# Sustainability and resilience

**M. Powers,** Georgetown University, Washington, DC, United States


This is an update of M. Powers, Sustainability and Resilience, Editor(s): Dominick A. Dellasala, Michael I. Goldstein, Encyclopedia of the Anthropocene, Elsevier, 2018, Pages 29–37, ISBN 9780128135761, https://doi.org/10.1016/B978-0-12-809665-9.10491-4.



### Abstract

This article explores philosophical issues posed by various ways current environmental discussions are structured. More specifically, the article examines the theoretical foundations and normative implications of conceptions of sustainability and resilience. It traces the trajectory of their development against the backdrop of traditional ideals of natural conservation and the preservation of biodiversity. Each section highlights the normative implications of divergent ways of thinking about environmental problems that are increasingly systemic in their origin and impact, global in scale, and pose substantial threats to human well-being and the conditions that support life on Earth.

## Introduction

This article explores some of the main philosophical issues posed by the dominant ways in which current environmental discussions are structured. More specifically, the article examines the conceptual foundations and normative implications of notions of sustainability and resilience and traces the trajectory of their development against the backdrop of traditional ideals of natural conservation and the preservation of biodiversity.

## Humanity's relation to the rest of nature

A diverse collection of contemporary authors, including scientists, security experts, economists, environmentalists, political activists, and policy analysts are generating new ways of thinking about humanity's relation to the rest of nature. In itself, the basic thrust of this kind of inquiry is nothing new. These issues are familiar features of the earliest known religious and philosophical texts and various literary genres that emerged more or less simultaneously in Europe and North America during periods of intense industrial development in the late 19th and early 20th centuries. However, the dominant terminology has changed dramatically since the late 1980s, and concepts of sustainability and resilience have been elevated to a central place within the global community of scientists and economic policy makers.

### Anthropocentrism: Intrinsic and instrumental value of nature

Reliance on conceptions of sustainability and resilience reflects a shift from a perspective that informed the activism of some members of an earlier generation of conservationists and figured centrally in the arguments developed within environmental ethics since its origin as a distinct field in the 1970s.

Those early activists and academics often emphasized the intrinsic value of nature—or considerations other than the benefits to humans—as the primary ground for norms of moral responsibility toward the rest of nature. Intrinsic value arguments highlight non-anthropocentric (i.e., human-centered, non-instrumental) reasons for caring about the existence of wild nature, preserving species diversity, and leaving substantial areas of the Earth largely beyond the reach and control of human beings (Brennan and Lo, 2016). They reject arguments for preserving stocks of resources solely because of their importance for securing human life and advancing well-being. Also, some Kantian and virtue ethics approaches justify a deeply respectful, even reverential posture toward the rest of nature by appealing to moral (rather than merely prudential) values.

Whatever prominence non-instrumental value arguments currently have within academic philosophy, or however much they still figure in the motivations of some conservation activists, they play only a marginal role in discussions of environmental issues within most scientific and policy circles. Most discussions of sustainability and resilience contain only isolated remarks about the importance of preserving wild nature or nonhuman species as something worth doing because of the inherent value of nature itself. When questions are raised about the sustainability of resources, for example, the main emphasis is on preserving stocks of resources necessary to avert potentially catastrophic consequences affecting future prospects for protecting human life and preserving its quality. This anthropocentric orientation is evident also in discussions of the resilience of Earth systems, where much of the emphasis is upon the essential role these systems perform in the provision of environmental services that ensure the persistence of a planet capable of supporting human life and the kinds of human endeavors that many have come to expect as a mark of progress for the species. As discussed in the section "**Conservation Goals**," this instrumentalist, anthropocentric way of thinking about the relationship of humanity to the rest of nature is evident even in discussions of how to set priorities for the preservation of biodiversity.

### Two natural limits: Resource depletion and systemic degradation

The current instrumental emphasis on nature as a source of human resources and services rests on the identification of two highly significant natural constraints on the future of human endeavors. There are natural limits to sustainable resource extraction and depletion consistent with the long-term satisfaction of various human ends, and there are natural limits to the resilience of Earth systems and the planet's ability to absorb and adapt to the systemic environmental degradation caused by human material production and consumption. Reflections on these natural limitations typically are informed by three additional assumptions.

First, there is a growing recognition of the systemic character of many environmental problems. Issues once viewed in isolation, such as species loss, are no longer assessed solely as discrete environmental challenges but as components of a larger, more fundamentally troubling pattern of ecological dysfunction. Deforestation, for example, is an urgent ecological problem driven by land use changes such as conversion of forests to pastureland, but deforestation also contributes to many other environmental problems, including water scarcity, climate disruption, and biodiversity loss. Unless land use changes responsible for deforestation are halted, the risk of cascading, mutually reinforcing ecological crises will be augmented. Moreover, many of the most common human activities result in multiple problems. Agriculture is well-known as one of the main contributors to climate disruption, but in addition, it places the largest demands on the world's water, and it is a primary cause of soil depletion, deforestation, biodiversity loss, and dysregulation of global nitrogen and phosphorus cycles. To address the full range of pressing ecological challenges posed by food systems, it will not be enough to make it carbon neutral; comprehensively sustainable food systems require transformation of production processes in ways that address a portfolio of ecological problems.

Second, there has been a fundamental shift in the way the scale of many environmental issues is appreciated. Instead of highlighting only the local or regional locus of environmental challenges, discussions of many of the most critical concerns now include a focus on preserving resources and ecosystems on a global scale, available for the benefit of humanity as a whole, and the kinds of environmental degradation that is often planetary in its impact. The most salient moral questions therefore are less about what should be done here and now for the sake of one adversely affected, geographically discrete community or nation and more about what should be done everywhere and forever for the sake of humankind. The shift in focus is due to the fact that many of the most pressing policy questions range far beyond what one nation, in isolation from others, can do to preserve its own resources or protect its environment. Climate disruption, ocean pollution and acidification, and the thinning of the ozone layer are among the familiar examples.

Third, there is greater attention given to deeper questions about the human ends that should inform our decision-making. For example, the primary concern for sustainable resources, healthy environments, and biodiversity might be for the sake of the long-term prospects for the global expansion of welfare-enhancing economic development, meeting the basic needs of future generations, securing the human rights of the global poor, or serving some grander vision of the human project. The resolution of competing arguments therefore often turns on judgments—explicit or implicit—of which of these human ends should be given the greatest normative weight.

In short, the dominant framework for public deliberation sees environmental problems and their causes as more salient to the extent that they constitute systemic, causally intertwined ecological threats, and more pressing to the extent that they arise on a larger geographic scale, and more worthy of higher priority in proportion to the moral weight of the human ends at risk.

## Conservation goals

The human-centered arguments differ from intrinsic value and non-instrumental approaches, for example, those that assume that species diversity and the conservation of nature are in themselves important goals, apart from any human end they might advance. For example, non-instrumentalists might think that other things being equal, World A with more species diversity and more richly varied exemplars of abiotic nature is better than World B where there is less diversity. However, skeptics will find such arguments puzzling. They will ask, better for whom, and why? Would a world with more viruses, parasites, and bacteria be a better world, especially in light of the fact that it causes more diseases and suffering in humans and animals? Would a world containing more varied natural rock formations be better even if these abiotic features are so remote that few if any people will ever see them or the persistence of no life form depends on their existence?

Ideals of an Earth rich in variety, pristine and pure, apart from their contribution to human welfare, often rest on an esthetically appealing conception of nature, whole and undiminished. Such esthetic reasons might gain plausibility if the argument for the preservation of species or intact habitats, for example, rests on the ancillary premise that there is a scientific fact of the matter about what constitutes a whole and undiminished natural world. However, a central tenet of evolutionary theory is that the natural world has never been and never will exist in a static, self-regulating state, forever reproducing itself. The natural history of the world is one in which species come into existence, die out, and others take their places. Geologic formations, riverbeds, and coastal areas also shift along with the life forms they contain. Nature is dynamic, its life forms are in constant flux, and it is an error to suppose that the present ecological state, seemingly in balance, is a predetermined condition (Powell, 2010).

### Biosphere integrity: Genetic diversity, functional biodiversity, and bioabundance

The International Union for Conservation of Nature's Red List Index, currently lists over 42,000 species of plants, animals, and other organisms at risk of extinction, including over 9000 species categorized as critically endangered. The instrumentalist's view is that the loss of biodiversity matters because it is an important indicator of ecological health which, in turn, is an indicator of prospects for maintaining the ecological conditions essential for human life.

However, not all species matter in equal measure to the instrumentalist. There are powerful reasons to focus on the preservation of certain key species rather than the absolute number of species. The underlying idea is that some species play a more fundamental role in ecological functioning, such as habitat forming species and top predators. This view is known as the keystone hypothesis. As we move upwards in scale to large regions, and even to the planetary scale, an overarching interest in preserving the proper functioning of whole ecological systems provides grounds for differentiating between the functionally valuable keystone species and species that are functionally marginal. So, in addition to the goal of preserving a larger inventory of species (perhaps useful for improving the prospects for maintaining genetic diversity), the instrumentalist approach prioritizes functional diversity in deciding what to preserve. The priorities of this approach do not necessarily match the priorities suggested by the presentation of images of iconic species, such as lions, tigers, and rhinoceros in the brochures and web pages of conservationist organizations.

In addition, another kind of loss that matters instrumentally for the sake of systemic functioning is bioabundance. Defaunation, or the loss of abundance of members of a species, especially among the functionally important keystone species, is in itself a threat to overall ecological health. Preserving the populations of a few rare birds may have enormous esthetic value, but their importance for the sake of overall ecological health depends on whether there are enough members of the species or their functional equivalents to perform their vital ecological function.

## Sustainability goals

Sustainability as an environmental ideal poses a structurally similar question to the one that conservationists face: what should we seek to sustain, and for the sake of what ends? The origin of the modern global discussion of sustainability ideals is commonly attributed to the 1987 Brundtland Report, popularly named for the chair of the World Commission on Environment and Development sponsored by the United Nations (WCED, 1987). The context in which the concept of sustainability entered the global conversation was marked by the growing awareness of threats to the environment caused by the pursuit of economic development and accumulating evidence of its adverse impact on land, water, and nonrenewable resources.

In one sense, the Commission's answer to the question of what should be sustained is obvious: the overarching aim was to achieve environmentally sustainable forms of economic development. The most general and widely quoted definition of sustainable development also articulates an answer to the companion question regarding the underlying ends or purposes: "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, p. 45). The Brundtland definition of sustainability thus highlights normative concerns about intergenerational justice. Intergenerational justice arguably took top billing since the Commission was troubled by its recognition that

rapid economic development, while vitally important for the sake of advancing the well-being of current generations, poses long-term threats of resource depletion and environmental degradation, which in turn, threaten the ability of future generations to experience the gains in material well-being that the global poor in particular will so desperately need.

However, the Brundtland definition did not settle either the question of what should be sustained or why. One problem with its approach is that it gives co-equal attention to "three pillars," economic, social, and environmental sustainability. The upshot is that it offers no clear guidance for how each aim should be weighted, and more basically, it downplayed concerns about how these three goals can compete. Nonetheless, it extolls the virtues of rapid economic development for the sake of poverty relief and the improvement of the global standard of living. To this end, it called for a 5 to 10-fold increase in economic growth.

The concept of environmental sustainability that forms one pillar in the Report's approach is open to multiple interpretations (Beckermann, 1994). Much of the emphasis is on the long-term sustainability of stocks of natural resources essential to the well-being of future generations. It can be interpreted as including both nonrenewable natural capital (e.g., oil and minerals) and the kinds and quality of renewable resources (e.g., clean water and food sources) that might be needed by future generations. However, the natural resources approach raises questions of its own. Presumably, the paramount end of environmental sustainability is the advancement of human well-being or opportunity for a comparable standard of living across the generations. But if a comparable intergenerational standard of living is the ultimate end of sustainable development, then it is uncertain how much attention should be paid to sustaining resources of any specific kind. Beyond knowing that future generations will require food, water, energy, and other basic features of an environment that can support life and health, there is little basis for guidance in striking the balance between consumption that meets the needs of the current poor and investment in programs designed to meet the needs of future generations. Some resources needed now (to produce energy, for example) might be superseded by new technology, but it is highly speculative for societies to tailor current consumption patterns to align with the aim of leaving enough of many kinds of resources for the future.

Moreover, the stated ends of sustainable development are not confined to the concern for intergenerational justice highlighted by the Report's definition. A great deal of rhetorical emphasis on intergenerational justice is tempered by what the Commissioners identified as especially pressing problems of international justice. For example, the Report's discussion of the concept of human needs stresses the importance of changing current economic practices to give priority to meeting the essential needs of the world's poor. Of particular note is the fact that its assessment of the plight of the global poor is prefaced with the moral judgment that the industrial world has already used much of the planet's ecological capital and that the unequal appropriation of ecological capital is the planet's "main environmental problem" and its "main development problem" (WCED, 1987, Overview, paragraph 17). This way of framing the international justice issues illustrates how sustainability was not conceived as a goal of particular nations concerning their own citizens, or as an aim of cities, private enterprises, or as a goal for communities seeking to manage resources at their disposal. Both the intergenerational and the international issues of justice point to concerns about resource distribution. The Brundtland Commission had in mind the importance of ensuring that all persons, now and in the future, have sufficient resources necessary to meet their essential needs. This is not a goal set for individual nations but a duty of humanity to collectively discharge in ensuring what the Report's title described as "our common future."

Furthermore, despite its obvious anthropocentric emphasis, the Report contains some language suggestive of a somewhat wider rationale for their concern for environmental sustainability. Beyond leaving nature sufficiently intact to save enough resources for the sake of future human populations the Report recommends that a "first priority is to establish the problem of disappearing species and threatened ecosystems" (WCED, 1987, article 6, paragraph 57). Most notably, it offered a decidedly non-anthropocentric rationale for that priority, observing that "the case for the conservation of nature should not rest only with development goals. It is part of our moral obligation to other living beings and future generations" (WCED, 1987, article 2, paragraph 55). The assumption seems to be that leaving room for the rest of nature also matters, even if not as central as anthropocentric concerns about intergenerational and international justice.

## Sustainable development goals

The 2015 United Nations Resolution endorsed 17 Sustainable Development Goals (SDGs) and 169 targets for their implementation (UN, 2015). The resolution was based upon the UN Commission report, *Transforming our World*: *The 2030 Agenda for Sustainable Development*. The Commission's Report retains Brundtland's commitment to "achieving sustainable development in its three dimensions—economic, social, and environmental—in a balanced and integrated manner." However, unlike Brundtland, the Resolution emphasizes that the eradication of poverty is the greatest global challenge, and the rationale for the pursuit of sustainable development is that it is essential for achieving that overarching aim.

Moreover, the Resolution, including its preface and overview of the purposes of the SDGs, along with the specifications of the targets reflect several other normatively significant departures from Brundtland.

First, Brundtland's admittedly modest nod to the importance of preserving biodiversity for the sake of nonhuman animals is absent in the SDGs. Instead, it speaks of a world "in which humanity lives in harmony with nature and in which wildlife and other living species are protected." The linguistic shift from Brundtland is subtle and ambiguous, but notably, there is no straightforward reference to any non-anthropocentric grounds for preserving nature. The document not only adopts an anthropocentric approach; it reinforces what seems to be a priority for poverty relief, based on its presumed importance as the overarching reason to achieve sustainable development goals.

Second, while the commitment in the Brundtland definition to meeting the essential needs of current and future generations is reaffirmed, the new Resolution does not highlight the existence of distributive considerations of intergenerational fairness. It speaks of human rights generally, but the importance of saving resources for future use is no longer the definitional centerpiece. The potential conflict of generational claims on resources is thus glossed over, and the task of securing human rights is cast largely in terms of a managerial approach, promoting "sustainable consumption and production, sustainably managing its natural resources."

Third, unlike Brundtland, neither the text of the UN resolution nor the report on which it is based, addresses issues of fairness in historical patterns of resource consumption at the global scale. There is no longer any mention of past consumption and no reference to the growing global competition for scarce resources that potentially pits the essential needs of the global poor against the demand for resources that sustain the lifestyles of the global affluent. Goal 10 does call for "reducing inequalities in income, as well as those based on sex, age, disability, race, class, ethnicity, religion, and opportunity—both within and among countries." However, the primary mechanisms identified for the achievement of that goal are increased trade, a shift from agriculture to industrial production within less developed nations, and a more orderly system of worker migration and employment opportunities. Moreover, there is no mention of whether the current organization of the global order raises issues about the fair distribution of the environmental burdens of resource extraction and industrial production.

Fourth, the list of 17 goals and 169 targets reflects a decentralized perspective on achieving sustainability and a retreat from thinking about securing universal access to resources on a global scale. It notes at the outset that the primary responsibility for sustainable development and poverty relief rests with sovereign states, and that if the SDGs are to be achieved all nations will need to build them into their national policies and plans. While the Resolution discusses the SDGs with reference to the responsibilities of the developed nations (and the private sector), the emphasis is placed on strategic recommendations for international aid and public-private partnerships designed to facilitate the internal development objectives of less developed nations. Of special importance is the role that policies promoting international trading relationships can play in tandem with policies aimed at state capacity building. For example, it highlights state capacity for improvement of education, management of water resources, marine reserves, forests, and public health, sanitation, and energy delivery systems. Absent is any reference to shared, cross-national responsibility for our common future.

The upshot is that the evolution of the concept of sustainable development from Brundtland to the SDGs retains the three pillars approach, but the accent on economic development is more pronounced. Unlike the original emphasis of Brundtland, sustainability in the SDGs looks more like a synonym for the aim of achieving more efficient use of whatever resources states and localities happen to have under their control than a prompt for reconsideration of more basic normative issues of fair distribution of resource access and the burdens of resource extraction and consumption. It is less explicitly concerned about fairness or distributive justice across generations and nations. While the Resolution adopts a comprehensive approach that recognizes the systemic interdependence of resources such as food, energy, and water, it nonetheless reflects a return to a scale of interest in sustainability that is less global and more localized within the boundaries of nation-states. It is focused on how less developed nations can more efficiently tackle their own problems of poverty relief and economic development through a mix of better resource management, more economically beneficial forms of foreign trade, and international aid directed toward state capacity building.

## Resilience: Earth systems and environmental services

The UN Resolution ratifying the SDGs prefaces its list of goals and targets with a sweeping statement of its "vision" of the world. While poverty relief and human rights take top billing, it does envision a "world where human habitats are safe, resilient, and sustainable" and it identifies existing patterns of production and consumption and the environmental degradation from development as the main threats.

In the run-up to the UN adoption of the SDGs, a number of scientists offered some suggestions about how to think of resilience and the need for incorporating it into sustainability goals (Griggs et al., 2013). Their proposal advocates moving beyond the unranked "three pillars" approach of Brundtland by prioritizing some key environmental concerns and by moving beyond a focus on resource depletion as the main environmental concern. Specifically, they argue for the fundamental importance of maintaining the resilience of Earth systems that regulate the planet's ability to function within the boundaries that have characterized the 11,000-year Holocene period. Their proposal for revision of the Brundtland approach is motivated by a belief in the paramount need to safeguard the Earth's life-support systems, and moreover, by a belief that it is important to assign that goal top priority within a much shorter list of goals than the UN ultimately approved. Their rationale was that the stable functioning of Earth systems is a prerequisite for a thriving global society, and the seriousness of the threat is of such urgent moral salience that a lengthy list of otherwise worthwhile goals risks the loss of practical focus. Moreover, they argued that the UN's own headline goal of poverty reduction cannot be achieved by better management practices alone, or by a scale of response in which individual states are expected to act on their own within the parameters of the current global framework. In particular, without changes to the global "economic playing field any near-term advances in development will be lost as our planet ceases to function for the benefit of the global population."

The proposal to prioritize the environmental goal of preserving the stable functioning of Earth systems is grounded in theoretical work on the resilience of ecological systems (Brand and Jax, 2007), and more specifically the concept of planetary boundaries (Rockström et al., 2009, 2023; Lancet Planetary Health Commission 2024).

## Conceptions of resilience

What then is the specific conception of resilience that figures so prominently in Earth Systems theory? In its generic sense resilience refers to the capacity of any complex system to absorb both internal and external disturbance and retain the same structure and function. Resilience thus understood is a capacity that is possessed by systems as diverse as ecosystems, social systems, or economic systems.

The resilience of any system, including an ecological system can be assessed on multiple scales. The health of an ecological system can be assessed on a scale as small as a shallow lake. With one nutrient load a lake might persist in a stable clear water state with aquatic plants, while under a different nutrient load, it would persist in a turbid state without vegetation. In either case, the ecological state is resilient if within a defined set of chemical boundaries, within which it can absorb disturbances in its nutrient balance without significant alteration of its structure and functioning. Ecological resilience in this instance is thus defined in purely descriptive terms. The scientific task is to quantify the boundaries within which identifiable disturbances can exist without the system undergoing transformation to another state.

However, purely descriptive conceptions are of limited practical value. The relevant notion of ecological resilience employed for many research purposes is one that builds in some notion of the state that should be preserved. In the example of the shallow lake, the point of scientific interest lies in the preservation of a resilient, life-supporting clear water state. Accordingly, the task is to quantify the boundary conditions of nutrient loads that define the parameters of the ecological system within which it is strongly resistant to transformation to the turbid state.

Within environmental policy contexts, planning agencies often speak of resilient socio-ecological systems, for example, the need for resilient coastal cities. The design of resilient coastal cities involves a variety of potential strategies that preserve the structure and function of these complex social systems. Typically, the aim is to provide protection from both the natural disturbances of regularly occurring extreme weather events and sea level rise associated with anthropogenic climate change and coastal land subsidence.

The concept of ecological resilience is exhibited not only in these small-scale contexts such as lakes, agricultural landscapes, glaciers, and coastal cities but also at the scale of planetary systems. Resilient Earth systems can absorb internal and external disturbances and remain within a safe operating space. A safe operating space for the planet is the environmental envelope that is known to support human life and the kinds of human activities that allow contemporary human populations to thrive and flourish (Steffen et al., 2015). Resilient Earth systems, thus defined, build into its definition a conception of the end sought to be achieved. It is from this explicitly defined end that scientists seek to quantify safe operating spaces for several Earth system processes that are essential to protect against transformation to ensure that the Earth does not veer away from the Holocene-like condition.

## Planetary boundaries

The application of the concept of ecological resilience to a planetary scale reflects an underlying concern that current patterns of human activity are creating an elevated risk of substantially altering nine crucial Earth system processes in ways that undermine the essential conditions that support life. The task of ensuring safe operating spaces for these processes begins with an effort to quantify planetary boundaries for each, within which there is a comfortable margin for operation—not a threshold that marks the tipping point of transition to another state—such that the functional conditions that have characterized the Holocene era are preserved.

The nine critically important processes identified within the current planetary boundaries framework include stratospheric ozone levels, ocean acidification, atmospheric aerosol loading, regulation of the climate system, biosphere integrity, freshwater use, land-system change, biogeochemical flows (e.g., nitrogen and phosphorus flows), and novel entities. Novel entities are new substances or new forms of existing substances that have the potential for unwanted geophysical or biological effects on the functioning of the planet and ultimately, on human health, such as artificial (xenobiotic) chemicals (including plastics).

Recent assessments conclude that six of the systems on its updated list of critical Earth systems exceed safe planetary boundaries for each (Rockström et al., 2023). These include the climate system, biosphere integrity, freshwater use, biogeochemical flows, novel chemicals and substances, and land-system change. Transgressions of planetary boundaries for two of these systems—the climate system and biosphere integrity—are particularly worrisome for two reasons. First, large changes in either, on their own, are sufficient to cause serious adverse effect on human well-being. Second, because they are highly integrated with other systems, they have the potential to alter these other systems in ways that predispose them to boundary transgression. For these reasons, research has resulted in the identification of these two systems as core planetary boundaries. They are considered core boundaries in the sense that preserving a safe operating space for each is assigned the highest priority.

## Unquantifiable risks and regional scale activities

The planetary boundary approach not only seeks to identify the critical planetary systems but insofar as possible to quantify the boundary conditions that constitute a safe operating space for each. However, the task of quantification is complicated by various factors having considerable normative significance. Two factors are particularly noteworthy.

First, for some crucial systems there are no criteria for quantifying the boundaries of safe operating space. The identification of novel chemicals poses a special concern since there are now approximately 100,000 chemical substances in global commerce, which were introduced into the Earth systems mostly since the end of World War II. These substances are in addition to other new entities such as nanomaterials, plastic polymers, and genetically engineered organisms. The chemical intensification of the planet is

included as a crucial concern in the planetary boundary approach because of the potential for such entities to persist in the environment, their wide distribution on a global scale, and their demonstrated potential to alter the functioning of other Earth systems. The threats to the resilience of Earth systems from these entities is reason for a precautionary approach. Although the potential magnitude of their impact remains uncertain, such entities earn a place in the approach because of their systemic effects and interactions, the global scale of their diffusion, and the potential harm to people, biodiversity, and the planet.

Second, quantification is complicated by the fact that planetary boundaries are highly sensitive to transgression as a consequence of regional-scale activities. For example, changes in land use (e.g., conversion of forest to cropland) can influence climate far beyond the region in which land-system change occurred. Similarly, changes in regional nutrient flows—for example, changes in the phosphorus and nitrogen flows due to agriculture intensification—can alter the balance of flows globally, which already exceed a key planetary boundary set for ecosystem processes. The upshot of such interaction is the creation of environmental problems characterized by adverse effects that occur far from the site of their primary causal origins. This geographic separation of cause and effect poses a challenge for those who hope that national self-interest will serve as an effective motivational impetus for remedy and prevention of the harm caused by human activities.

By contrast, the political challenge in less complex, less interdependent societies was easier. The task was to deal with environmental impacts that were largely local in origin, transitory in their effects, and politically manageable. Now there is a serious mismatch between the systemic character and planetary scale of environmental problems and the local scale and fragmented character of the problem-solving capacity that is distributed among separate sovereign political entities. Climate change is a prominent example. The planetary boundaries approach reveals how environmental problems —such as disruption of weather patterns and desertification —manifest in one part of the world but their causal origins rest primarily in the production and consumption decisions made elsewhere.

The destabilization of planetary systems affects everyone, and its prevention cannot be achieved by better domestic management practices alone—for example, in the way scarce resources within a country might be conserved or pollution might be reduced within a state's territorial jurisdiction by adjusting its economic organization. Moreover, countries can effectively avoid the environmental consequences of domestic consumption by importing water-intensive goods or materially-intensive forest products, or by outsourcing environmentally destructive forms of production or waste disposal, thereby conserving their own domestic resources, and protecting their natural environment from pollution, biodiversity loss, or other harms (Parrique et al., 2019). The locus of resource extraction and industrial production, where much environmental damage and resource depletion occurs, is increasingly concentrated in regions of the world that are home to many of the global poor, while the sites of most intense consumption are home to the global affluent. The distribution of the benefits of modern technology is therefore decoupled from the distribution of its environmental burdens (Wiedemann et al., 2015).

The addition of the planetary boundaries problem to the inventory of urgent environmental problems, together with the enhanced awareness of the increasingly global scale in which all of these problems emerge has important implications for the conceptualization of sustainability goals. We need a comprehensive definition that can accommodate an understanding of the wider geographic range of adverse impacts extending beyond national boundaries and the increasingly globalized economic institutions and practices that generate them. In other words, we need a definition suitable for assessing the global economic order and its multiple ecological impacts. In general terms, the economic practices and political institutions that make up the global political economy are ecologically unsustainable if they exhaust the necessary resource base or otherwise degrade the environmental conditions essential for preserving life and securing the basic elements of human well-being (Powers, 2024).

## Sources of environmental crises: Globalization, capitalism, and modernism

The planetary dimensions of humanity's ecological challenges and the global scale of their causes is now more widely appreciated. However, the root causes and potential remedies of the extraordinary anthropogenic impact on the rest of nature are matters of intense disagreement. The depletion of both renewable and nonrenewable resources and the environmental degradation produced by patterns of production are sometimes traced to the technology, social ethos, and institutions that characterize economic globalization.

The colonial era dating from the 16th century was made possible by ocean travel, which changed the scale of human activity and its impact. The industrial revolution since the 18th century expanded the technological repertoire of human societies, and with it, the range of distantly available resources required to support human societies grew. The emergence of global markets in the 19th century expanded the geographic scope of resource extraction, and the parallel ascension of global capitalism led to the proliferation of products that often improve human well-being, but in the process also increase appetites for ecologically destructive consumer goods.

The post-war period from 1945 to the present marks a particularly important turning point. In this period known as the Great Acceleration the world's population doubled and the global economy grew by more than 15-fold (Steffen, 2007). Both trends intensified the pressure on the global environment and precipitated worldwide conversations about the sustainability of resource use and the resilience of the Earth in the face of environmental degradation arising on a planetary scale.

### Capitalism and institutional imperatives

A familiar theme in environmental politics is the role of capitalism. For some observers, the proximate cause of both resource depletion and environmental degradation resides in the inherent nature of how capitalist economic systems operate. The claim is that the main driver of environmental harm, or at least the main cause of its severity, is the endless quest for profit maximization. Profit growth comes from producing and selling more material goods and services to more people who have sufficient economic means to consume them. But, as critics observe, we live on a finite planet, with limited resources and ecological boundaries that define a safe operating space for life on Earth (Foster, 2022). Other critics, however, focus on the impacts of specific market practices of firms that search the world for natural resources and new labor pools, extract resources and produce consumer goods as cheaply as possible, while externalizing the social costs, especially the burdens of environmental degradation and remediation (Armstrong, 2024; Powers, 2024).

By contrast, an alternative diagnostic approach argues that the state of current environmental crises is a systemic problem of modern economic life, one that transcends any specific form of economic organization. The root causes of these crises are deeply ingrained, but unsustainable human desires for the ever-expanding material benefits of economic growth and development. These are reflected in the history of sustainable development discourse which seeks to reconcile potentially competing ideals of ecological sustainability with pro-growth economic policies (Raworth, 2017). Moreover, on this view, the pro-growth ethos of modern societies is not strictly an artifact of the current global capitalism, but an inherent feature of the institutional architecture and power relationships found in many socio-ecological systems (Smil 2019). Both socialist governments and traditional autocracies mirror the internal dynamics of modern capitalism in key respects. Pro-growth policies tend to perpetuate and magnify materialist aspirations among the social and economic elites, generate hierarchies of consumption and envy, and offload the environmental burdens of production and extraction on future generations and the most vulnerable, least powerful of their contemporaries.

### Ecomodernism and technological optimism

All of the proposed diagnoses of the main causes of the environmentally self-destructive path of humanity are met by counterarguments from a more optimistic view, sometimes described as ecomodernism, or more generally, characterized as technological optimism. The ecomodernist position is developed in detail in *An Ecomodernist Manifesto* (Asafu-Adjaye et al., 2015). The authors call for two different forms of decoupling. If the problem (as they put it) is leaving room for the preservation of nature, societies need to decouple consumption from the drawdown of natural resources and decouple the footprint of human societies from much of the Earth's surface, not by outsourcing the harms of consumption to other communities, but through other strategies for social reorganization. One such proposal is to concentrate populations in urban centers. The ideal of living in harmony with nature—if that means living in close proximity to and exercising responsible stewardship of its resource bounty—should be replaced with an aim for humanity to liberate itself from dependence on nature. The ecomodernist hope is that the price of well-being, defined as a high material standard of living, need not be to sacrifice the rest of nature, and that with appropriate technological fixes, the global poor can be liberated from both material poverty and the misery of dangerous and grueling work currently performed to sustain the lifestyles of the global affluent.

More generally, technological optimist arguments rest on the belief that there is no viable alternative to the policies that speed the development of new, more efficient technologies. Human societies, they argue, will not be willing to accept the return to a romanticized, pre-modern existence. However, this premise is open to counterarguments. It is said to place too much faith in an approach that led to the current crises in the first place and favors a lifestyle of material consumption that should be rejected for other reasons. For example, some critics question the equation of improvement in human well-being with endless expansion of material standards of living, while other critics underscore the finite limits to resources required by new technologies. Moreover, critics argue that the technological vision offers false hope to those who bear the greatest burdens of supporting lifestyles that are unsustainable on a planet made less resilient as a result. Until the full realization of their utopian vision, the calculus of environmental triage will continue to result in sacrifice zones, clusters of environmentally destructive economic activity located wherever the poor and the powerless reside. Moreover, the critics argue specifically that the ecomodernist proposal for living apart from and beyond dependency on the rest of nature is not a prospect that most of humankind is likely to find attractive or feasible.

One thing that transcends the divide between most ecomodernists and other technological optimists on one side, and their various less optimistic critics on the other side, is the recognition that many of the most pressing ecological challenges are systemic in origin and effect, routinely arise on a global scale, and will continue to fuel debates about the human ends to be realized by sustainable social and economic organization.

## Conclusion

This article has shown how discussions of sustainability and resilience involve a diversity of conceptual frameworks relied upon in different contexts and reflect a variety of practical purposes they are meant to serve. Resilience can be assessed at a local scale, for example, as a concern of coastal cities and low-lying nations, or assessed from a much wider geographic perspective employed in the planetary boundaries approach. Sustainability goals adopted by corporations, nations, and the international community differ in their practical ambitions and the countervailing objectives taken into consideration. In nearly all contexts, the perspective is

anthropocentric, focusing on consequences for protecting human life and advancing human well-being. Moreover, global policy conversations are dominated by the overarching aim of reconciling a commitment to environmental sustainability with policies that foster economic development for the sake of goals such as poverty relief. Underlying such discussions are deep disagreements regarding forms of economic organization best suited for—or least well-equipped for—realizing both ecological and poverty reduction goals.

## References


Armstrong, C., 2024. Global Justice and the Biodiversity Crisis. Oxford University Press, Oxford.

Asafu-Adjaye, J., et al., 2015. An Ecomodernist Manifesto, p. 32. http://www.ecomodernism.org/manifesto.

Beckermann, W., 1994. Sustainable Development: is it a useful concept? Environ. Val. 3 (3), 191—209.

Brand, F.S., Jax, K., 2007. Focusing the meaning(s) of resilience: resilience as a descriptive concept and a boundary object. Ecol. Soc. 12 (1), 23. http://www.ecologyandsociety.org/vol12/iss1/art23/.

Brennan, A., Lo, Y.-S., 2016. Environmental ethics. In: Stanford Encyclopedia of Philosophy [online]. https://plato.stanford.edu/archives/win2016/entries/ethics-environmental/.

Foster, J.B., 2022. Capitalism in the Anthropocene. Monthly Review Press, NY.

Griggs, D., et al., 2013. Sustainable development goals for people and planet. Nature 495, 305—307, pmid: 23518546. https://doi.org/10.1038/495305a.

Parrique, T., et al., 2019. Decoupling Debunked: Evidence and Arguments against Green Growth as a Sole Strategy for Sustainability. Brussels: European Environmental Bureau. https://eeb.org/library/decoupling-debunked/.

Powell, R., 2010. What's the harm? An evolutionary theoretical critique of the precautionary principle. Kennedy Inst. Ethics J. 20 (2), 181—206.

Powers, M., 2024. A Livable Planet: Human Rights in the Global Economy. Oxford University Press, NY.

Raworth, K., 2017. Doughnut Economics: Seven Ways to Think like a 21st-Century Economist. Chelsea Green Publishing, White River, VT.

Rockström, J., et al., 2009. A safe operating space for humanity. Nature 461, 472—475, pmid: 19779433. https://doi.org/10.1038/461472a.

Rockström, J., et al., 2023. Safe and just Earth system boundaries. Nature 619, 102—111. https://doi.org/10.1038/s41586-023-06083-8.

Smil, V., 2019. Growth: From Microorganisms to Megacities. MIT Press, Cambridge, MA.

Steffen, W., 2007. The Anthropocene: are humans now overwhelming the great forces of nature? Ambio 36 (8), 614—662.

Steffen, W., et al., 2015. Planetary boundaries: guiding human development on a changing planet. Science 347 (6223). https://doi.org/10.1126/science.1259855.

The Lancet Planetary Health Commission, 2024. A just world on a safe planet: a *Lancet Planetary Health*—Earth Commission report on Earth-system boundaries, translations, and transformations. Lancet Planet. Health 8 (10), e813—e873.

United Nations, 2015. Resolution 70/1. Transforming Our World: The 2030 Agenda for Sustainable Development. http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E.

Wiedemann, T., et al., 2015. The material footprint of nations. Proc. Natl. Acad. Sci. U. S. A. 112 (20), 6271—6276. https://doi.org/10.1073/pnas.1220362110.

World Commission on Environment and Development (WCED), 1987. Our Common Future. Oxford University Press, New York.