communications sustainability

Perspective

A Nature Portfolio journal

https://doi.org/10.1038/s44458-025-00009-3

A systems reset for sustainable development

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Although sustainable development is an agreed vision for all countries, it lacks theoretical grounding. The contemporary market-based economy maximizes flows of material from nature through the economy to society, amplifying trends away from sustainability. We provide an alternative conceptualization of sustainable development, based not only on the flow of contributions from nature to economic actors, but equally of subsequent benefits to society, the effects of indirect drivers from society on economic actors, and direct drivers of economies on nature. This facilitates understanding of the dynamics and limits of the system, impacts on nature, the values influencing current trends away from sustainability, and of potential responses. This more holistic conceptualization enables actors to align their actions, supporting collective action towards sustainability across all scales. It thereby opens up space for inclusive co-habitation of the planet by people with diverse worldviews, enhanced achievement of the Sustainable Development Goals and more holistic framing for a post-2030 agenda for sustainability.

The prevailing global economic system inherited and reinforces a worldview that separates humans and nature. This dualist perspective has profoundly shaped contemporary societies and economies, particularly the neoliberal capitalist model that drives the global economy. Within this, markets prioritize instrumental values, natural resource extraction, short-term material gains, private ownership, and economic growth[1]. This focus on a narrow set of values has contributed to widespread environmental degradation, biodiversity loss, and climate change - now acknowledged as interrelated planetary crises[1–4]. Addressing these systemic challenges requires transformative change that reorients societal structures toward sustainability and values pluralism and inclusivity[5–8].

Over the past five decades, multiple concepts of sustainability have emerged in response to escalating local-to-global crises[9,10]. These ideas have coalesced under the term "sustainable development", first defined as "*meeting the needs of the present without compromising the ability of future generations to meet their own needs*"[11]. Sustainable development offers an integrated vision to reconcile economic, ecological, and social dimensions of growth by recognizing their interdependencies. However, theoretical underpinnings of the concept have been limited and remain fragmented from disparate intellectual traditions[9]. Approaches have variously emphasized planetary or whole-system limits[3,4], socio-ecological interactions and feedbacks[12], and alternative economic models such as circular, green, or 'doughnut' economies[13–15]. Importantly, these frameworks largely emerged from western (i.e. European and North American) market-based capitalist contexts in the 'post-war era'. As a result, they inadequately reflect the plurality of worldviews and value systems, particularly those recognizing the intrinsic worth of nature and relational values such as care, reciprocity, and responsibility, which are central to many Indigenous and local knowledge systems[16,17].

These lacunae contribute substantially to the limited success of the sustainable development paradigm in addressing interlinked environmental, economic and social crises. Application of the paradigm often fails to reconcile competing objectives, obscures causal relationships, and most importantly, perpetuates reliance on economic models that privilege narrow societal interests and values. To address this, we draw on inclusive and interdisciplinary concepts developed by the Intergovernmental Platform on Biodiversity and Ecosystems Services (IPBES) since 2012 to integrate diverse strands of sustainability thinking. Our objective is to propose a robust systems model of sustainability that may enable the transformative change needed for sustainable futures[2,7].

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Revisiting sustainability

Sustainable development

The concept of sustainable development entered into mainstream discourse in the 1970s-80s. While a broad consensus emerged on the centrality of the three domains– environment (nature), economy and society–approaches to sustainability have been diverse[9,10,18]. Theoretical and analytical studies have tended to remain within the perspectives of one of the three domains. For example, studies focused on nature and its conservation developed increasingly complex optimization algorithms to prioritize areas most important for biodiversity[19–22]. Over time, social and economic considerations have been incorporated, but largely within the same optimization frameworks[23], generating broader debate about the goals and social foundations of conservation[24–26]. Economic approaches typically formalized axioms and assumptions in mathematical equations, from which optimal solutions are derived that consider humans as 'rational agents' in markets[27–29]. Social perspectives have varied, focused around the role of equity[9,10], to applications of critical social theory[30], to analyses addressing the hierarchy of human needs implicated in a good quality of life[31]. Applied approaches have included a focus on livelihoods through an integrative capitals-based approach in low-income settings where nature, economy and society are closely entwined[32,33]. With greater complexity and in market-oriented contexts, nexus studies have expanded to examine interactions among three or more components[34], and more recently to higher-order nexuses such as those explored in the IPBES Nexus Assessment[35]. Related approaches, such as doughnut economics, have combined considerations of planetary boundaries with social foundations[13].

As a policy framework, the systems approach to sustainability, with its anchoring in western science and values, gained prominence through the World Commission on Environment and Development[11,36]. Its framing was appealing in part because it cast economic growth as a central solution to sustainability challenges, thereby sidestepping the discourse on limits[9,37]. This instrumental framing of sustainable development was adopted in the first United Nations Conference on Environment and Development in Rio de Janeiro in 1992[38], and further elaborated for economic and business actors through formulations of the 'triple bottom line' and 'people, planet and profit'[39]. The current framing of sustainable development was operationalized through the Sustainable Development Goals (SDGs) in 2015[40–42]. Compared to the Millenium Development Goals (MDGs), the SDGs set new frontiers in inclusivity in multilateral negotiations: they applied to all countries rather than only to developing ones, and covered the broader scope of nature, economy and societal domains, rather than just socio-economic ones[43]. This reflected greater attention on environmental crises and increasing voice of Global South countries and Indigenous People and local communities in setting global priorities, though subsequent state-led negotiations reduced the scope of many such contributions[42,44,45].

Since adoption of the SDGs, research and action have pivoted around analysis and delivery of the 17 goals and their 169 targets, and exploring interactions among the goals[34,46,47]. Despite this focus, progress has been limited: by 2024, only 17 per cent of targets were on track[48]. The SDGs have faced many criticisms. A central critique is that the concept of sustainability has been co-opted by its institutionalization in international frameworks focused on development and economic growth, and thereby used to mask neoliberal, market-based objectives[9,49]. Other critiques focus on technical and operational challenges and limitations, such as inadequate understanding and leveraging of the interlinkages necessary for system-wide success[1,34,50]. Underlying all these concerns, however, is a more fundamental issue: the concept of sustainable development still lacks a robust theoretical foundation, and this impedes operationalization[9].

Multiple values of nature

Understanding of the fundamental dependence of human well-being on nature has been significantly advanced through the comprehensive conceptual framework proposed by IPBES that integrates scientific, Indigenous and other knowledge systems and the concept of 'nature's contributions to people' (NCP)[51,52] (Fig. 1). These provide a holistic and pluralistic approach

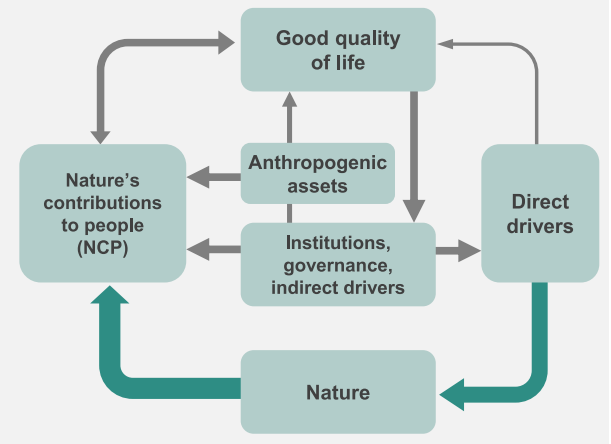

Fig. 1 | The IPBES conceptual framework. This illustrates the co-production of nature's contributions to people through interactions of nature and society, which together support a good quality of life. These contributions are shaped by the diverse values held by individuals and communities, which influence indirect drivers (economic, demographic, institutional, cultural, technological), and their influence on direct drivers of environmental change (land- and sea-use change, unsustainable exploitation, climate change, pollution, invasive alien species)[51].

to articulating the diverse benefits that people derive from nature. NCP extends the traditional ecosystem services typology beyond provisioning, supporting, regulating and cultural services[53], to also include more intangible aspects such as cultural identity, sense of place and 'gifts' of nature[54,55]. Crucially, the framework acknowledges and integrates multiple worldviews and knowledge systems, including Indigenous, local and scientific traditions, that underpin human-nature relationships. The IPBES conceptual framework also broadens understanding of the multiple ways that people value nature to recognize intrinsic and relational values in addition to instrumental values[17,54].

To help uncover how people relate to and value nature, the concept of 'life frames' was introduced, which conceptualizes people's relationships with nature (Fig. 2, and see caption). Current market-based economies are founded in a life frame of 'living from' nature (Fig. 2, label 'i'), prioritizing exploitation over stewardship. As a result, they tend to undermine non-market instrumental, relational and intrinsic values of nature[16], along with notions of reciprocity between people and the natural world[56]. Although the concept of sustainable development was introduced to better integrate environmental and social concerns, its roots in capitalism, and thus in extractivism, mean it internalizes many of their underlying assumptions, and thus only partially aligns with broader sustainability values[8]. Sustainable development may be viewed as expressing a set of normative 'broad values' (Fig. 2, label 'ii')–such as intergenerational equity and planetary health–yet these are predominantly interpreted in the light of instrumental values and the dynamics of market systems. The SDGs, framed as 17 aspirational goals for global well-being, replicate this broad value orientation, with negotiated language reflecting the market-based priorities of the multi-lateral system[42,57]. This paper focuses on the arrow labelled (iii) in Fig. 2, illustrating the potential for sustainable development and the SDGs to become more reflective and inclusive of worldviews that foreground non-instrumental values.

A systems model of nature, economy and society

Our approach begins from the recognition of a dualist separation of humans from nature, and within the human sphere, a further dichotomy between people's tangible material needs and their more intangible psychological, social, cultural and political relations[30,58]. Peoples' direct needs (e.g., food, clothing, shelter) comprise our ecological niche, or the basic requirements humans derive from nature. From a social perspective, these relate to the original meaning of '*oikos*' (i.e., 'household', 'home', in Ancient Greek). The

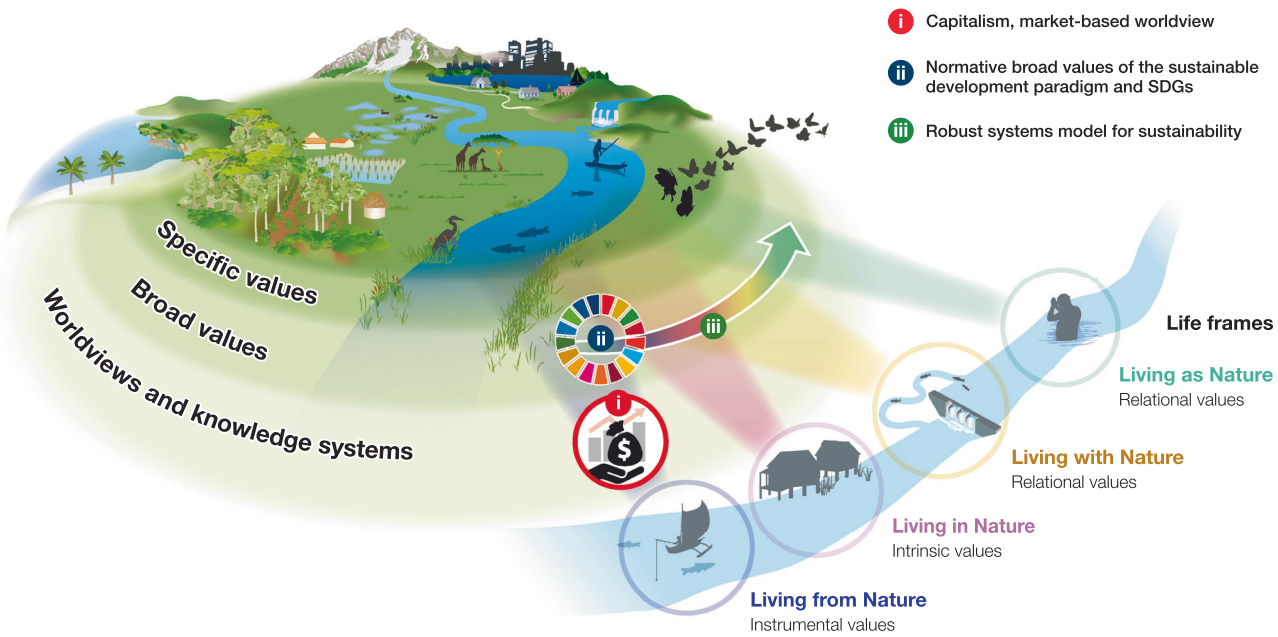

Fig. 2 | The IPBES values typology illustrates the interrelationships between worldviews, broad values and specific (instrumental, intrinsic and relational) values. The concept of life frames clarifies subsets of values depending on how people–nature relationships are framed[54]: 'living from' nature emphasizes direct use of instrumental values, 'living in' nature focuses on nature as a setting for peoples' lives; 'living with' nature centres on both intrinsic and relational values; 'living as' nature emphasizes relational values of oneness, kinship and interdependence of people with nature. Superimposed on this typology are i. the capitalist market-based worldview, which primarily aligns with instrumental values and the 'living from' life frame; ii. the normative broad values of the sustainable development paradigm and Sustainable Development Goals, which, while rooted in instrumental values, extend partially to incorporate intrinsic values of nature; and iii. the arrow illustrates the focus of this paper in proposing a robust systems model for sustainability to enable the concept to become inclusive of, or make space for, intrinsic, non-market instrumental and relational value systems across other life frames. Source: IPBES Values Assessment, adapted from Figs. SPM2, 2.5[16])

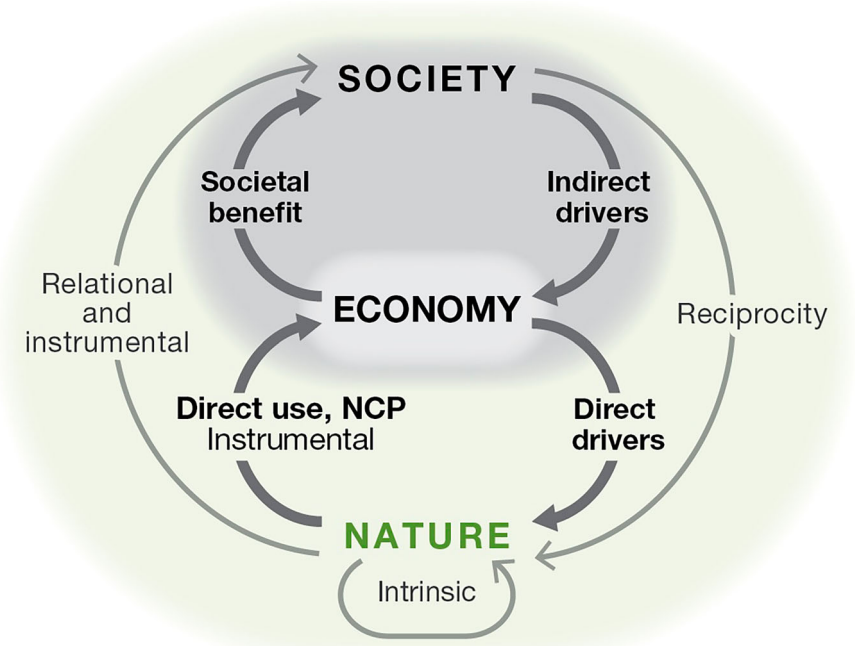

Fig. 3 | Systems model of sustainable development illustrating the layering, nestedness and key linkages between nature, economy and society. The core model is in the center in bold text and arrows: nature forms the foundation, with material contributions (through direct use of NCP (=nature's contributions to people)) flowing directly into the economy, which generates societal benefits to actors in society. Actors in society hold values that influence the indirect drivers determining how the economy operates, and thus the scope and intensity of direct drivers impacting on nature. The form of the model reinforces concepts of circular economy. The fuller model (normal text, lighter arrows) includes broader values that are poorly addressed in the sustainable development paradigm: intrinsic, non-economic instrumental and relational values, and reciprocity of interactions between people and nature.

term 'economy' (from '*oikonomia*', combining 'oikos' with '*nomos*', meaning 'management') thus refers to the management or stewardship of these needs. All humans engage in this broad sense of 'economy', which ranges from direct use and cooperative, non-monetary community systems based on shared labour and skills—sometimes described as 'grassroots economies' with examples across all continents[59], to today's global currency-based economy (and increasingly, digital distributed ledger technologies[60]) to facilitate exchange among people.

Building from ecological systems thinking, we conceptualize nature as encompassing human society, which in turn encompasses the economy. The economy plays an intermediary role between nature and society (Fig. 3). Thus, *nature* forms the foundational layer, with material contributions

Table 1 | Nodes of the systems model of sustainable development.

System nodes		Objectives for sustainable development	
		Agenda 2030/SDGs	New
Nature	Living elements of biodiversity (including animals, plants, microbes etc, and humans), as well as non-living resources from nature, such as water, essential elements for life (such as carbon, oxygen and other element cycles), and elements of the earth system. Includes all aspects of human cultures, knowledge and belief systems. Natural capital is represented by the stock or population of all of these elements of nature, excluding those in the societal and economic domains.	Achieve 'environmental sustainability'[38], or 'halt and reverse the loss of biodiversity'[81].	Maintain elements of natural capital (assets) at sufficient levels to sustain their internal dynamics (e.g. reproduction, element cycles), and capacity to generate contributions to people. Inclusive of other models of conservation - convivial conservation[24,82], shared earth[83], etc.
Society	All individual humans belong to communities and societies, holding a range of values and rules for guiding inter-individual and inter-community behaviour, characterizing different cultures and belief systems, as well as interactions with the rest of nature[17,54]. These values drive the 'underlying causes' of peoples' choices and behaviours, influencing the indirect drivers that determine economic practices, and their impacts on nature[2,7,54]. Includes 'human' capital described in other capitals models (see main text). Includes all aspects of economic behaviour and institutions. Social capital includes all the elements of individual to global societal aspects, excluding those included in economic capital.	'Inclusive social development' and more aspirationally as 'no one left behind'[38].	Rights of all (societal groups to individuals) for equal expression, power and influence, and access to benefits from nature and economic activity[7,84].
Economy	Ways in which people obtain material sustenance from nature, generate livelihoods and incomes, from subsistence through manufacture and service, to artistic and digital. Most broadly, this includes contributions from nature that are not traded corresponding to the ecological niche of *Homo sapiens* (ie. the food, materials, shelter and other aspects of nature needed by humans) (cf. 'oikos' or household, and 'nomos' or management, the Ancient Greek roots of the word 'economy'). Narrowly framed by current economic models (extractivism) relates to transactions quantified using currencies, used to trade goods and services, and accounting of obligations accumulated between people. Includes 'produced', 'manufactured' and 'intellectual' capital described in other capitals models, and potentially 'financial' capital (see main text, and refs. 62–64).	Viable economic development.	Economic capital/assets grown achieving balance of in/outflows to nature and society, and securing or growth of their relevant capitals. Development of transformative economic approaches[85,86]

Detailed description of system nodes, the principal objective for sustainable development as framed or implied in the original sustainable development paradigm, and new objectives enabled by this system's framing.

flowing directly into the *economy* via *direct use and extraction*, which generates *benefits* that are distributed to actors in *society*. *Society*, in turn, holds the values that influence the *indirect drivers* determining how the *economy* operates, and thus the scope and intensity of *direct drivers* impacting on *nature*. Nature, economy and society are (i) parts of a whole in which all elements must be in balance, (ii) interdependent and inter-grading layers rather than separate pillars and (iii) nature is the foundation for all the other elements. Moreover, (iv) the economy is a subset of society, serving as a key mediator between nature and society. The full systems model is further elaborated in the following sections in terms of the three elements of a system[61]: (a) its nodes; (b) the interlinkages among them, and (c) the overarching purpose or goal (Tables 1, 2).

As with all models, selected components of the system are illustrated, and not all elements of the IPBES conceptual framework are used in depicting the system model. We highlight two levels in the model (Fig. 3). First, the core (3 domains, 4 interactions, in bold text), which focuses on material contributions traded in markets (i.e., food, materials and energy from nature[2]) and the related interaction loops dominant in the market system. Second, the full model (light grey linkages, normal text), which makes visible nature's contributions and interactions that are secondary in the market-based worldview. These include instrumental but non-traded contributions, intrinsic and relational values, and reciprocity loops between people and nature. While this model does not represent all worldviews and their values (Fig. 2), grounding it in IPBES's framings allows for comparability with worldviews that perceive different relationships among nature, economy or society, including those that do not distinguish these components as separate.

In relation to weaknesses in the theoretical underpinnings of sustainable development[9] this framing offers several contributions. It: identifies a single integrated system rather than three separate but interacting systems; ensures no component (e.g., the economy) can be considered dominant to the others; brings together the different schools of thought behind each component by making their connections explicit; proposes a layers perspective that avoids the implicit siloing of pillars; addresses the direct causal relationships between human activities and biodiversity decline by focusing on the material needs of humans from nature that are traded in markets; and is grounded in an inclusive values framing that extends beyond traded instrumental contributions from nature to encompass those that are not traded, and to relational values, in line with the full scope of values recognized by IPBES.

Table 2 | Linkages across nodes of the systems model of sustainable development.

System linkages		Objectives for sustainable development	
		Agenda 2030/SDGs	New
Direct use of Nature's contributions to people (NCP) (instrumental values)	NCP are flows from nature that benefit people that may regulate our environment, correspond to direct physical uses or may provide intangible (psychological, recreational, cultural or spiritual) benefits. These correspond to values that may be labelled as intrinsic, instrumental or relational. The sustainable development model, and thus this expression of it, focuses on instrumental values from nature that are transacted in economies, as these are the flows from nature to economy and thence to society that are driving biodiversity decline[75,87]. Intrinsic and relational values are included within the sustainable development framework but need greater prominence, as does recognition of NCP flows relevant to other worldviews and values systems.	Ensure sustainability of economic or commoditized resource (NCP) flows that support economies and society, to ensure 'the ability to provide for future generations'	Expand the focus on sustainability of NCP flows to non-economic instrumental NCP, as well as intrinsic values of nature and relational NCP. Assure sustainability and security of NCP flows valued across other worldviews.
Societal benefits	Flows of benefits from economy to people (narrow and broad framings, see text), from individual to societal levels. For example, food extracted/cultivated from nature (NCP flow) contributes to nutrition of people (societal benefit). The in/equality of distribution of benefits among people may vary, influenced by values held by people/ society.	Focus on meeting minimum needs (no-one left behind, eliminating poverty).	Meet minimum (dignified) needs of individuals alongside limiting (maximum) benefit flows constrained by total capacity (at relevant scales). Identify acceptable levels of inequality in distribution of benefits, accommodate pluralism/ inclusion to address benefits important within different worldviews[88].
Indirect Drivers	Factors (social, economic, demographic, institutional, cultural, technological political, etc.) influenced by the values and beliefs held by people in society, including of what constitutes a good quality of life. Extended to aspects of underlying causes of the indirect drivers[7,89].	Indirect drivers cited include global population, consumption and economic growth	Address underlying causes (values, behaviours) to reinforce indirect drivers that enable 'sustainability-alignment' of economic activity. Pluralism and inclusion enable accommodation of compatible indirect drivers across different worldviews.
Direct Drivers	Actions with consequential impact(s) on nature, classified into 5 main classes: land/ sea use change, direct exploitation, climate change, pollution, invasive alien species and 'others'. Impacts may be due to direct use/ extraction or as a byproduct of actions with other intent. If the impact of direct drivers exceeds the regenerative capacities of nature, natural stocks (capital) decline. Positive drivers may include actions that result in restoration, rehabilitation and/or adaptation[89].	Focused on direct economic actions that should not exceed threshold levels, or the ability of natural systems to recover, but dominated by short term maximization objectives.	Similar, acknowledging greater complexity of interactions when a greater diversity of NCP is addressed, including potential synergies, inter-dependencies etc. Include attention to status and trends in NCP and values of nature held in other worldviews.
Intrinsic, non-economic instrumental and relational values, and reciprocity	Values not measured monetarily or traded in the current market systems, include intrinsic, some instrumental and relational values. By not being quantified, their value is discounted (often to zero), thus are impacted/crowded out in existing markets and their flows and status are in decline[2,54,68]. The notion of human–nature reciprocity is not recognized in the market system[56]. Shaded in grey (Fig. 2) to illustrate their invisibility in the current markets, and only weakly in sustainable development as currently operationalized.	Included in the notion of 'meeting the needs of future generations' but without explicit recognition or quantification.	Explicit acknowledgement as values to be secured by increasing alignment with sustainability values, and increasing pluralism/ inclusion by reducing dominance of market system.

Detailed description of system linkages, the principal objective for sustainable development as framed or implied in the original sustainable development paradigm, and new objectives enabled by this systems framing.

System nodes. The nodes in this system model are nature, economy and society (Table 1). They can be viewed as comprising capitals (natural, economic, social, respectively), which can be broadly defined as the stocks that generate value, or support the functions, flows or linkages between them. These capitals provide the foundations for the functioning of the system[61]. Importantly, capitals are not substitutable across nodes: an item cannot be reclassified from, for example, natural to economic capital, although it can be transformed through flows (see next section). The concept of capitals has been developed in varied frameworks, such as for sustainable livelihoods[32,33]. Other frameworks emerged to operationalize sustainable development for businesses, often subdividing capitals into finer categories that address their focus, for example, differentiating

human (individual) capital from social capital[62], and manufactured, financial and intellectual capitals from economic (or produced) capital[63,64]. All of these can be accommodated within this systems model.

Common to any capitals model, a key objective is to sustain, build or enhance capitals, not degrade them. Thus, investment relates to building and strengthening capitals, and ensuring interlinkages among them are positive. Investment in any and all capitals is important, and which is prioritized should be based on the state of the system and of the contributions of each capital. A critical shortcoming of the prevailing economic system is to discount the importance of natural and social capitals[65], focusing only on maximizing conversion from natural to economic capitals, and thence to finance, and for individual over public benefit. This has led to the erosion of both natural and social capitals to levels that undermine the functioning of the system as a whole[9].

System linkages. The linkages in our system model (Table 2) express flows, or conversion, from one type of capital (e.g., wood in a forest) to another (e.g., building material), or the influence of one on another (e.g., indirect drivers of society on economy, or direct drivers of economy on nature). In a finite system (such as all human and natural systems on Earth), once a critical threshold of any capital is crossed, the possibilities for substitution or compensation dwindle to zero. This is evident in many local systems at the limits of over extraction (e.g., collapse of the Newfoundland cod stocks in the 1980s, which resulted in fishery failure[66]), and increasingly at planetary scales for Earth system functions (e.g., exceeding the capacity of carbon sequestration for climate regulation, which has resulted in global warming[67]).

A key principle of systems theory is that flows must balance across a system. When harmful linkages are left unaddressed (e.g., in siloed approaches), their consequences or costs are externalized (i.e., ignored), impacts accumulate, and the system becomes increasingly unstable, potentially leading to catastrophic consequences. For instance, the lack of economic opportunities for people living in poverty may lead to an intensification of extraction from nature, further depleting natural stocks that are already highly compromised, and amplifying feedbacks that exacerbate poverty, (over)exploitation and nature decline[68]. Such reinforcing loops are now contributing to the transgression of regional and global thresholds in Earth system processes, raising the possibility of a new geological epoch defined by human actions: the Anthropocene[69,70].

System purpose. The purpose or goal of this systems model is embedded in its name. 'Sustainable' requires that the planet with its people persist into the future. 'Development' reflects the palatability of economic growth being considered as the principal mechanism for overcoming limitations in meeting peoples' needs, but this framing often undermines recognition of limits[9,41]. In support of the purpose, objectives or sub-goals may be specified for individual elements that define their contribution (Tables 1, 2). Our systems framing mechanistically links nature and society to economy, and thus consideration of the dynamics and limits of the entire system (nature), within this the needs of all people (thus equity within society), and within this the mechanisms of meeting peoples' needs (economy). If development is understood as improving the whole system, then the term *sustainable development* is consistent, but if it applies only to increasing the size of economies, it is inconsistent with sustainability of the whole.

At or near global limits, increases in quality of life may only be possible through appropriate mixes of redistribution of flows, innovation and minimization of trade-offs[1,7]. Equally important is explicitly recognizing the full spectrum of nature's values beyond those traded in markets[54]. This includes non-traded instrumental values (e.g., climate regulation, flood protection, climate regulation), relational values (e.g., psychological and mental benefits, sense of place and identity), and intrinsic values (nature for its own sake). Incorporating these into decision-making is necessary to balance the system. Finally, by recognizing the full set of linkages addressing reciprocity between people and nature[56], this systems model of sustainable development can be aligned with other worldviews also represented in IPBES's conceptual and values frameworks[51,55].

From dualism to holism

While defining elements of a system (nodes and linkages) is necessary for analytical purposes, individual elements cannot be fully understood in isolation from the whole. The elements serve as entry points for tracing the cascade of interactions among nodes and linkages for specific types of interactions (e.g. [71]). As with the IPBES conceptual framework[51,55], this systems model for sustainability (Fig. 3) enables multiple narratives to be drawn (Box). For example, starting with indirect drivers, which result from societal values, one can examine how these affect the economy node and from this (a) the influence of direct drivers on nature, and (b) how economic benefits are shared from economy to society. Alternatively, focusing on an economic actor, such as a company, allows both lower and upper loops to be traced, (a) from direct drivers, through nature (and impacts on it) to resources used (nature's contributions), and (b) how benefits from a company are shared in society, and the societal values that direct how the company operates. In all cases, higher-order interactions and feedback loops need to be considered across all nodes and their interlinkages, and diverse actors can develop their own narratives of sustainability[72,73].

The systems model may also be applied at multiple scales, such as across the geographies over which a business or other entity may act, to address teleconnections in trade. It can also help frame the application of specific tools, such as on disclosure of impacts and dependencies, science-based targets, capitals analyses, or integrated reporting, by maintaining a holistic perspective. This approach allows for seeing the bigger picture of the whole system (the forest), while focusing on individual elements or nodes (the trees), providing a robust systems framing of 'strong sustainability'[9,74] (see Box).

Beyond the capitalist worldview from which sustainable development emerged, this systems model is intended to at a minimum open up space for the diversity of worldviews that inhabit the planet. Other worldviews may hold values that can be aligned with those depicted here, but others, such as many Indigenous worldviews do not view people separately from nature, nor consider a monetary economy as a central component (though see ref. 59). For these, because the current paradigm is driving the global crises and exceedance of global limits, bringing it into alignment with sustainability values by reducing its footprint to within global limits opens up sufficient 'space' on the planet to enable co-habitation of people of all worldviews.

From market failure to values failure

Today's market system inherited a value set from centuries of trade and economic domination that preceded it[7]. Maximizing production of three classes of material contributions from nature—food, materials and energy (NCP classes 11–13[55])—has been its focus, resulting in the direct drivers that push nature into decline, and the decline in all other classes of contributions[75]. The objective to maximize material production and individual profit drives actors to ignore or externalize costs. This not only increases the direct drivers of nature's decline, it also shifts the burden of these costs onto others, often with less material wealth, thus amplifying inequalities. Consumerism reinforces these by promoting participation of all actors in the market-based model, regardless of whether individuals experience gains (increasing wealth) or losses (declining wealth, increasing impacts/costs) from participating. This establishes reinforcing feedbacks that have produced the three underlying causes of nature's decline[7]: domination of nature and people, unequal power and wealth, and prioritization of material/short term gain.

Extending the same views (values), practices (activities) and structures (institutions) to maximize production from other components of nature only reinforces the vicious cycles[7], as has been demonstrated with early approaches to carbon sequestration (NCP class 4) in response to climate

change. These resulted in significant impacts to nature (selection of non-native fast-growing trees that deplete native ecosystems, or trees planted in suboptimal locations) and people (displacing native species and ecosystems and the contributions they provide, or substituting of food crops for carbon sequestration and/or biofuels)[76]. Seminal reviews interpreted climate change and biodiversity loss as market failures[77,78], but from the systems perspective developed here this may not be entirely correct, as markets have been highly efficient at delivering what they value - maximized production and profit. These failures are more akin to values failures (see refs. 17,54), in that markets do not operate with sufficient breadth of values to deliver holistic outcomes across nature, economy and society. If the values driving markets were truly sustainability-aligned[8], the markets could deliver sustainable outcomes (and recognizing that other solutions are also possible, such as through reforming rules or institutions).

Sustainability through diverse pathways

This systems model shines a focus on the economy and its intermediary role between nature and society, highlighting causal chains and circularity to address the dominant direct drivers causing biodiversity decline[1,2] and the actors responsible for them. See Box 1, for an illustration of how actor roles and options can be explored. Without transformational choices by these actors, no amount of direct actions on nature will be sufficient to halt or reverse biodiversity decline[2,79]. As the iconic 1.5°C warming limit is transgressed and humanity's impact exceeds multiple limits on a finite planet, the need for the global economy to return within safe limits is paramount.

To contribute to this urgent challenge, we draw on new understandings of nature's multiple values to strengthen the theoretical and conceptual underpinnings to sustainable development that have been lacking[9]. Current neoliberal markets and mainstream models of sustainable development

Box 1 supporting | alignment with a systems model, for places and actors

The systems model provides a consistent lens for analyzing cases, actors or areas of enquiry by requiring that the system purpose, nodes and linkages are considered by all stakeholders. It enables whole-system enquiry (Fig. 3) while also accommodating detailed analysis (Tables 1, 2), and helps ensure alignment among different actors who may hold different values[54,71]. This box explores three linked perspectives for applying the model: (a) a place-based system (landscape or seascape), (b) a farm producing monoculture cash crops, and (c) a fertilizer manufacturing company.

a) Place-based (e.g., a landscape/seascape)

For a given place, the model assesses the balance of contributions and influences across different actors and sectors with respect to all seven elements of the system and the whole.

Purpose: The location, inclusive of all actors, must frame its commitment to sustainability, i.e., achieving balance across nature, economy and society.

Capitals/layers: Are nature, economic and societal elements of the system in balance?

Within each capital: for nature, this is equivalent to healthy, functioning or improving nature; for the economy, viability and productivity; for society, acceptable levels of equity and good quality of life. What is the state of each? Is any one substantially in worse condition than the others, or in need of restoration or investment?

Among capitals: is the capital underpinning any layer undermined or reinforced by interests (actors) from another layer? For example, are the interests of a farm (b) or a fertilizer company (c) complementary?

Interaction/flows: for each of the four links, what is its effect on: the source or destination capital? If one is being degraded (e.g., overextraction from nature, pollution impacting nature (or people), activities within the link must change to halt and reverse the damage (and end externalization of costs); feedback loops? Do activities in a link reinforce destabilizing feedbacks, or do they support stabilizing, balancing feedback loops?

Across all of these, what actions are needed and by whom to bring the capitals and flows to a long-term balance, in which capitals are stable or growing rather than declining, and feedback loops are stabilizing, rather than amplifying degradation.

b) A farm growing monoculture cash crops.

In landscapes converted to monoculture farming, biodiversity and many NCPs are lost to maximize production of single crops for markets and shareholder profit. For the farm (individual actor), the challenge is to shift toward more balanced production that addresses nature and social goals alongside economic ones.

Applying the Earth system functional integrity boundary[4,80] for illustration, at least 25% of each km^2 of the farmed landscape should be under semi-natural habitat that provides sufficient NCP to support a good quality of life for people living in the landscape. Achieving this requires reducing the extraction of commercial crops from the land (NCP/direct use) and altering farming practices that degrade nature (direct driver), to invest (indirect driver) in restoration and rehabilitation (direct driver) of the farm/landscape. Although crop production and financial profit for individual farm owners may decline (though in some cases they may also increase depending on the system and nature-based farming solutions), the benefits of a healthier natural system—including more equitable non-monetary and social gains for farm workers and nearby residents—would increase. Over time, while the economic capital of the farm may decrease (reduced cash crop production), natural capital (semi-natural habitat) and social capital (well-being, shared benefits, community resilience) would be strengthened. The result is improved balance across capitals, stabilizing interaction loops, and potentially even long-term gains in economic capital through diversified and more resilient farming systems (Fig. A).

c) A company in a production sector

Companies in extractive or manufacturing sectors, such as fertilizer producers, sit primarily in the economic domain. Currently, a company's purpose has been to maximize market share and profit. Fertilizer companies, for example, have historically maximized the throughput of a commodified resource from nature (nitrogen/phosphorus), minimized costs associated with extraction, processing and use of fertilizer in farming (direct driver), marketed products to farms in ways that maximize sales and may encourage overuse (indirect driver), and sought to maximize profit for shareholders/owners (individualized monetary benefit). These interactions have driven reinforcing feedback loops that expanded economic capital while undermining natural capital and exploiting and harming social capital. To align with sustainability, such companies must operate under new policies and frameworks that incorporate nature and social goals alongside commercial viability. This involves collaborating with farms and other actors in the landscape to transform the vicious, reinforcing cycles into virtuous, stabilizing cycles—delivering positive outcomes for nature and society while maintaining economic viability of the company.

Fig. A illustrates the 'conventional/unsustainable' and 'sustainable' interaction loops for this hypothetical example, focused on the farm (b). The systems model clarifies where each actor sits in relation to the capitals, the interaction links, and other actors, and thus highlights their agency and responsibility in contributing to the agreed purpose of sustainability.

While the model reiterates ideas that are now widely recognized, its strength lies in its holistic application: it enables a consistent view across the whole system, its constituent parts, and the actors involved, and to other adjacent, overlapping and/or interacting systems. In doing so, it facilitates alignment around a shared vision and purpose—even when fully coordinated action may be unrealistic.

(continued from previous page)

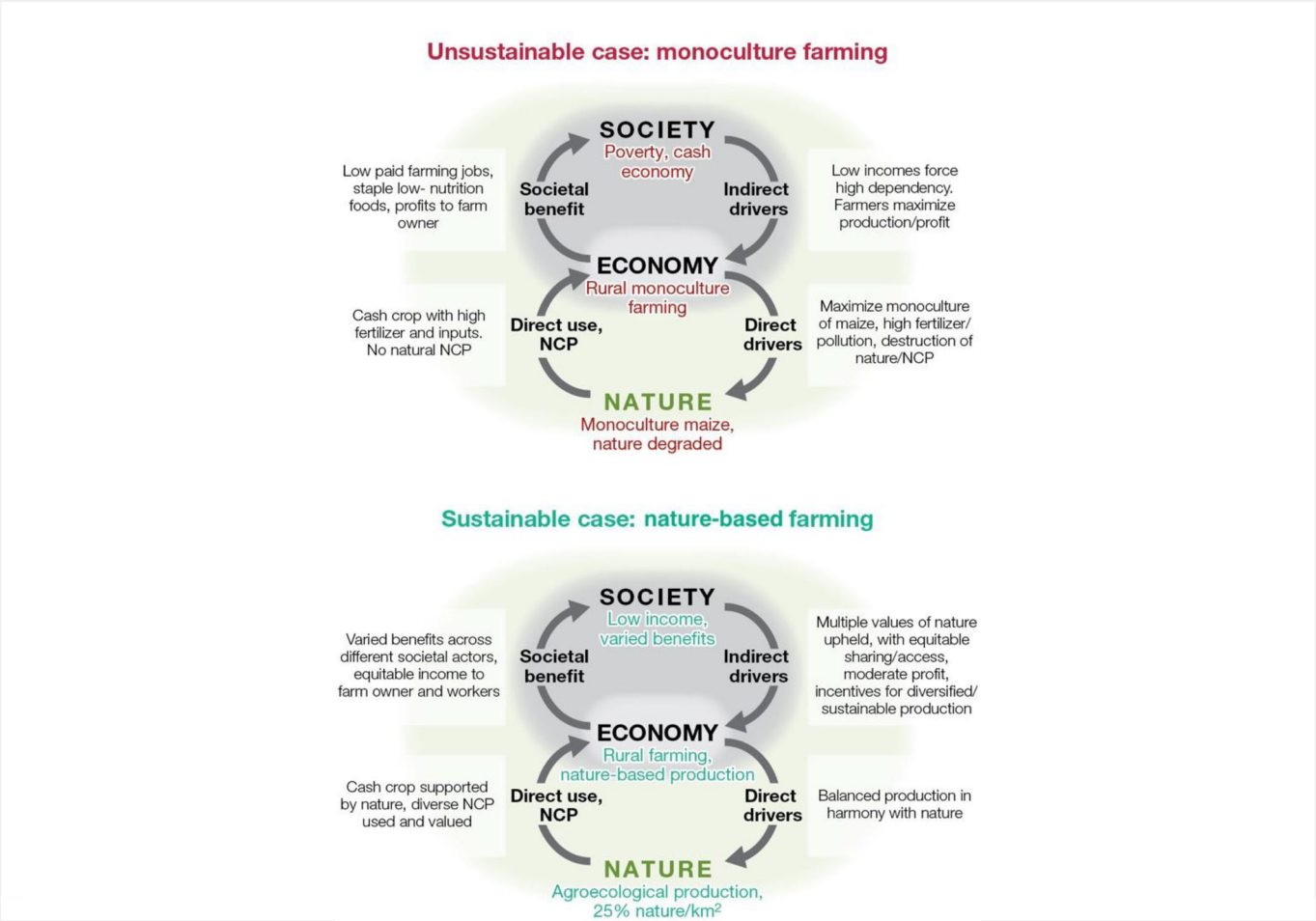

Fig. A. Illustration of the systems model of nature, economy and society, focused on a farm following unsustainable vs. sustainable practices. Using this model, actors in varied contexts–a) place-based, b) the farm, or c) a fertilizer manufacturer–can locate themselves and the actions they are responsible for, to promote alignment with other actors.

incentivize—or fail to sufficiently disincentivize—the very trends driving today's global crises. These crises should therefore not be viewed merely as market failures, but more fundamentally as values failures. Addressing them requires transformative change[6,7], through shifts in views, structures and practices that enable a fuller inclusion and diversification of value systems in decision-making[17,54]. While this paper has focused primarily on values (views), complementary shifts in practices (i.e., 'response options') and structures (i.e. governance) capable of addressing complex interactions across scales and involving the full range of relevant actors are also needed[1,7].

This systems model of sustainability (Fig. 3) offers a solid theoretical and practical foundation for moving beyond the dominance of the current neoliberal capitalist model, and toward a more inclusive framework that embraces sustainability-aligned values. Our aim is not to discard sustainable development, but to redefine it using a deeper sustainability paradigm—one that accommodates the full scope of small to large changes needed to realize sustainability visions for and beyond 2030. In shifting to more holistic foundations for sustainability thinking, this framing provides a smoother runway both for delivering on the SDGs and for supporting emerging discussions on a post-2030 agenda for sustainability that is more robust in theory and more effective in practice.

Received: 29 May 2025; Accepted: 9 October 2025;
Published online: 08 January 2026

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Acknowledgements

The authors would like to thank extensive comments and peer discussions that have improved and focused this manuscript immeasurably, from Patricia Balvanera, Eduardo Brondizio, John Donaldson and Pamela McElwee, as well as some who wished to remain anonymous. AP was funded by ANID/BASAL FB210006. While the authors of this paper have all

led IPBES assessments since 2019, they authored the present paper in their personal capacity. The paper solely reflects the views and contributions of the authors. It does not represent the views or the position of IPBES.

Author contributions

All authors contributed to this work. D.O. led and conceptualized the framing, all authors (D.O., A.A., M.C., J.M.C., P.A.H., M.J., K.O., A.P., H.E.R., J.S., P.S.) wrote, edited, reviewed and approved the work.

Competing interests

The authors declare no competing interests.

Additional information

Supplementary information The online version contains supplementary material available at https://doi.org/10.1038/s44458-025-00009-3.

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Peer review information *Communications Sustainability* thanks Emran Hossain and the other, anonymous, reviewer(s) for their contribution to the peer review of this work. Primary Handling Editors: Heike Langenberg. [A peer review file is available].