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Sustainable development: The Conceptual Trajectory from the Brundtland Report to Safe and Just Earth System Boundaries

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***Abstract*—**This article re-examines the concept of sustainable development from historical and critical perspectives. It is based on the hypothesis that the concept's increasing presence in academic, political and media discourse has not led to semantic stability. Instead, it has remained a living concept, continuously reshaped according to successive knowledge frameworks. The article traces the origins of the idea's first articulation in literature on the limits of growth and at the 1972 Stockholm Conference, moving on to the pivotal moment of the 1987 Brundtland Commission report. It then examines the institutional embodiment of the concept, moving through the Rio Summit, the Millennium Development Goals and the 2030 Sustainable Development Agenda, and up to the most recent scientific developments related to the frameworks of safe and just earth system boundaries and the doughnut economy. The article also highlights the expanding gap between normative ambition and actual achievement, as revealed by the latest United Nations reports from 2024 and 2025.

The article concludes that sustainable development is not an expired slogan, but rather a renewed research agenda that reformulates its questions in response to changes in the scientific and political conditions of the global environmental and development crisis.

***Keywords*—**sustainable development, Brundtland report, safe and just earth system boundaries, doughnut economy, degrowth/post-growth.

Introduction

The concept of sustainable development has rarely been as prevalent in public discourse as it is today. It now appears in government documents, institutional plans and conference slogans to such an extent that some researchers consider it to be a vague term that has lost much of its analytical precision. However, this widespread use should not distract from a key fact: the scientific content of the concept has evolved since its initial formulation by the Brundtland Commission in 1987. Instead, it has continued to evolve through ongoing processes of reconfiguration in interaction with the accumulation of knowledge in earth system sciences, political economy, and intergenerational justice. In other words, what began as a general ethical and normative framework formulated within a specific international political context gradually transformed into a more 'measurable' scientific framework. It now rests on precise quantitative thresholds for the performance of the Earth system, as well as social criteria for distributive justice among peoples and generations.

The importance of this issue stems from a core methodological observation: much of the international literature on sustainable development tends to limit itself to presenting the Brundtland definition, treating it as both the starting point and the conclusion of the conceptual debate. Such literature often overlooks the fact that the concept originally emerged from a sharp political and economic conflict between industrialised Northern countries and developing Southern countries regarding which should take priority: protecting the environment or eradicating poverty. Furthermore, the concept evolved after Brundtland, passing successive institutional and scientific milestones that have not always received the same level of academic documentation.

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From this perspective, reconstructing the entire historical trajectory of the concept, from its earliest manifestations to its most recent scientific frameworks, is not merely an intellectual exercise. It is a methodological necessity in order to understand why the concept remains the subject of active debate and why international institutions and scientific communities continue to offer new interpretations whenever the conditions of the global environmental and development crisis change.

On the basis of this framing, the central problematic emerges as follows: How did the concept of sustainable development evolve from its original formulation to its current form? Despite being nearly four decades old, what keeps it at the heart of contemporary scientific debate rather than rendering it an exhausted idea?

To answer this question, the article takes a historical-analytical approach, tracing the major milestones in the concept's evolution. It begins with the concept's earliest roots in literature on the limits of growth and the 1972 Stockholm Conference, then moves on to the foundational Brundtland moment. Next, it examines the institutional implementation trajectory through the Rio Summit, the Millennium Development Goals, and the 2030 Agenda. Finally, it examines the most recent critical scientific approaches that have reformulated the concept in light of safe and just Earth system boundaries and the doughnut economy, while also considering the current situation as reflected in the latest United Nations reports.

1. The Origins of the Concept (1968–1972)

Awareness of the limits of economic growth did not emerge in isolation; important intellectual precursors emerged in the early 1970s. The Club of Rome commissioned a group of researchers at the Massachusetts Institute of Technology (MIT), led by Dennis Meadows, to conduct a forward-looking study examining the relationship between population growth, economic expansion and the finite nature of natural resources. In 1972, the study was published under the title The Limits to Growth. It is considered one of the earliest scientific attempts to assess the impact of human activity on environmental systems at a global level using a methodological approach[1]. The report sparked widespread controversy and contributed to the intellectual groundwork for what would later be known as sustainable development, although it was later criticised for being excessively pessimistic about the capacity of technological innovation to overcome resource constraints.

A year before the Stockholm Conference, the conference's Secretary-General, Maurice Strong, convened a preparatory meeting in Founex, Switzerland, in 1971. This meeting brought together twenty-seven international experts, including the French-Polish economist Ignacy Sachs. The aim was to narrow the gap between the divergent views of industrialised and developing countries on the feasibility of placing environmental issues on the international agenda. Many Southern countries viewed this sudden attention to the environment with suspicion, fearing that it would be used as an excuse to impose new constraints on their economic development. Some even considered boycotting the conference.

The meeting resulted in the Founex Report, which distinguished for the first time between environmental problems specific to industrialised countries, linked to overconsumption, and problems specific to developing countries, linked to poverty itself. The report emphasised that addressing environmental degradation in the Global South cannot be separated from addressing economic underdevelopment. In doing so, the report established the first intellectual basis for linking environment and development rather than treating them as two separate issues[2].

In the same year, the first United Nations conference devoted entirely to human environmental issues was held in Stockholm, with delegations from over one hundred countries in attendance. The conference resulted in the adoption of the Stockholm Declaration, which set out twenty-six principles for preserving and enhancing the human environment. It also led to the establishment of the United Nations Environment Programme (UNEP)—the first UN organisation specialising exclusively in environmental issues[3].

While many of the conference's outcomes were non-binding and advisory, Stockholm established the first institutional link between economic growth, pollution, and the well-being of peoples. In this sense, it paved the way for the adoption of the 2030 Sustainable Development Agenda and its seventeen Sustainable Development Goals[4].

This foundational trajectory did not stop there. In 1974, Ignacy Sachs returned to the debate at the Cocoyoc seminar in Mexico, organised by UNEP together with the United Nations Conference on Trade and Development (UNCTAD). During the seminar, Sachs proposed the concept of 'developmental ecology', which he defined as a more integrated approach to reconciling economic growth, social justice, environmental limits, and the cultural specificities of each region. This approach was later recognised as the most direct intellectual precursor to the

framework that the Brundtland Commission would formulate thirteen years later under the name ‘sustainable development’[5].

The Cocoyoc Declaration, which emerged from the seminar, explicitly emphasised that the inability to meet basic human needs in a world marked by deep inequalities and rapidly accelerating environmental degradation constituted the central dilemma from which any new vision of development must begin. This is precisely the idea that the Brundtland Commission would later reaffirm as the core concept of sustainable development.

2. The Foundational Moment: The Brundtland Commission and Our Common Future (1983–1987).

In 1983, the UN General Assembly established the World Commission on Environment and Development in response to growing international concern about the depletion of the ozone layer, global warming and deteriorating ecological systems linked to rising living standards worldwide. The Commission was chaired by former Norwegian Prime Minister Gro Harlem Brundtland. After roughly four years of work and extensive consultations with experts, governments and civil society across the globe, the Commission issued its famous report in 1987, entitled Our Common Future, later known as the Brundtland Report[6].

These consultations were not merely formal. The Commission held public hearings in several world capitals, from Oslo to Jakarta, Nairobi, São Paulo and Moscow, allowing government and NGO representatives, scientists and local community leaders to express their differing views on the relationship between the environment and development. As a result, the final report reflected a reconciling tone between the positions of industrialised Northern countries, primarily concerned about environmental degradation, and developing Southern countries, who viewed poverty itself as the most significant source of environmental deterioration and feared that the new environmental discourse might constrain their development.

The report succeeded in moving beyond this apparent dichotomy by advancing a central idea: Poverty and environmental degradation are two sides of the same coin, and breaking this vicious cycle requires a new development model that calls for rethinking production and consumption patterns in the North as much as it calls for rethinking growth pathways in the South.

To this day, this report (WCED, 1987) is the most widely cited definition of sustainable development. It defined it as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This definition encompasses two key aspects: an intergenerational equity dimension and a dimension linking the continued availability of resources to the fulfilment of current human needs.

The report also distinguished three integrated dimensions of sustainable development: economic, social, and environmental. It argued that extreme poverty in southern countries and unsustainable patterns of production and consumption in northern countries are two sides of the same environmental and development crisis. This approach represented a qualitative shift in that it linked social justice to environmental sustainability within a single analytical framework rather than treating them separately.

What is sometimes overlooked in the circulation of the Brundtland definition is that the report did not stop at this general ethical formulation. It also set out a specific method: the concept of ‘needs’ is not fixed; it is linked to the limits imposed by the current level of technology and social organisation on the environment’s capacity to respond to the needs of the present and future generations. According to the Commission, sustainability is therefore not a final, static condition that can be achieved once and for all, but rather an ongoing process of adaptation in which its parameters change as scientific knowledge, technical capacities, and institutional structures evolve.

This methodological condition is rarely invoked in common discussions of the concept, but it has become the foundation for many later scientific reviews of sustainability limits, from safe and just Earth system boundaries to the doughnut economy, as a logical continuation of Brundtland’s idea of the dynamic, renewable nature of environmental limits, rather than a break with it.

3. From discourse to institution: The Rio Summit and the Millennium Development Goals (1992–2015).

The United Nations Conference on Environment and Development, held in Rio de Janeiro in 1992 and known as the Rio Summit (or Earth Summit), marked a turning point at which the concept of sustainable development shifted from the broad normative framework set out in the Brundtland Report towards more specific international commitments[7]. The summit concluded that sustainable development could be pursued and achieved at local, national, regional and international levels and that integrating economic, social and environmental considerations was essential to sustaining life on the planet.

Four major reference documents were produced at the Summit: the Rio Declaration on Environment and Development, Agenda 21, the United Nations Framework Convention on Climate Change (UNFCCC), and the Convention on Biological Diversity (CBD). These instruments transformed Brundtland's vision into commitments that countries were expected to translate into real policies.

Agenda 21, which ran to over 300 pages across 40 chapters, represented the UN's first attempt to formulate a comprehensive action plan for sustainable development. It addressed a wide range of issues, including combating poverty and changing consumption patterns, protecting the atmosphere, tackling deforestation and managing hazardous waste. An entire chapter was dedicated to strengthening the role of key groups — women, young people, indigenous peoples and non-governmental organisations — in implementing the plan. The UN Commission on Sustainable Development was established under this agenda to monitor the follow-up to the Summit's outcomes at the international level.

However, the decade following the Rio Summit did not live up to the stated ambitions. Funding for Agenda 21, which was estimated to cost hundreds of billions of dollars per year at the time, remained below what was required. This shortfall prompted the United Nations to convene a new summit ten years later in Johannesburg, South Africa, in 2002, titled the World Summit on Sustainable Development. The summit involved more than 100 heads of state and government, and over 20,000 participants.

Unlike its predecessor, the Johannesburg Summit focused more on practical implementation mechanisms than on drafting new principles and treaties. It adopted a Plan of Implementation packaged within a political declaration that included specific, time-bound targets, such as halving the proportion of people without access to safe drinking water and sanitation services by 2015. However, observers also noted that the Summit failed to reach agreement on binding targets related to the use of renewable energy[8].

At the start of the third millennium, UN member states adopted the Millennium Development Goals (MDGs) as a practical translation of sustainable development. The MDGs focused primarily on poverty, education, and health in developing countries.

Twenty years after the first Rio Summit, the Rio+20 conference was held in 2012. This event reaffirmed the importance of a green economy and institutional governance for sustainable development, paving the way for negotiations that culminated in the adoption of the 2030 Sustainable Development Agenda in 2015. This agenda contains seventeen interlinked development goals[9]. This represented a qualitative shift, moving the concept from an essentially environmental framework towards a more comprehensive approach that integrates poverty, health, education, energy, climate, and institutions into a single, integrated system.

4. The Scientific Turn: From the Seventeen Goals to Safe and Just Earth System Boundaries (2015–2024).

Following the 2015 Agenda, the evolution of sustainable development was not confined to the institutional and political aspects represented by its seventeen goals. It also underwent a profound epistemic transformation due to the development of the Safe and Just Earth System Boundaries framework.

This framework was proposed by environmental systems scientist Johan Rockström and his team at the Stockholm Resilience Centre in 2009. They identified nine key Earth system processes, including climate change, biodiversity loss, land-system change, freshwater use, and ocean acidification[10]. Each process was described as having a threshold that should not be exceeded if the planet is to remain stable and habitable for human life. The article concludes that the future of human development depends on societies' ability to live and work within the planet's environmental limits. It emphasises that maintaining Earth system stability is a prerequisite for human well-being, whereas exceeding these limits increases the likelihood of widespread and potentially irreversible environmental change.

Thus, the concept of planetary (Earth) boundaries provides a coherent scientific framework for guiding sustainable development policies and the governance of natural resources at national and global levels. This framework was later updated in 2015 by Will Steffen[11] and colleagues, who refined the boundaries. Then, in 2023, a research team led by Katherine Richardson published the first comprehensive quantitative assessment of all nine boundaries. They concluded that humanity had already crossed six out of nine boundaries considered 'safe'[12]. Many researchers interpreted this result as evidence that the dominant development model no longer operates within the safety margin set by science.

In parallel, Rockström and his colleagues developed a more integrated approach, termed 'safe and just Earth system boundaries', in a body known as the Earth Commission in 2023. This approach adds a dimension of

distributional justice between individuals and peoples to the purely environmental dimension[13]. The authors concluded that seven out of eight of the boundaries common to environmental safety and social justice have already been exceeded. However, this approach has sparked a methodological debate about the legitimacy of a limited group of experts establishing quantitative thresholds for social justice.

At the same time, the British economist Kate Raworth presented an alternative model to traditional measures of economic growth in 2012. This model, known as the Doughnut Economy[14], combines a social foundation that guarantees the minimum human needs derived from the Sustainable Development Goals with an environmental ceiling grounded in the same nine planetary boundaries. The area between the social foundation and the environmental ceiling constitutes the 'safe and just space' in which humanity can thrive[15].

This is reflected in Raworth's article, "A Safe and Just Space for Humanity: Can We Live within the Doughnut?", which is regarded as one of the foundational works that contributed to shaping contemporary thinking on sustainable development through an innovative theoretical framework known as the Doughnut Model. The article begins with the premise that true sustainable development cannot be achieved merely by enhancing economic growth; rather, it requires finding a balance between two mutually reinforcing dimensions. The first of these is the social foundation, which ensures that all individuals' basic needs are met, including access to food, water, health care, education, employment, equality, and social justice. The second dimension is the environmental ceiling, which represents the planetary limits that must not be exceeded in order to preserve the stability of ecological systems and prevent issues such as climate change, biodiversity loss, and the depletion of natural resources. The article emphasises that the space between these two limits represents the 'safe and just space for humanity', where human well-being can be pursued without harming the planet's ecological capacity.

The article concludes that the main challenge for the international community is to eliminate poverty and inequality while respecting the planet's environmental limits. To achieve this, economic policies must be reoriented towards more sustainable and equitable models of production and consumption. The article also criticises the reliance on GDP as the main indicator of progress and calls for the adoption of more comprehensive indicators that account for social and environmental dimensions alongside the economic dimension. This proposal has provided one of the intellectual foundations that has shaped subsequent international debates on sustainable development and its objectives. It has also helped to consolidate the concept of development as a balanced process that integrates social justice, economic efficiency, and environmental protection within a coherent framework. Since 2020, cities such as Amsterdam have adopted this model as a reference framework for their local development policies.

The reframing of the concept has not only involved introducing new quantitative thresholds, but also reordering the hierarchical relationship among the dimensions of sustainable development itself. In 2016, Rockström and Pavan Sukhdev proposed an illustrative model known as the 'wedding cake' within the Stockholm Food Forum[16]. Rather than presenting the seventeen goals side by side as in the original UN document, this model reorganises them into three stacked layers: a bottom layer representing the biosphere, including goals related to climate, marine life, and terrestrial ecosystems; a middle layer representing society, with its own goals on poverty, health, education, and equality; and a top layer representing the economy.

The core of this model challenges the prevailing priority logic that treats economic growth as an independent end. It instead argues that environmental stability is a precondition and necessity for achieving social and economic goals, rather than an outcome that follows from them. This reasoning has led to the model being widely circulated in academic and international educational circles as a basis for teaching the Sustainable Development Goals in a "tiered", hierarchical manner rather than through flat, sectoral logic.

Another critical approach has gone even further, questioning one of the implicit assumptions that underpins Goal 8 of the Sustainable Development Goals: the need for sustained economic growth. Since 2020, Jason Hickel and Georgescu Kallis have developed post-growth scholarship, drawing on a comprehensive review of over 800 empirical studies. They concluded that the historical trajectory has not achieved the absolute decoupling of economic growth and natural resource consumption at the global level at a sufficient pace or scale — at least not to meet the carbon budget constraints required to keep warming below 1.5°C or even 2°C. Furthermore, they argue that the thesis of green growth, which assumes that ongoing economic expansion can be reconciled with the preservation of ecological systems, still lacks adequate empirical support[17].

This line of argument has led post-growth researchers to call for advanced economies to be reorganised around meeting human needs rather than continuing the perpetual accumulation of GDP. This remains the subject of

renewed scientific debate, with other researchers questioning whether reducing economic output is an effective tool for environmental transformation compared to a strategy centred on rapid decarbonisation while maintaining growth[18]. Overall, this ongoing debate reveals that the most recent scientific approaches to sustainable development no longer limit themselves to measuring how closely the seventeen goals are being approached. Instead, they are increasingly revisiting and challenging the foundational theoretical assumptions on which these goals themselves are built.

5. The current outcome: Between Normative Ambition and Implementation Stagnation (Reports for 2024–2025)

Recent United Nations reports reveal a widening gap between the normative ambition of the 2030 Agenda for Sustainable Development and the actual progress made. The 2024 Sustainable Development Goals report shows that only 17% of the targets are currently on track to be achieved by 2030, while around half of the targets are making limited or moderate progress. Furthermore, more than one-third of the targets are either off track or deteriorating relative to their level at the time the plan was adopted in 2015[19].

The report provides precise quantitative indicators illustrating the magnitude of this gap. It notes that approximately 23 million additional people fell into extreme poverty in 2022 compared with 2019. It also states that, in 2023, more than 153 million additional people experienced hunger compared with pre-pandemic levels. Meanwhile, the number of people displaced forcibly reached nearly 120 million, i.e. close to double the level observed when the 2030 plan was adopted in 2015, amid a development finance crisis estimated at a funding gap of around four trillion US dollars per year, particularly in developing countries.

The report warns that if current trends continue at their present pace, roughly 590 million people will remain trapped in extreme poverty by 2030. It also projects that one in five children under the age of five will continue to suffer from stunting caused by chronic undernutrition. The report also warns that fossil fuel production will exceed the level consistent with maintaining global warming below 1.5°C by 110%. Furthermore, two billion people are expected to lack access to safely managed drinking water, three billion to lack access to safely managed sanitation services, and one billion four hundred million to lack basic hygiene services.

Nevertheless, the report contains some encouraging indicators, showing that progress is possible when political will and resources are mobilised. Notably, Central and Southern Asia succeeded in reducing the proportion of working poor by 46% between 2015 and 2023. The report also notes that 134 countries met targets for reducing under-five child mortality. For the first time, the commitment to providing developing countries with annual climate financing of 100 billion US dollars was fulfilled in 2022[20].

The 2025 report, issued to mark ten years since the adoption of the 2030 Agenda, confirmed that the development goals had made a meaningful difference to the lives of millions of people. However, the current rate of progress is insufficient to meet the targets set out in the Agenda. Of the targets for which data is available, only 35% are either on track or making moderate progress. Nearly half of the targets are advancing very slowly or only in a marginal way, while 18% have fallen below their reference level[21].

The report documented genuine gains achieved over the past decade, including enrolling more than 100 million additional children and young people in education, reducing maternal and child mortality rates, achieving a 70% global increase in internet use, decreasing new HIV infections by nearly 40% since 2010, and providing 92% of the world’s population with access to electricity.

However, according to the report itself, these gains are fragile and uneven across population groups and regions. In 2025, more than 800 million people were living in extreme poverty — about one in ten people globally. It is also likely that, by the end of the decade, more than three-quarters of these people will live in sub-Saharan Africa or fragile, conflict-affected countries. Furthermore, only one in five countries is on track to halve its national poverty rate by 2030. One in eleven people worldwide suffers from hunger. 1.12 billion people live in slums or informal settlements. The number of forcibly displaced persons reached 120 million, i.e. more than double its level in 2015. Meanwhile, official development assistance fell by 7.1% in 2024 after five consecutive years of growth, with further declines expected in 2025.

Taken together, these indicators show that even after eleven years since the adoption of the 2030 Agenda, the gap between the ambitious normative framework of the concept of sustainable development and the reality of its implementation has not been closed. Moreover, overlapping climate, geopolitical and financial crises have made progress even more challenging. This helps to explain why the concept continues to be the subject of renewed

scientific and political debate rather than being treated as a resolved matter or a mere technical implementation issue.

Conclusion:

It is evident from the foregoing that the concept of sustainable development has not remained confined to the initial formulation presented in the Brundtland Report in 1987. Instead, it has undergone a long trajectory of epistemic reconfiguration, the roots of which extend even further back than the coining of the term itself. This trajectory began with a sharp political debate between industrialised Northern countries, preoccupied with pollution and environmental depletion, and developing Southern countries, which viewed poverty as the most serious environmental threat. Attempts to move beyond this debate were made through the Founex Report (1971) and the concept of 'development ecology' proposed by Ignacy Sachs (1974), before culminating in Brundtland's comprehensive formulation which sought to reconcile the needs of the present with the rights of future generations.

The concept then entered a phase of institutional embodiment through the Rio Summit, the Agenda for the Twenty-First Century, the Johannesburg Implementation Summit, and the transition from the Millennium Development Goals to the 2030 Agenda with its seventeen Sustainable Development Goals. Finally, the concept advanced to a more rigorous and measurable scientific stage. This is reflected in the hierarchical reordering of these goals through the 'wedding cake' model, strict quantitative thresholds for the performance of the Earth system set by the frameworks of 'safe and just Earth system boundaries', metrics of distributional justice represented by the 'Doughnut Economy', and ultimately a fundamental re-examination of the assumption of continuous economic growth itself through post-growth scholarship.

Despite its widespread use in public discourse, this long and multifaceted developmental pathway gives the concept a genuine capacity for scientific renewal rather than a superficial form of it. At each stage, the guiding questions, analytical tools and foundational theoretical assumptions that underpin the concept are reshaped as new knowledge regarding planetary limits and the requirements of social justice among individuals, generations and nations accumulates. Recent UN reports for 2024 and 2025, which highlight the ongoing and widening gap between the normative ambition of the 2030 Agenda and the reality of implementation after a decade of international effort, do not constitute evidence of the concept's failure or the exhaustion of its usefulness. Instead, they suggest that the real challenge is no longer to formulate a comprehensive theoretical definition of sustainable development, but to bridge the persistent gap between this ambitious normative framework and the political and financial commitment needed for implementation. In recent years, this gap has been further complicated by the convergence of overlapping climate, geopolitical and financial crises.

One of the most significant lessons to be drawn from this multi-decade trajectory, spanning more than half a century, is that sustainable development is not a fixed endpoint that can be reached once a particular indicator or target has been met. Rather, as reflected in the most recent scientific and UN interpretations of this concept, sustainable development is an ongoing journey of innovation, adaptation and commitment to human dignity and planetary boundaries.

This requires researchers, particularly in regional contexts, to continually revisit the concept's tools and theoretical foundations, linking them to local specifics instead of merely importing a ready-made definition or repeating the concept as a slogan. In this way, sustainable development becomes a living, evolving analytical framework, rather than a fleeting label in general development discourse.

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