The need for a systems approach to planetary health

Planetary health was launched to better understand and address the ways in which human impacts to natural systems are adversely affecting human health. Planetary health provides the opportunity to adopt new ways to: produce a useful evidence base characterising complex, global environmental change and human health linkages; do transdisciplinary systems-based research involving end users; and thereby co-create solutions for transformative change. A systems approach for planetary health involves understanding that human health outcomes emerge from complex interactions between natural and social systems and that stakeholder engagement is necessary in the coproduction of this knowledge.

The Rockefeller Foundation–*Lancet* Commission introduced a new field: planetary health that is defined as "the health of human civilisation and the state of the natural systems on which it depends".[1] Planetary health presents the opportunity to take a transdisciplinary approach to develop strategies to reduce and prevent risks to human health and natural systems. The opportunity to improve and sustain human health through the enhancement of stewardship of natural systems and the reduction of exploitative use of resources linked to unsustainable consumption and production patterns is a new concept in global health and medical practice.

The report advocated for a closed-loop, systems approach to improve understanding of the complex inter-relationship between human health and wellbeing and natural systems.[1] Systems thinking is "a holistic approach for understanding the dynamic interactions among complex economic, environmental, and social systems and for evaluating the potential consequences of interventions".[2] A systems approach to planetary health involves scientific analysis of systems complexity and recognition of the role that human beings play in framing and co-creating knowledge about the socioecological system. Systems-based methods for integration and analyses of data across disciplines are being increasingly recognised for facilitating the transdisciplinary collaboration required to advance the understanding of planetary health. Identification of practical opportunities for prevention and mitigation of the impacts on human health caused by human-driven environmental changes requires a systems-based understanding of the interconnections and feedbacks to strategically address upstream drivers rather than the consequences (direct and indirect) to human health alone.

The study of planetary health at a given spatial scale of interest (ie, city, subnational, national, and regional) requires an understanding of how human-driven stressors, singly or in combination, lead to global and local environmental change and how this change affects human health. The relationship between human-driven environmental change and human health can be non-linear, affected by delays, and dominated by feedback loops across social, economic, and environmental dimensions. These complex, dynamic interactions—including interactions between globally and locally driven changes—and feedbacks can lead to immediate or delayed emergence of positive or adverse health outcomes. Examples include the potential for either poorly designed biofuel policies to adversely affect poverty, nutrition, and health, or the promotion of diesel engine vehicles for climate change mitigation to cause negative health effects.[3]

For more in **biofuel policies and food security** see http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE_Reports/HLPE-Report-5_Biofuels_and_food_security.pdf

Systems approaches have been used by inter-governmental organisations and national government agencies. UN Environment's Green Economy Initiative has adopted systems approaches to support national assessments of the associations between economic development, natural resources, and societal interests of concern.[4] The United States Environmental Protection Agency has embraced systems thinking and applied collaborative systems-based approaches, such as participatory system dynamics simulation modelling, as useful tools to address challenges such as land use, coastal pollution, and social wellbeing at the watershed scale. Future Earth and the Urban Health and Wellbeing programmes of the International Council for Science have also worked based on systems approaches.[5] These systems approaches are defined by: scientific methods that aim to understand human health as an emergent property of socioecological complexity; and the role that human beings have in defining, framing, and engaging in the processes of knowledge generation and action.

For more on **the system dynamics simulation modelling by the United States Environmental Protection Agency** see https://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=312531

A systems approach also considers values. People perceive and attach value to qualities of their environment and the ways in which they interact with it. Value is created as an emergent property of complex rule-based

interactions between people and their environment. A systems approach to planetary health considers and readdresses the ways in which people have previously interacted with and used the planet's resources and asks whether those interactions remain healthy for society and the human population. For these reasons, a systems-based understanding of the context-specific challenge of planetary health is necessary to anticipate potential side-effects, unintended consequences, trade-offs, and synergies, and effectively inform policy and planning to identify, prepare for, monitor, and mitigate policy outcomes towards achievement of long-term sustainability. Application of a systems approach to planetary health has several benefits. One benefit of systems thinking is the identification of potential non-linear changes and interactions between multiple environmental stressors that might have greater impact than does the sum of their parts. These effects are important because they might result in a sudden change in natural systems prejudicial to human health. An analysis of abrupt shifts occurring in marine ecosystems showed that they were due to a combination of factors such as nutrient inputs, fishing, climate change, urbanisation, and sewage acting at different scales.[6] Early identification and evidence-based action can help to avoid irreversible damage to natural systems and human health.

The systems approach grounds planetary health in a specific decision context, at the spatial scale, and with the data available to characterise it. This approach can provide a framework to understand key dynamic interactions, feedbacks, and unintended consequences across sectors. This understanding can help to identify the probable socioeconomic consequences of conservation, health, and development policies under consideration. For example, protection of peatlands from land clearance by fire might not only protect the public from hazardous exposures to fine particulate matter in fire emissions but also strengthen mitigation efforts to reduce global greenhouse gas emissions.[7] Systems-based analyses can help to reveal and quantify the health benefits of climate change mitigation strategies as a result of reduced air pollution,[8] increased physical activity, or healthy diets.[9] Identification of such wins-wins of policy strategy can support efforts towards policy coherence for sustainable development[10] and make trade-offs explicit.

Another benefit of the adoption of systems approaches lies in the inclusive, multi-stakeholder process involved in its implementation. Stakeholders can include researchers, policymakers, and civil society representatives. This type of process makes clear at the outset that a systems approach is a collaborative cross-sectoral undertaking designed to produce a shared understanding of the system of inter-relationships, feedbacks, and trade-offs that can support decision making and governance processes.[11] Inclusive stakeholder participation, if done well, can result in systems-based understanding upon which to plan for sustainable, healthy futures that people want. Despite the inherent and irreducible uncertainty associated with the understanding of complex systems,[1] stakeholders need to be part of and own the decisions that should be made while an inclusive participatory process builds social capital in science and society, which in itself can be of value.

The systems approach we have described is a transdisciplinary approach by which planetary health science can be bridged to policy to drive change.[12] Systems approaches should be complementary to other tools or strategies already in use for sustainability planning. For example, to address planetary health challenges such as climate related health impacts in urban settings, development of a shared systems-based understanding could be the first step to inform the scale of green infrastructure strategies to reduce water runoff and flood risks, and thus avoid unintended consequences such as increased mosquito populations.[13] The design of green infrastructure strategies could be enhanced by the use of health impact assessments to identify and maximise health benefits such as walkability, public safety, and reduced urban heat island effect.[14] Other examples include work of the World Wildlife Fund and The Economics of Ecosystems and Biodiversity initiative by UN Environment in various landscapes, including Cambodia, Indonesia, Thailand, Myanmar, and Tanzania. In these case studies, various modelling approaches were integrated in a single framework of analysis to identify possible side-effects and synergies emerging from policy implementation.[15] Methods and tools included systems thinking, system dynamics, spatially explicit land-use models, and ecosystem services models. These methods and tools were harmonised and linked together through the support of a diverse group of researchers, and under the leadership of a variety of local stakeholders representing various Ministries and interest groups.

Such complementary, integrated systems-based approaches can support more efficient planning and implementation processes and help to optimise policy interventions by identifying win-win strategies across societal, environmental, and economic concerns.

Health risks could be greatly reduced and the benefits of sustainable development policies could be exploited if the drivers and consequences of global and local environmental changes are understood and responded to in policy and planning; however, new approaches are needed for this to happen. A transdisciplinary systems approach to planetary health elucidates interactions and feedback relationships in complex natural and social systems as important drivers of human health and wellbeing. This approach also reflects values based on people's interactions with and use of natural systems. The main benefits of a systems approach are the potential to identify non-linear and irreversible changes in natural systems with serious implications for health, to develop a shared understanding of planetary health challenges in a relevant decision-making context, and the engagement with stakeholders to apply this cross-sectoral understanding to bridge science, policy, and action.

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