



Haines, A; Harris, F; Kasuga, F; Machalaba, C (2017) Future Earth-linking research on health and environmental sustainability. *BMJ (Clinical research ed)*, 357. j2358. ISSN 0959-8138 DOI: <https://doi.org/10.1136/bmj.j2358>

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ANALYSIS

Future Earth—linking research on health and environmental sustainability

Andy Haines and colleagues describe how new research platforms present an opportunity to advance understanding of how to safeguard health in the face of global environmental change

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Humanity is confronted by multiple environmental challenges that threaten to undermine the advances in health achieved over recent decades. The Rockefeller Foundation-Lancet Commission on Planetary Health showed how climate change, loss of biodiversity, changes in land use, ocean acidification and overfishing, nitrogen and phosphorus loading, and environmental pollution more generally all have the potential to adversely affect health.¹ A recent joint publication by the World Health Organization and Convention on Biological Diversity articulated the myriad connections between biodiversity and health and the threats to both posed by environmental change.²

The rapid changes in the global environment have led many scientists to conclude that we are living in a new geological epoch—the Anthropocene—in which human activities have become the dominant driving force transforming the Earth's natural systems.³ These natural systems provide food, clean water, and air and modulate the global temperature within limits in which humanity has been able to flourish for around 11 500 years during the preceding Holocene epoch.

The scale and pace of change is substantial—for example, the extinction of species is occurring at rates around 100 times higher than before humans existed.⁴ The population sizes of vertebrate species have, on average, declined by half over the past 45 years.⁵ More than 2.3 million km² of primary forest has been felled since 2000.⁶ About 90% of monitored fisheries are harvested at, or beyond, the maximum yields that can be sustained.⁷ In many parts of the world groundwater is being extracted faster than it can be replenished, particularly to meet growing demands from industry and for irrigated agriculture.³ Thus water scarcity and other environmental changes could affect crop productivity in some key food producing regions, at a time when food requirements are increasing because of population growth and demand for livestock products. Intensive

food production is increasingly associated with nitrogen and phosphorus pollution, loss of biodiversity, and, in some cases, injudicious use of antimicrobials and pesticides.

Atmospheric concentrations of carbon dioxide, methane, and nitrous oxide, which are major greenhouse gases, are at their highest levels in at least the last 800 000 years.⁸ Despite the Paris Agreement on climate action, current commitments to reduce greenhouse gas emissions will be insufficient to keep global temperature change within the target 2°C increase from pre-industrial times and could result in temperatures 3°C higher or more by the end of the century.⁹

Many of these trends are driven by the highly inefficient, inequitable, and resource intensive pattern of development pursued by industrialised nations and, increasingly, emerging economies. At the same time population growth in developing countries, particularly in sub-Saharan Africa, will both contribute to environmental pressures and make adaptation to them more difficult.¹⁰ In 2012, 12.6 million people are estimated to have died as a result of living or working in an unhealthy environment, accounting for 23% of all deaths,¹¹ and widespread global environmental changes pose additional major challenges for human health. Transdisciplinary approaches that generate, coordinate, and use effective and innovative research on environmental change and health are needed to develop and implement solutions to the many current and expected health threats. We describe how one initiative, Future Earth, plans to bridge the research agendas on health and environmental sustainability.

Barriers to action

The Rockefeller Foundation-Lancet Commission on Planetary Health identified three categories of challenges that limit action on health and environmental change.¹ The first is conceptual

and empathy failures (imagination challenges), such as over-reliance on gross domestic product as a measure of human progress and pursuing perpetual economic growth without regard to future health effects of environmental degradation or to consequences of inequitable distribution of economic gains.

The second category is knowledge failures (research and information challenges), such as insufficient understanding of social and environmental drivers of ill health, lack of integrated and holistic approaches to complex interlinkages between the environment and human health, accompanied by a historical scarcity of transdisciplinary research and funding. However, in some cases, sufficient evidence to act already exists, so the third challenge is implementation failures (governance challenges). These include widespread inability to use research evidence effectively and systematically within decision making frameworks, compounded by governments and institutions being slow to recognise and respond to threats, especially when faced with uncertainties, limited resources, strong vested interests,¹² and time lags between action and effect. By facilitating the development of a global scientific community committed to advancing sustainability, Future Earth brings together resources, diversity of contexts, and shared priorities and commitments. This will contribute to overcoming potential politicisation of evidence, ensure the sustainable collection of and access to long term global trend data, and support collective action toward equitable health as a public good threatened by global environmental change.

It is imperative to develop and implement effective policies to overcome the environmental and health challenges of the Anthropocene epoch.¹ Over 70% of current greenhouse gas emissions and 80% of economic activity result from cities, which will dominate predicted population growth.¹³ Thus decisions made over coming decades about urban infrastructure, energy and transport systems, consumption patterns, delivery of essential services, and environmental protection will determine the prospects for sustainability. The development of food systems and agricultural policies that reduce environmental impacts and enhance resilience also provide critical opportunities to safeguard health.

Many policies targeted at reducing greenhouse gas emissions and other causes of environmental damage can also benefit human health—for example, through reduced fine particulate air pollution, protection of watersheds for continued provision of water resources, and healthy low environmental impact diets.^{14 15} Ecosystem approaches such as the conservation and restoration of mangroves can enhance protection against extreme events.¹⁶ The United Nations sustainable development goals, which will lead the development agenda until 2030, encompass many targets and indicators relevant to health and the environment, such as those on sustainable agriculture and food systems, clean energy, water and sanitation, healthy and sustainable cities, education, and universal health coverage.¹⁷

Despite the profound implications, relatively little research has been funded on global environmental change and health. The recent decisions by the Rockefeller Foundation and the Wellcome Trust to support research and capacity strengthening in this area are therefore timely and should encourage other funders to make substantial contributions.^{18 19} We also need to invest in linking health and environmental data and monitoring to better understand trends and impacts,² and to foster integrated understanding among policy makers, who conventionally tend to operate in silos with environmental and health considerations divorced from economic decision making.

Future Earth

In this context, Future Earth is a major international initiative that aims to facilitate research by linking disciplines, knowledge systems, and societal partners (including civil society and national and international policy makers). Through its support, Future Earth hopes to fill important gaps in evidence and to promote the application of research findings to policy and practice.²² It was founded on pre-existing international research initiatives on global environmental change sponsored by DIVERSITAS, the International Geosphere-Biosphere Programme, and the International Human Dimensions Programme.

During the process of its formation, Future Earth has been supported by 20 global research projects, ranging from the Global Carbon Project, to oneHEALTH, to the Earth System Governance project. The initiative is now reaching out to forge new collaborative relationships, coordinated through global and regional hubs. With the goal of effectively bridging the science-policy interface, it includes experts from government ministries, intergovernmental framework secretariats, and multilateral organisations, and through active participation, it is closely engaged in international processes such as the United Nations' sustainable development goals, UN Habitat, the UN Intergovernmental Panel on Climate Change, the UN Framework Convention on Climate Change, the Convention on Biological Diversity, and the Intergovernmental Platform on Biodiversity and Ecosystem Services. Through this process, Future Earth can promote inclusion of health in these processes and other relevant policy forums for planning development and risk analysis. Additionally, the health community has an opportunity to identify information needs where Future Earth can help support the generation of new knowledge relevant to health.

The Future Earth 2025 Vision aims to help humanity and natural systems “thrive in a sustainable and equitable world,” and to support the knowledge generation needed for this transformation.²³ Eight major societal challenges to sustainability have been defined, with one specifically directed at improving human health, although the others directly or indirectly address social, economic, or environmental determinants of health (box 1). Over the next year, Future Earth will be launching knowledge action networks based on the identified challenges. Broadly, the networks will provide a mechanism for global and open engagement, coordination across stakeholders from within and outside the research community, and wide translation of research findings into policy and practice.

The knowledge action network (KAN) on health (Future Earth Health) will coordinate and integrate the health theme within all of Future Earth's work and foster transdisciplinary research directed at solutions that promote our future health and sustainable development. Given the many disciplines in the academic community that are relevant to health, as well as the range of sectors in society that influence health directly or indirectly, the network will engage both the health community and wider stakeholders to form innovative synergies. Through this approach, Future Earth Health has the potential to tackle each of the three challenges to maintaining and enhancing health by encouraging new research and assisting in the implementation of research findings. The broad goals include:

- Promote an integrated approach to understanding the links between health and natural systems by bringing together data and knowledge from different disciplines—for example, by supporting research on the links between biodiversity loss and human health.

Box 1: Key challenges in Future Earth's 2025 vision²³

- Deliver water, energy, and food for all and manage the synergies and trade-offs among them by understanding how these interactions are shaped by environmental, economic, social, and political changes
- Decarbonise socioeconomic systems to stabilise the climate by promoting the technological, economic, social, political, and behavioural changes enabling transformations, while building knowledge about the impacts of climate change and adaptation responses for people and ecosystems
- Safeguard the terrestrial, freshwater, and marine natural assets underpinning human wellbeing by understanding relations between biodiversity, ecosystem functioning, and services and developing effective valuation and governance approaches
- Build healthy, resilient, and productive cities by identifying and shaping innovations that combine better urban environments and lives with declining resource footprints and provide efficient services and infrastructures that are robust to disasters
- Promote sustainable rural futures to feed rising and more affluent populations amid changes in biodiversity, resources, and climate by analysing alternative land uses, food systems, and ecosystem options and identifying institutional and governance needs
- Improve human health by elucidating, and finding responses to, the complex interactions among environmental change, pollution, pathogens, disease vectors, ecosystem services, and people's livelihoods, nutrition, and wellbeing
- Encourage sustainable consumption and production patterns that are equitable by understanding the social and environmental impacts of consumption of all resources, opportunities for decoupling resource use from growth in wellbeing, and options for sustainable development pathways and related changes in human behaviour
- Increase social resilience to future threats by building adaptive governance systems, developing early warning of global and connected thresholds and risks, and testing effective, accountable, and transparent institutions that promote transformations to sustainability

- Identify and tackle key policy relevant questions and barriers to reaching vulnerable populations, including building resilience to environmental and societal changes.
- Assess the effectiveness of sustainable practices and policies that are intended to reduce harmful emissions and environmental damage, thus protecting human health
- Provide the evidence base for cost-effective policies at global, regional, and national levels, to support the achievement of the sustainable development goals.

With a projected launch planned for later this year, the developing Future Earth Health network is consulting widely to identify and target priority activities. Current plans include scoping potential sources of data that would facilitate integrated research, including data on environmental change, relevant health indicators, and policies to reduce or adapt to the negative effects of environmental change. Additionally, Future Earth Health plans to develop a systematic review collaboration to search for, critically appraise, and synthesise evidence related to environment and health—for example, agriculture, nutrition, and food safety and security; urbanisation; energy policy; land degradation; and disaster risk. The network will aim to assess and propose research priorities, mobilise funding, develop research briefs, and facilitate translation of science into implementation tools for policy makers and civil society. Importantly, it will communicate and collaborate with health professionals, policy makers, and the wider public and facilitate linking to other disciplines. This will be achieved through activities such as webinars and surveys, as well as active participation in Future Earth's Open Network, an online tool for building collaboration around research and engagement for global sustainability.

The health network will be open and inclusive, aiming to provide a supportive environment conducive to collaborative research to help advance methodological approaches to understanding complex problems and potential solutions. Given the broad and ambitious remit, the network's success will depend on wide participation in this innovative research and science-policy-society agenda, with the medical and public health communities envisioned as key champions. Although the network is still in the development stage, we invite interested parties to register on the Open Network (<http://network.futureearth.org/>), where they can keep up to date with its development and contribute to the discussions. You can also contact Future Earth at http://network.futureearth.org/contactus_

Contributors and sources: AH chaired the Rockefeller Foundation-Lancet Commission on Planetary Health and now chairs the group tasked with developing the Future Earth Health network. FH researches nutrition and sustainability and helped develop the health network. FK is one of the Global Hub Directors of Future Earth Secretariat, and is in charge of coordination in the development of health network. CM is science officer for the Future Earth oneHEALTH project, and is a doctoral student in environmental, occupational and geospatial health sciences. AH and FH wrote the first draft of this article, FK and CM contributed text and approved the final version. AH is the guarantor.

Competing interests: We have read and understood BMJ policy on declaration of interests and declare the following interests: AH received funds through LSHTM from the Rockefeller Foundation to support activities of the Commission on Planetary Health. He is also coinvestigator on three project grants funded by the Wellcome Trust. He chairs the development team of the Future Earth Health knowledge action network. FH receives funds from United Nations University and the University of Tokyo for organisational and project support in the development of the health network. She also receives support from a Wellcome Trust grant for her research at LSHTM. CM is science officer for the oneHEALTH project, which is supported by contributions from DIVERSITAS, Future Earth, and EcoHealth Alliance.

Provenance and peer review: Commissioned; externally peer reviewed

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Key messages

- Global environmental change as a result of growing demands for resources and energy threatens the health of current and future populations
- Potential solutions must address three broad challenges: imagination (flawed concepts), research and information, and governance
- Innovative cross sectoral approaches are essential to protect and promote population health
- The international sustainability research platform Future Earth presents an opportunity to advance transdisciplinary research through scientific integration, co-creation of knowledge, and enabling solutions driven research
- Its health knowledge action network will provide a platform for open and global engagement for the health community and wider stakeholders and promote research to support policy and practice that safeguards the health of future populations

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