Global Sustainability

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Perspective: a healthy planet for healthy people

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Review

Cite this article: Ekins P, Gupta J (2019). Perspective: a healthy planet for healthy people. *Global Sustainability* **2**, e20, 1–9. https://doi.org/10.1017/sus.2019.17

Received: 21 January 2019
Revised: 23 September 2019
Accepted: 25 September 2019

Keywords:
governance; policies; politics

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Non-technical abstract

This perspective article from the co-chairs of the United Nations Environment Programme's Sixth Global Environment Outlook (GEO-6) uses the assessment of the literature in the GEO-6 to show how a healthy planet and healthy people are linked together. It argues that the health of the planet is deteriorating and that this deteriorating ecosystem health has major direct and indirect impacts on human health and well-being. Direct impacts include the impacts of polluted air on the lungs of people, while indirect impacts include the impacts of land degradation on food security. Therefore, protecting the environment will also have major benefits for human health and well-being.

Technical abstract

As the cumulative impacts of human behaviour negatively influence our ecosystems, human health and well-being are affected. This integrative perspective article argues that a healthy planet and healthy people are mutually supportive. It is based on a state-of-the-art review of the literature on ecosystems, policy approaches and outlooks for the future that has been integrated within the United Nations Environment Programme's Sixth Global Environmental Outlook. This paper argues that a healthy planet provides a range of contributions that are critical for enhancing the lives and livelihoods of people; it provides evidence of the growing ill health of the planet and what that does to human health and well-being; it explores the causes of an unhealthy planet; and it identifies the possible ways in which these causes can be addressed to support healthy people. However, it recognizes that although there are strong social and economic arguments to support the promotion of a healthy planet, change will not happen without strong political will to address the lack of public awareness of the environment's contribution to human health, social inertia and the power of vested interests.

Social media summary

An increasingly unhealthy planet affects the well-being of billions. Promoting a healthy planet promotes healthy people.

1. Introduction

Probably the most important key message of the Sixth Global Environment Outlook (GEO-6, 2019) of the United Nations Environment Programme (UNEP) is that current policy measures are not on track to address the serious local to global environmental challenges facing humanity. In fact, the global community is cruising towards a breakdown of the services that ecosystems provide for all life on earth. In this perspective article, we give a brief overview of the wealth of information in GEO-6 that provides the evidence for this sombre message, followed by some thoughts as to how humanity might respond to this predicament.

GEO-6 is a global integrated environmental assessment going beyond the issue-by-issue assessments of climate change (Intergovernmental Panel on Climate Change), biodiversity (Intergovernmental Platform on Biodiversity and Ecosystem Services), chemicals (Global Chemicals Outlook), resources (International Resource Panel), water (World Water Assessment report), oceans (World Ocean Assessment), waste (Global Waste Management Outlook) (Wilson *et al.*, 2015) and so on. Unlike the others, it also draws heavily on regional assessments carried out in the different continents. With a mandate from the United Nations Environment Assembly, it is steered by a High-Level Intergovernmental and Stakeholder Advisory Group to ensure political relevance and a Scientific Advisory Panel and Assessment Methodology Group to ensure scientific integrity. The co-chairs and UNEP's GEO-6 secretariat mobilized an army of academic volunteers to work together in

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collaboration. GEO-6 follows in the tradition of the past GEOs and regional GEOs; however, this time round it is mindful of the UN General Assembly's Agenda 2030 injunction to 'leave no one behind' (UN General Assembly, 2015). Through its emphasis on health, equity, economics and a theory of change, it provides a compelling integrated narrative for the need to reimagine top-down and bottom-up development pathways that stay within the Earth's 'safe operating space', locally and globally, while pursuing the social, economic and equity objectives of the Sustainable Development Goals (SDGs).

Much of the environmental evidence in GEO-6 is not surprising, reinforcing earlier messages through its new evidence of the increasing harm being caused to ecosystems and to human health. However, so far, such evidence has not mobilized policy-makers and other decision-makers to make the kind of transformative and urgent response for which scientists are increasingly calling. This leads us to pose the following question: does the increasingly clear relationship between the planet's health and human health create a strong enough argument for environmental protection? In this personal perspective article, as the two co-chairs of the GEO-6 process, we reflect on the possible public resonance of its organizing theme and title: 'Healthy Planet, Healthy People' (Ekins *et al.*, 2019).

A 'Healthy Planet, Healthy People' storyline is about the relationship between the environment and humans. The concept of 'Nature's Contributions to People' (NCP) refers to how nature ('diversity of organisms, ecosystems, and their associated ecological and evolutionary processes') both contributes to human life (e.g., through food and water) and threatens it (e.g., through diseases and natural disasters) (Diaz *et al.*, 2018). Given that the beneficial contributions underpin both human civilization and survival, their value in total is incalculable. The NCP concept was introduced to include but go beyond the concept of ecosystem services developed by the Millennium Ecosystem Assessment (Millennium Ecosystem Assessment Board, 2015) in order, among other things, to reflect better the role of indigenous peoples and local communities in protecting the environment. There continues to be a tension between feeling the need to put monetary values on ecosystem goods and services, in order to communicate the importance of nature to decision-makers who tend not to appreciate this, and recognizing that the multiple and complex relations between ecosystems and between ecosystems and human societies can never be adequately expressed in monetary terms. In what follows, we try to ride both horses, seeking never to lose sight of the full complexities of NCP, but reporting money values that have been assigned to these contributions where they have appeared in the recent peer-reviewed scientific literature.

2. A healthy planet supports healthy people

During the last thousands of years, the Earth has provided a hospitable environment for human societies to flourish. The natural greenhouse effect provides a comfortable climate, and water flows across the globe support humans and their activities. Humans are so used to exploiting the resources of the planet and enjoying the free clean air, water and climate the biosphere provides that the latter are simply taken for granted, unvalued and unaccounted for by our socio-political and economic systems – the 'externality' concept that is at the heart of environmental economics and that leads, as was noted many years ago, to the tragedy of the commons (Hardin, 1968). The tendency as societies 'develop' is for the environment to be seen increasingly as something that can be controlled, commodified and used to serve human needs while at the same time serving as a receptacle of discarded wastes.

Everyone depends on a healthy environment for good human health, with health understood as physical, social and psychological well-being. However, the poor are fundamentally dependent on nature for its direct supply of air, water, land and food to sustain their livelihood activities as well as their day-to-day survival and health. There are estimates that approximately 70% of the poor depend directly on the land, water and air for their lives and livelihoods (Sukhdev *et al.*, 2010). More than 2 billion people work in the informal sector, including 85.8% of workers in the African labour force, 68.2% of workers in Asia and the Pacific and 40% of the Latin American labour force (ILO, 2018). They depend on predictable weather and healthy pollinators for their subsistence agriculture, on stable as opposed to extreme weather events for their lives and livelihoods, on a steady flow of water in their rain-fed or glacier-fed rivers and on the fish in rivers and coastal waters for much of their protein.

Indigenous peoples and local communities have long revered the forests and waters and have treated these resources as gifts from God – in fact, these communities who live on approximately one-fifth (22%) of the global land surface have actually still managed to conserve approximately four-fifths of the global biodiversity (Sobrevila, 2008). However, only 10% of the 2.5 billion people who are directly dependent on the land actually own their land (Oxfam, International Land Coalition, Rights and Resources Initiative, 2016), and in particular women farmers own only a fraction of the land they work on (FAO, 2011). These communities are increasingly under pressure as their lands become polluted and their livelihoods are put at risk through, for example, the impacts of extractive industries (extracting 84 billion tonnes in 2015; Ekins & Hughes, 2017) or because they are forced off their properties through distress sales or land-grabbing (Rulli *et al.*, 2013). Even in cities, approximately 1 billion people in growing urban slums have no property rights (Habitat for Humanity, 2016). Slum-dwellers face specific challenges with respect to excessive exposure to air pollution, water pollution and waste, with 3 billion people worldwide having no access to proper waste management facilities (Wilson *et al.*, 2015). Insecure tenure and property rights affect the motivation and abilities of communities to invest in their lands or properties.

Those in the formal market economy are also dependent on a healthy planet, but differently so, through global investment and trade in extracted resources that are then used to produce a variety of goods and services for commercial ends. The technologies of all goods and services use the minerals and other resources of the Earth and produce a steady stream of waste. Thus, NCP supports a growing global world product of more than USD 75 trillion in 2017. As just one example of NCP, pollinators are conservatively estimated to provide a service of USD 351 billion to the commercial agricultural sector (Lautenbach *et al.*, 2012). Another calculation of the contribution of ecosystems to human welfare puts the value at USD (2007) 125 trillion annually, significantly more than the global world product (Costanza *et al.*, 2014). More important than this notional aggregate value is the calculation from the same source that USD 4–20 trillion worth of ecosystem services have been lost between 1995 and 2011. Clearly, these numbers do not reflect the huge value that these ecosystems have for humans, but at least they serve to indicate the order of magnitude of damage being caused and to relate this in some way or other to the global economic system.

https://doi.org/10.1017/sus.2019.17 Published online by Cambridge University Press

We conclude that a healthy planet and a stable climate are critical for supporting healthy people in both the informal and formal economies.

3. An unhealthy planet leads to unhealthy people

Just as a healthy planet contributes to human health and well-being, the increasingly poor health of the planet is harming the well-being of humans as well as the rest of life on Earth.

Local environmental thresholds practically everywhere are being crossed with respect to different ecosystems through uncontrolled grazing or resource extraction in or excessive use of the commons and the uncontrolled emissions of solid, liquid and gaseous wastes into the lithosphere, atmosphere and hydrosphere. Emissions of persistent, bio-accumulative and toxic pollutants, greenhouse gases (GHGs) and others are changing the composition of the atmosphere, leading to concentrated urban air pollution, household air pollution in rural homes in developing countries and climate change. Groundwater is being extracted beyond recharge levels and heavily polluted in specific locations and is affected by changing freshwater supplies, reduced recharge zones and localized scarcity or floods with long-lasting impacts. More than 100 million chemical substances have been released into the environment. The mismanagement of antibacterial drugs, pesticides, endocrine disrupting chemicals and persistent organic pollutants threaten both humans and wildlife, particularly in aquatic systems. The oceans are warming and acidifying, killing coral reefs especially, but not only, in tropical areas. Coral reefs, which are among the most biodiverse ecosystems in the world, provide services worth USD 29 billion annually, so their loss will have significant impacts on coastal populations (Burke *et al.*, 2011). The oceans are being drained of their fish resources. They are also subject to growing pollution, especially from the 8 million tonnes of plastic that enter the oceans annually (Jambeck *et al.*, 2015), as well as from offshore oil pollution and hydrocarbon accidents.

Globally, scientists are increasingly warning that human behaviour is seriously affecting the planet, which some scientists express in terms of crossing planetary boundaries (Steffen, 2015). One of these 'boundaries' is related to biodiversity – genes, species and ecosystems – which is disappearing at rates that have caused scientists to conclude that the sixth global mass extinction event (with earlier events long ago identified from the fossil record) either is, or could be, underway (Barnosky *et al.*, 2011; Ceballos *et al.*, 2017). Between 1970 and 2014, populations of vertebrates – mammals, birds, fish and reptiles – fell by an average of 60%, with freshwater species exhibiting a decline of 83% (WWF, 2018). Another key global marker is climate change: global average temperatures have increased by 0.8–0.9°C since 1880, and 8 years in the last decade have been the warmest on record (Climate Central, 2018). Current climate policies will only achieve a third of what is needed to meet the 1.5–2.0°C objective of the Paris Agreement on Climate Change (Xu & Ramanathan, 2017). Warming has cascading effects on the polar climate system, with sea ice in the Arctic retreating, permafrost thawing, snow cover extent decreasing and ice sheets, ice shelves and mountain glaciers continuing to lose mass, all of which trigger other changes across the planet. Thawing peat lands contribute 5% of GHGs annually (Joosten, 2015). Increasingly, it seems that environmental stresses, along with other socio-political factors, are contributing to migration (Ekins *et al.*, 2019).

These environmental changes are negatively affecting human health and well-being. Air pollution is the number one cause of environment-related sickness causing premature death, as well as chronic ill health and loss of income (approximately USD 5 trillion annually) (World Bank & Institute for Health Metrics and Evaluation, 2016). In 2015 alone, 9 million people died prematurely from long-term exposure to air pollution (Landrigan *et al.*, 2017); 103 million years of healthy life were lost due to heart disease, stroke, lung cancer, chronic lung disease and respiratory infections (Cohen *et al.*, 2017; Health Effects Institute, 2017). This is probably because more than 50% of the global population lives in cities, but only approximately 12% of such cities meet World Health Organization air quality standards (World Health Organization, 2014). In rural areas, household air pollution affects 2.8 billion people (Smith *et al.*, 2014), and in 2012, between 2.9 and 4.3 million people died as a result (Landrigan *et al.*, 2017), with an estimated gross domestic product (GDP) loss of 0.68% in low-income countries (Landrigan *et al.*, 2017). Air pollution especially affects vulnerable people because of their age, health, living circumstances or occupation (Crimmins *et al.*, 2016). Air pollution costs USD 225 billion in lost labour income, most of which occurs in poorer countries (World Bank & Institute for Health Metrics and Evaluation, 2016).

Water insecurity (quantity and quality) affects health and livelihoods. Melting glaciers reduce the security of flow in rivers potentially affecting 1 billion people (UNEP, 2016a), and a high percentage of these people confront acute water shortage for at least 1 month annually. Mostly poorer women spend approximately 40 billion hours on collecting water (UNDP, 2006). Contaminated water causes 1.7 million fatalities from treatable diseases annually (Ashbolt, 2004). Such diseases cost USD 140 billion in revenues lost and USD 56 billion in medical costs annually (Lixil/Water Aid/Oxford Economics, 2016). Rising contamination from chemicals, including antibiotics and endocrine disruptors, and fracking could lead to water becoming the number one cause of death by 2050 (O'Neill, 2012). Wetlands conservatively valued at up to USD 800,000 ha/year (2007 price levels; de Groot *et al.*, 2012) are being lost rapidly (40% in 1997–2011, at a loss of USD 2.7 trillion to local people; Costanza *et al.*, 2014). Poor ocean health affects access to cheap protein (i.e., fish) for approximately 275 million people (Wilkinson *et al.*, 2016) and the access to 20% of the animal protein supply for 3.1 billion people in total (FAO, 2011), potentially affecting small-scale fisheries that support 58–120 million people (World Bank, 2012). It also threatens livelihoods in the tourism (USD 2.3 trillion) and commercial fishing sectors (USD 252 billion) (Ferreira, 2016).

Land degradation (29%) and related loss of biodiversity affects (subsistence) agriculture for approximately 3.2 billion people (Le *et al.*, 2016; UNCCD, 2017). Growing soil salinization could reduce agricultural revenues by USD 27.3 billion (Qadir *et al.*, 2014) and exacerbate famine. Deforestation particularly affects poor local communities and indigenous peoples (WWF, 2016), and unsanitary waste collection and disposal expose 2 billion people mostly in the developing world to health hazards (Kuehr, 2014), especially the 15 million waste pickers (Binion & Gutberlet, 2012).

Biodiversity loss is linked to the rise in zoonotic diseases and may be responsible for 60% of human infectious diseases (CDC, 2017; Karesh *et al.*, 2012), for the fall in the resilience of agricultural systems because of loss of pollinators and genetic diversity and hence for food insecurity and for invasive species that lead to hundreds of billions of USD losses globally (approximately USD 22 and 120 billion a year in the EU (Kettunen *et al.*, 2009) and the USA (Pimentel *et al.*, 2005), respectively). The

https://doi.org/10.1017/sus.2019.17 Published online by Cambridge University Press

illegal trade in species, conservatively valued at USD 150 billion annually, is also a major contributor to the loss of genetic, species and ecosystem diversity (Higgins & White, 2016).

Creeping and sudden disasters further undermine the ability of farmers, fishers and coastal residents in particular to cope, often displacing people (2016: 24.2 million; IDMC/NRC, 2017) and otherwise adversely affecting them (1995–2015: 4.2 billion) and killing them (1995–2015: 600,000), all with huge economic (1995–2016: USD 1.4 trillion; ELD, 2015), psychological and well-being costs. Between 1995 and 2015, 700,000 people died and 1.7 billion people were affected by extreme weather events, costing USD 1.4 trillion (UNISDR/CRED, 2015). Approximately 90% of the economic losses were faced by upper-middle- and high-income countries. However, the loss to the poorest countries at only 1% of the global total is significant as this latter loss was equivalent to 1.5% of the GDP of the poorest countries, and over 99% of it was uninsured (Watts *et al.*, 2017). This number is significantly higher for small island (1–8% of GDP on average over 1970–2010; UNEP, 2016b) and coastal states, who also face existential threats. Vulnerability to climate change is far from equally distributed: 20 of the 36 highest GHG-emitting countries have the least vulnerability, while 11 out of the 17 low to moderate emitters have the highest vulnerability (Althor *et al.*, 2016).

In total, approximately 25% of current mortality is caused by environmental factors (Prüss-Üstün & Neira, 2016), and this excludes the loss of life, home and livelihoods of those affected by extreme weather events and possibly the rise in zoonotic diseases. The costs to global welfare as a consequence of air pollution alone is estimated at USD 4.6 trillion annually (Landrigan *et al.*, 2017).

4. Causes of an unhealthy planet

What are the causes of all this? Two key drivers of environmental pressures are the continued prioritization of 'growth' and technological development without accounting for the environmental consequences. The tendency for countries to seek to 'grow now, clean up later' may have increased incomes worldwide, but in ignoring environmental values has increased welfare much less, and may have reduced it in some countries, while the same model has also delivered growing inequality. 'Cleaning up later' is also becoming more difficult, or is impossible when change is irreversible. Similarly, technology and innovation have enhanced productivity and some aspects of lifestyles, but have also exposed humans to increasing risks. Furthermore, the rising population (which, according to some estimates, could be approximately 7.5 billion in 2018, 10 billion in 2050 and 12 billion in 2100; Samir & Lutz, 2017) and the increasing proportion of the world living in urban areas (50% today to possibly 66% in 2050; UN DESA, 2014) are creating additional demands on the Earth's resources, although clearly those with access to the most resources have a larger environmental footprint. Finally, climate change is no longer a future possibility, but a present reality, with the Earth committed to further climate change from past emissions that will also act as an important driver and amplifier of environmental pressures.

In terms of environmentally intensive sectors, the energy sector is responsible for most GHG emissions, which are strongly correlated with incomes. The richest 10% of households globally emit 66% of the GHGs, while the poorest 50% emit 15% (Hubacek *et al.*, 2017). Much material extraction is associated with environmental damage and is also strongly correlated with incomes: the wealthiest countries use ten times more materials per capita per year than the poorest (Schandel *et al.*, 2016).

Agriculture accounts for 70% of water use, with aquifers being used beyond recharge rates (Hoekstra & Mekonnen, 2012). Approximately 56% of the land footprint of the EU's consumption is from other countries (EEA, 2015). While 2 billion people have food deficiencies (Global Panel on Agriculture and Food Systems for Nutrition, 2016), over 2 billion people are overweight (NCD Risk Factor Collaboration, 2017) or obese. Current meat production (including feed for animals) accounts for 70% of farmland, drives deforestation, emits approximately a fifth of GHGs and uses approximately 8% of water resources (FAO, 2006), as well as causing massive chemical pollution and biodiversity loss. Meat consumption per capita in 2017 in the USA was double that of India and the continent of Africa (OECD, 2018). Food waste is 95–115 kg per capita annually in rich countries and 6–11 kg per capita annually in poor countries (Wilson *et al.*, 2015), at a global rate of 33%, with 56% occurring in rich countries (Lipinski *et al.*, 2013).

Approximately 30% of urban dwellers have no access to basic services, and coastal city dwellers are particularly vulnerable to sea-level rise (UN-Habitat, 2003). In terms of environmental and resource efficiency – that is, environmental impact and resource use per unit of GDP – cities do better than rural areas and richer countries do better than the developing world (Yale Center for Environmental Law & Policy, 2018), but in absolute terms, cities and richer countries have greater negative environmental impacts and resource uses than rural areas and developing countries, respectively.

There is therefore a clear rich–poor dimension in the causes of environmental problems. There is also a strong gender dimension to the production, distribution, trade, transportation and consumption systems and waste streams that lead to heavy environmental pressures (Angeles, 2017; Cohen, 2015).

In the arena of population dynamics, from 1950 to 2017, total fertility rates decreased by 49.4% (Christopher *et al.*, 2018). High fertility and population growth rates impede development and are associated with low income, low human development indicators and gender inequality. Addressing these issues, as well as enhancing education, especially for girls and women, and reducing infant mortality are likely to reduce population growth (Do & Kurimoto, 2012; van Bavel, 2013).

5. Policies for a healthy planet

The evidence for action is now incontrovertible. Scientific assessments in different fields (see Section 1) are presenting coherent messages of an increasingly unhealthy planet that is also on the brink of dangerous anthropogenic climate change with globally cascading impacts on land, water, oceans and biodiversity, and hence human health and well-being.

Current trends show that despite increasing efficiencies in production and consumption, the volume of degradation will increase. Despite expected improvements in water and food production, the SDGs regarding these and other environmental issues will not be achieved. As GEO-6 states: 'Overall, the world is not on track to achieve the environmental dimension of the SDGs and related [multilateral environmental agreements] by 2030 and 2050'.

While incremental policy to address individual problems is necessary, it will not be sufficient. Going beyond symptoms and end-of-pipe solutions requires addressing the underlying drivers – the undifferentiated pursuit of growth; the potential negative impacts of technology; the gender inequality and social inequity that drive population growth and urbanization; and mitigating and adapting to climate change.

https://doi.org/10.1017/sus.2019.17 Published online by Cambridge University Press

What is clear from GEO-6 is that there has been considerable innovation in environmental policy. The evidence suggests that no policy instrument is *a priori* better than another, that policy design (including vision, baselines and targets and feedback mechanisms for ratcheting up/down) is critical and that countries learn from each other. Not surprisingly, policy diffusion is slower and less ambitious where there are conflicting interests, and redistributive policies are needed. There is a need for policies that are both credible and flexible over the medium and long term as policy-makers discover what works and how quickly. Policy-makers urgently need better evidence for the effectiveness of policy through both the application of traditional scientific methods and the generation of new and disaggregated data and knowledge using citizen science, big data, Earth observation and indigenous and community knowledge, taking a strongly gendered and equity-sensitive approach throughout (Sutherland *et al.*, 2014; UNEP, 2016c).

It is also clear that environmental policy alone will not be enough to resolve environmental problems. The integration of environmental policy into other policy areas will also be required. This will not be successful without adequate attention being paid to potential co-benefits and trade-offs and substantial political will to see through the transformative change and reconfiguration of systems and institutions that are needed.

GEO-6 concludes that meeting the SDGs by 2030 and achieving broader environmental sustainability goals by 2050 are possible. Though very challenging, it is possible to achieve the necessary decoupling between economic growth and resource use (resource decoupling) and pollution (impact decoupling) through investing in decarbonization, dematerialization and detoxification within a circular economy in respect to both the land and the oceans. According to GEO-6, the Paris Agreement targets require low-carbon technologies to reduce carbon emissions in the global economy by 4–6% annually in order to approach near-zero emissions from the energy sector by 2050. Achieving the 1.5°C target would also require deep reduction in short-lived climate pollutants (Haines *et al.*, 2017; Shindell *et al.*, 2017; Xu & Ramanathan, 2017). In the agricultural sector, a shift away from meat consumption could have multiple benefits – it could reduce the pressure on deforestation, water consumption and chemical pollution; it could release land to feed far more people directly; and for nature protection, and it could enhance human health. These effects would be reinforced by policies to reduce food wastage. Decoupling water from economic growth (e.g., through reusing grey water, increasing water efficiency and reducing demand through smart and drip irrigation) is also essential, as is managing the water in an integrated manner. In the transport sector, a focus on public transport, electric vehicles and active transport (walking and cycling) is required. Combining a healthy lifestyle with decentralized and improved technologies could make a key difference.

The spatial planning of urbanization could achieve greater well-being with lower land use and reduce the rate of increase of pollutants. Increased investment in green infrastructure including ecosystem- and resilience-based approaches and protected areas could enhance both biodiversity and local resilience to extreme weather events. The latter also requires an adaptive governance strategy that pays full attention to disaster management.

Already there are indications of many local initiatives worldwide to address these issues. There are many stories of investment in nature-based solutions, in the circular economy and in promoting smart and sustainable cities, of raising social awareness and of demanding the decentralization of systems. Some initiatives are amalgamating in larger social movements and using different tools, including litigation. In the Netherlands, the court has ruled that the government must increase its GHG reduction target because of the validity of the science and the recognition that continued emissions violate the human rights of others (Court Case 200.178.245, 2018).

At the global level, treaties on biodiversity, transboundary waters, oceans and climate change have been negotiated and continue to be subject to negotiations. These have mobilized action – 180 countries have submitted their National Biodiversity Strategies and Action Plans in implementation of their responsibilities under the Convention on Biological Diversity, and the Climate Change regime has spawned more than 1500 laws and policies worldwide (Nachmany & Setzer, 2018). However, as has already been noted, despite these treaties, biodiversity is under severe threat, and the 1.5°C target appears out of reach. The transboundary water agreements have scarcely been ratified and global regulation is lacking on marine litter, plastic pollution, chemical safety (including antibiotic pollution and endocrine disruptors), electronic waste, military-related waste, pesticides and sand mining.

Doubtless, the global vision and goals that have been outlined in the SDGs are a start. Goal-setting in itself can have positive impacts: for example, between 1990 and 2010, 2 billion people are reported to have gained access to potable water in fulfilment of the Millennium Development Goals (World Health Organization/UNICEF, 2012). But the far more ambitious SDGs require much more than goal-setting for their achievement. It is hard to see how they can be reached without legally binding multilateral environmental agreements that minimize the opportunities for free-riders.

A set of principles to govern policies was adopted in the Rio Declaration on Environment and Development of 1992. In May 2018, the UN General Assembly adopted a Resolution to begin negotiations on a legally binding Global Pact for the Environment (UN General Assembly, 2018) based on key principles. Although it is early days, this is a step in the right direction and could provide the impetus to steer investments into more sustainable pathways through a proactive, precautionary and equitable approach.

Although GEO-6 provides some good news regarding policy choices and implementation, the nature and scale of the damage calls for a wholesale re-examination of the fundamental drivers of the economic system, most notably its prioritization of ever-greater material consumption without adequately taking into account the contribution to human health and well-being of greater equity and environmental quality, as expressed through the SDGs. These contributions are entirely omitted from the money-based measures of production and consumption that drive the investments of the financial sector, and governments everywhere struggle to get the mandate to redress the balance in the face of the relentless pressures of commercialization and consumerism. Moving towards the sustainable consumption and production of SDG12 will require the political assertion and expression of values that emphasize the promotion of environmental and human health in a context of reduced material inequality, rather than undifferentiated economic growth.

6. Healthy people and a healthy planet are mutually supportive

There is compelling evidence in GEO-6 that a healthy planet is vital for all life, underpinning the very existence and well-being

https://doi.org/10.1017/sus.2019.17 Published online by Cambridge University Press

of the poorer half of the world's population and the economic welfare of the richer half. Evidence has also been presented here that the planet's health is deteriorating fast, with biodiversity loss and climate change as key global indicators. Locally, air, water and land pollution are cumulatively exposing billions of people to loss of heath, livelihoods and well-being. While air pollution is the number one environmental cause of deaths and disease worldwide today, water may become the number one cause by 2050. And failure to reduce GHG emissions in line with the Paris Agreement targets could cause ongoing climate change, compromising global human health irreversibly.

Conversely, redesigning societies and institutions to promote healthy consumption, healthy production and healthy spatial planning could be greatly beneficial for society. More conscious consumption, less meat in diets, less food waste and a more active lifestyle (more cycling and walking) could greatly enhance human health while promoting a healthier environment. And human well-being more widely could be promoted through more energy and environmentally efficient compact city design, renewable energy and moves towards a circular economy.

However, mobilizing men, women and children to want to change their behaviour away from actions that threaten their and future generations' long-term health and well-being will require approaches that are sensitive to gender, age and culture and incorporate policy mixes across the full range of available instruments: goals such as the SDGs, knowledge, education, subsidies, rewards, environmental taxes, standards, environment impact assessments, the adoption of treaties and the Global Pact. And because policies are seldom neutral and because people will experience losses as well as gains, the politics of such a transformation will not be straightforward. At the most fundamental level, the hope must be that recognizing human rights to basic resources could have multiplier effects by enhancing the legitimacy of policy, mobilizing biodiversity protection through empowering local communities and indigenous peoples (Forest Peoples Programme/The International Indigenous Forum on Biodiversity/The Secretariat of the Convention on Biological Diversity, 2016) and increasing food security by providing tenure security, including for women (Croppenstedt *et al.*, 2013). Comprehensive sustainable development education will also be required in order to enable the next generation to manage the problems they will inherit.

Finally, there are sound economic reasons for taking action. Perhaps surprisingly, the evidence is mounting that the approach outlined above, combined with the current trend of automation and data exchange in manufacturing technologies, could enable frontrunner countries to become more competitive and enter a new age of economic growth. UNEP's landmark 2011 report on the Green Economy found that switching from existing investment patterns by investing 2% of global GDP in restoring natural capital could result in a higher economic growth outcome from 2017 onwards (UNEP, 2011).

Investment in greater resource efficiency could also deliver substantial economic gains. Two of the many estimates of the benefits to be gained from greater resource efficiency are set out in detail by Dobbs *et al.* (2011) and the Business and Sustainable Development Commission (BSDC, 2012). Dobbs *et al.* estimate that, in 2030, implementing all of the technologies considered would save private investors USD 2.9 trillion per year, a figure that rises to USD 3.7 trillion from a social perspective if financial subsidies to the energy, agriculture and water sectors, as well as energy taxes, are removed, and carbon is priced at USD 30 per tonne. Some 70% of these savings would offer a rate of return of greater than 10% per year.

The BSDC estimates that achieving the SDGs 'opens up an economic prize of at least US$12 trillion for the private sector, and potentially 2–3 times more' across the four broad sectors of food and agriculture, cities, energy and materials, and health and well-being (BSCD, 2012).

The Global Commission on the Economy and Climate (2014) finds that more than half and as much as 90% of the global emissions reductions required to get onto the 2°C climate pathway could generate net benefits to the economy. These include health benefits from reductions in urban pollution and traffic congestion, increases in efficiency and improvements in energy security and supply. Another estimate is that economic investment in achieving the 2°C target could leverage health benefits that are 1.4–2.5 times greater than the cost of mitigation. A 2.5-fold health benefit implies that for a cost of USD 22.1 trillion in climate policy, a return of USD 54.1 trillion in health benefits is possible. Research shows that increasing the target to 1.5°C could be very beneficial for China and India (Markandya *et al.*, 2018). A reduction of global food waste of 33% could make further substantial savings (Lipinski *et al.*, 2013; UNEP/UNITAR, 2013). These kinds of estimates suggest that the costs of inaction to the global community and nations in the face of current environmental challenges run into trillions of dollars and significantly exceed the costs of action to address them effectively.

7. Conclusion

GEO-6 seeks to present integrated knowledge in order to unleash a change in behaviour. It signals that current approaches are inadequate, but emphasizes that it is possible to achieve the SDGs by 2030 and the broader goals of environmental sustainability by 2050. It recommends the development of a vision that incorporates country-specific pathways to sustainable development, innovation to phase in sustainable practices within a renewable and circular economy, the phasing out of unsustainable practices, greater experimentation, the use of different kinds of knowledge and the engagement of all kinds of social actors. By producing, in addition to the main GEO-6 report, derivative products aimed at different actors – businesses, youth and women – GEO-6 hopes to stimulate change across society.

The UN Environment Assembly has stated: 'The 2030 Agenda represents a paradigm shift to replace today's growth-based model with a new model that aims to achieve sustainable and equitable economies and societies worldwide' and 'aims to address the root causes of unsustainable consumption and production patterns, and transform them into sustainable lifestyles and livelihoods that benefit all' (UN, 2016). Our hope is that one of the results of the UN Environment Assembly in 2019 will be that those in charge of national development strategies will be convinced by the evidence in GEO-6 of the need, feasibility and benefits of this paradigm shift towards reducing societies' negative impacts on the planet's health. This would enhance the health and well-being of humans the world over.

Acknowledgements. We acknowledge here the high-quality work of the GEO secretariat, the researchers, the High Level Panel and the Scientific Advisory Committee. We have used the reports and the policy-makers' summary in preparing this paper, but the perspective on GEO-6 presented in this paper is our own.

https://doi.org/10.1017/sus.2019.17 Published online by Cambridge University Press

Author contributions. The two authors have equally contributed to the conceptualization of this paper, although the writing of this paper has been done mostly by the second author.

Financial support. This work for this paper has been supported by research time financed by the University of Amsterdam and University College London.

Conflicts of interest. None.

Ethical standards. This paper builds substantially on the ideas in the Co-Chairs Message prepared for the GEO. This paper in its current form and current narrative has not been submitted elsewhere for publication.

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