-health linkages into cross-sectoral and sector-specific planning.[164] If developed, this global action plan should encompass broad biodiversity-health linkages, including regarding mental health, using a holistic framework.

Second, the conservation movement needs to recognize the diverse ways its actions and strategies can support or harm mental health. In one survey of nearly 9,000 conservationists worldwide, over 85% said conservation action should "do no harm" to local people, and 73% said advancing well-being should be a goal of conservation.[165] Furthermore, conservation actors must uphold a wide range of international human rights laws,[166] such as the International Labour Organization's Convention 169 on the rights of Indigenous and tribal peoples. Ultimately, conservation actions are more likely to be successful with local support.[167] Overall, there are strong moral, legal, and pragmatic arguments for why conservationists should care about mental health. Reflecting this, there have been multiple high-profile calls for more people-centered conservation. For example, the Kigali Call to Action for People and Nature emerged from the inaugural Africa Protected and Conserved Areas Congress in 2022, attended by over 2,400 participants (https://apacongress.africa/download/english-version-of-apac-kigali-call-to-action/). This call emphasized the need for conservation approaches that empower Indigenous peoples and local communities, tackle injustice caused by conservation, and take an integrated approach at the interface between climate, nature, health, and conflict. More globally, the Kunming-Montreal global biodiversity framework aims to "restore, maintain and enhance nature's contributions to people, including ecosystem functions and services […] through nature-based solutions and/or ecosystem-based approaches for the benefit of all people and nature" (target 11). This, along with many other targets in the framework, has diverse implications for health, including mental health.[168]

Whether this Kunming-Montreal global biodiversity framework fosters rather than harms mental health will depend on its implementation. For example, the framework also includes the controversial target to nearly double the current extent of area-based conservation to 30% of the world surface by 2030 (target 3: "30 by 30"). This expansion is likely to affect the lives of hundreds of millions of people.[169,170] Area-based conservation and protected areas cover many practices and governance approaches, so their consequences for mental health may be context dependent. Nevertheless, expanding strictly protected areas risks stopping people from accessing nature's benefits, violence, and displacement—all of which are likely to harm the mental health of some of the world's most vulnerable and poorly protected people. Tools such as social safeguards, grievance processes, and participatory governance tools have been proposed to prevent this harm, but their effectiveness is contested.[171–173] However, the "30 by 30" target could be met in other ways. For example, other effective area-based conservation measures (OECMs) are "a geographically defined area other than a Protected Area, which is governed and managed in ways that [aim to] achieve positive and sustained long-term outcomes for the *in situ* conservation of biodiversity, with associated ecosystem functions and services and where applicable, cultural, spiritual, socioeconomic, and other locally relevant values."[174] OECMs include areas traditionally managed by Indigenous peoples and local communities and have been proposed as an instrument for meeting conservation targets in socially just and beneficial ways.[175–177] These OECMs may help support residents' mental health by recognizing their rights to natural resources, land, culture, and self-determined governance systems.

Many other conservation approaches might also play roles in mental health. For example, the framework also includes targets to ensure that at least 30% of degraded ecosystems are under restoration (target 2). Forest restoration is likely to be a core approach for meeting this target. Erbaugh et al.[178] estimate that nearly 300 million people live in areas that could be prioritized for tropical forest restoration. The social impacts of forest restoration are often context specific and variable between groups,[179,180] but our perspective indicates ways it could affect residents' mental health. Consequently, there is an urgent need to integrate mental health considerations into the planning, implementation, and monitoring of activities to meet the targets of the Kunming-Montreal Global Biodiversity Framework. One possible mechanism for this is via National Biodiversity Strategies and Action Plans (NBSAPs), where countries define how they will assess, value, and protect nature nationally. Willetts et al.[168] propose strategies for integrating health considerations into NBSAPs. These strategies include aligning NBSAPs with national health plans, supported by direct funding lines from national budgets, and interdisciplinary evaluations of initiatives to address coupled biodiversity-health issues. Willetts et al.[168] also emphasize the need to consider the Indigenous determinants of health, recognized in the 2023 World Health Assembly on the Health of Indigenous Peoples, when designing NBSAPs.

CONCLUSION

Nature's contributions to people's lives are increasingly well-understood (e.g., IPBES[3]). Equally, extensive evidence documents

social determinants of mental health (e.g., Lund et al.[25]). Yet, these two bodies of evidence are barely connected, producing a patchy and geographically biased understanding of the complex relationships between nature loss, conservation, and mental health. This lack of evidence contrasts with the increasingly well-developed understanding of the mental health impacts of climate change, translating into climate policy and practice. We offer a framework illustrating nature's contributions to social determinants of mental health and the role of conservation action, calling for evidence to support global mental health and conservation decision-making in two main ways. First, such evidence can strengthen the case for protecting human health by protecting nature. Second, it can help avoid forms of nature conservation that harm mental health and deepen inequalities, instead promoting approaches that enhance public health. A greater understanding and recognition of these links can guide policy and practice to tackle nature loss while fostering mental health globally.

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AUTHOR CONTRIBUTIONS

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DECLARATION OF INTERESTS

The authors declare no competing interests.

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