A New Economics to Achieve Sustainable Development Goals

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Summary

“The Anthropocene” has been proposed as the new geological epoch in which we now live. We have left behind the Holocene, an epoch of stable climate conditions that permitted the development of human civilization. To address the challenges of this new epoch, humanity needs to take an active role as stewards of the integrated Earth System, collaborating across scales and levels with a shared vision and values toward maintaining the planet within a safe and just operating space.

In September 2015, the United Nations adopted the 2030 Agenda for Sustainable Development, which has at its core 17 Sustainable Development Goals (SDGs). These goals built on and superseded the Millennium Development Goals (MDGs). Unlike the MDGs, they apply to all countries and represent universal goals and targets that articulate the need and opportunity for the global community to build a sustainable and desirable future in an increasingly interconnected world.

The global health crisis caused by COVID-19 has been a strong hit to a vulnerable development system, exacerbating many of the challenges that humanity faces in the Anthropocene. The pandemic has touched all segments of the global populations and all sectors of the economy, with the world’s poorest and most vulnerable people the most affected.

Understanding the interdependence between SDGs is a key area of research and policy, which will require novel approaches to assess and implement systemic global strategies to achieve the 2030 Agenda. Global society requires a new vision of the economy, one in which the economy is recognized to be a subsystem of the broader Earth System (a single complex system with reasonably well-defined states and transitions between them), instead of viewing nature as just another source of resources and sink for wastes. This approach will require acknowledging the value of nature, which, although it has been widely recognized in the scientific literature, has been often ignored by decision-makers. Therefore, there is a need to replace the static, linear model of gross domestic product (GDP) with more dynamic, integrated, natural, and human system models that incorporate the dynamics of stocks, flows, trade-offs, and synergies among the full range of variables that affect the SDGs and human and ecosystem well-being.

The SDGs will only be achieved if humanity chooses a development path focused on thriving in a broad and integrated way, rather than growing material consumption at all costs. Achieving the SDGs is a future where society reconnects with the rest of nature and develops within its planetary boundaries. The new economics and the visions and strategies are aimed at achieving these shared global goals.

Keywords: sustainable development, sustainable development goals, ecological economics, human well-being, natural capital, ecosystem services

Subjects: Environmental Economics

The Challenges of a New Era

The development of our civilization has meant a significant improvement in many aspects of the quality of human life (although not evenly distributed across and within countries). This progress has also meant a global environmental impact so large that some scholars compare our capacity to change the planet's biosphere to the geological forces that have marked the change of epochs (Steffen et al., 2011). "The Anthropocene" has been proposed as the new epoch in which we now live. We are driving our planet from a stable state to a new regime, we are "pushing the Earth into planetary terra incognita" (Steffen et al., 2007, p. 614).

When the Anthropocene started is still debated (Zalasiewicz et al., 2015). For example, even near the onset of the Holocene, about 10,000 years ago, the development of agriculture in different parts of the world led to a more sedentary life, which was the origin of villages and then cities (Steffen et al., 2011). Early agricultural development could have affected the Earth System functioning so deeply that it could have prevented the start of the next ice age, which in turn could have happened through the large emissions of carbon dioxide and methane that were the products of large scale deforestation (Steffen et al., 2007).

The rate of land-clearing for agriculture at the beginning of human civilization affected large areas of land, but it was restricted by the availability of energy during a time when human and animal power were the only powers available. This changed dramatically with the Industrial Revolution around 1800 AD, a period in history that has also been proposed as the origin of the Anthropocene. The use of fossil fuels made it possible to significantly increase the rate of land-clearing (Steffen et al., 2011). The increase of food production that this allowed produced an enhancement of human health, life expectancy, and population growth. In the period from 1800 to 2000, population grew more than 6-fold, the global economy around 50-fold, and energy use about 40-fold (McNeill, 2001). At the beginning of the Industrial Revolution, approximately 10% of the global land surface had been "domesticated." By 1950, this had increased to 25%–30% (Steffen et al., 2007).

The Industrial Revolution could be considered the first stage of the Anthropocene. The second stage started around the 1950s, a period termed "the Great Acceleration" (Steffen et al., 2007), defined by a very rapid increase in population and economic activity. That pattern of economic growth and development translated into global human domination of the planet, where 30%–50% of the Earth's surface is exploited by humans, especially for agriculture and urbanization (Crutzen, 2002). This rapid expansion is causing destabilization of our climate and biosphere. According to the latest assessment of the Intergovernmental Panel on Climate

Change (IPCC), each of the last three decades has been successively warmer than any preceding decade since the 1850s, with a trend that today represents a warming of approximately 0.85°C during the period 1880–2012 (Intergovernmental Panel on Climate Change, 2014).

The impact of the Great Acceleration on biodiversity is equally staggering. The trends from the Anthropocene are having an unprecedented impact on biodiversity, with estimates of extinction rates at 100–1,000 times greater than the background level. This rate is projected to increase by a further 10-fold this century (Zalasiewicz et al., 2010). Furthermore, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) reported in 2019 that direct drivers of biodiversity loss, such as changes in land and sea use, direct exploitation of organisms, climate change, pollution, and invasion of alien species, were driving one million species to the brink of extinction (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 2019). Moreover, these drivers are the consequence of indirect drivers, reinforced by societal behaviors that include production and consumption patterns, human population dynamics and trends, trade, technological innovations, and local and global governance (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 2019).

The biodiversity crisis, interconnected with the climate crisis, is putting at risk the functioning of our planetary system that supports human well-being. Global food security is one of the clearest examples of this socioecological link (Worldwide Fund for Nature, 2020). Food systems depend on biodiversity and the range of ecosystem services it provides to agricultural productivity, such as soil fertility, pollination, pest control, water provision, and protection against extreme weather events (Secretariat of the Convention on Biological Diversity, 2020). Furthermore, about a third of global ecosystem services are already degraded (Millennium Ecosystem Assessment, 2005), posing a threat to all sectors of society.

The level of impact on our planet is unequally distributed, as is its consequences. This relationship can be better understood by combining two well-known indices, the Human Development Index and the Ecological Footprint. This shows that countries with higher human development have a higher ecological footprint due to their higher levels of consumption. On the other side, people from countries with a lower Human Development Index and Ecological Footprint are the ones more vulnerable to the threats posed by the loss of biodiversity and climate change. Therefore, the challenge for humanity is to find a development pathway that can balance global development within the capacity of the planet to support it.

Sustainable Development: Toward Planetary Stewardship

To address the development challenges posed by the Anthropocene will require a “systems approach.” Meadows (2008, p. 11) defines a system as “an interconnected set of elements that is coherently organized in a way that achieves something.”

This definition can be used to analyze development by linking economic development, social inclusion, and environmental protection (Sachs, 2015). These three elements (i.e., society, economy, and the environment) can at the same time be divided into subelements, such as specific ecosystems in the environment, institutions in the social element, and industrial

sectors in the economy. It can be oversimplistic to consider these dimensions of sustainable development as elements, since each of them could be considered systems on their own, but for the sake of the analysis of development presented here they are useful.

Identifying the elements of a system is fairly easy. Understanding a system becomes complex when the interconnections between elements are analyzed. In the case of global development, the interconnections are the multiple ways in which society, economy, and the environment interact. The problem is that these elements are often studied in insolation due to academic silos and practical constraints.

The third component of a system, its functions or purposes, are even harder to identify since they are not necessarily expressed explicitly. The best way to deduce them is by watching the system for a period of time to see how it behaves (Meadows, 2008). In the case of sustainable development, the purpose in theory should be to create social well-being while maintaining a healthy biosphere. However, by looking at how the current system behaves, it is evident that the economic element has a far greater role in guiding current global and national development decisions. The current purpose is arguably biased toward economic growth.

There is one final consideration regarding systems and development. If interconnections and purposes remain intact, systems generally do not change in a significant way. Conversely, if interconnections and purposes change, the system can be greatly altered (Meadows, 2008), switching from one stable state toward another (Folke et al., 2010). In terms of human development, this means that if the current purpose can be changed, then development can be directed toward a different stable state, in this case toward true sustainable development.

In order to have a “development compass” that ensures society can stay within the capacity of the Earth System to sustain it, Rockström et al. (2009) created the “planetary boundaries” approach. This approach identifies key processes of the Earth System and quantifies for each process the boundary level that should not be transgressed in order to avoid global environmental risks. Nine planetary boundaries were identified for the following Earth System processes: climate change, ocean acidification, stratospheric ozone depletion, atmospheric aerosol loading, biogeochemical flows (interference with P and N cycles), global freshwater use, land-system change, rate of biodiversity loss, and chemical pollution. These boundaries are measured at a global scale for each Earth System process using control variables (table 1).

Table 1. Planetary Boundaries and Their Control Variables

Earth System process	Control variable	Planetary boundary (zone of uncertainty)
Climate change	Atmospheric CO_2 concentration, ppm Energy imbalance at Earth’s surface, W m^{-2}	Atmospheric CO_2 concentration: 350 ppm (350–550 ppm) Energy imbalance: +1 W m^{-2} (+1.0–+1.5 W m^{-2})
Ocean acidification	Carbonate ion concentration, average global surface ocean saturation state with respect to aragonite (Ω_{arag})	Sustain ≥80% of the pre-industrial aragonite saturation state of mean surface ocean, including natural diel and seasonal variability (≥80%–≥70%)

Stratospheric ozone depletion	Stratospheric O_3 concentration, DU	<5% reduction from pre-industrial level of 290 DU (5%–10%)
Atmospheric aerosol loading	Overall particulate concentration in the atmosphere, on a regional basis	To be determined
Biogeochemical flows: interference with P and N cycles	P: inflow of phosphorus to ocean, increase compared with natural background weathering N: amount of N_2 removed from atmosphere for human use, Mt N yr^{-1}	P: < 10× (10× - 100×) N: Limit industrial and agricultural fixation of N_2 to 35. Mt N yr^{-1}, which is ~ 25% of the total amount of N_2 fixed per annum naturally by terrestrial ecosystems (25%–35%)
Global freshwater use	Consumptive blue water use, km^3 yr^{-1}	<4000 km^3 yr^{-1} (4000–6000 km^3. yr^{-1})
Land-system change	Percentage of global land cover converted to cropland	≤15% of global ice-free land surface converted to cropland (15%–20%)
Rate of biodiversity loss	Extinction rate, extinctions per million species per year (E/MSY)	<10 E/MSY (10–100 E/MSY)
Chemical pollution	For example, emissions, concentrations, or effects on ecosystem and Earth System functioning of persistent organic pollutants (POPs), plastics, endocrine disruptors, heavy metals, and nuclear wastes	To be determined

Source: Rockström et al. (2009).

The planetary boundaries approach was updated in 2015 by Steffen et al. (2015), who found that humanity has already transgressed two boundaries: the rate of loss of biosphere and biochemical flows. Furthermore, humanity is close to surpassing the boundaries related to climate change and land-system change, both of which are in a zone of uncertainty where the risk of transgressing them is increasing.

Getting close to any of the boundaries poses a threat to the stability of the Earth System; therefore, sustainable development should mean, broadly speaking, that humanity needs to take the role of stewards of the Earth System (Folke et al., 2011), collaborating across scales and levels with a shared vision and values toward maintaining the planet within a safe operating space—one that can maintain the stable conditions of the Holocene that made possible humanity's development. In a broad sense, the idea of stewardship has always been framed in the concept of economics, since the etymology of economics means "household management" (from Greek οίκος "household" and νέμομαι "manage"). Therefore, considering a system approach and its boundaries, perhaps a more appropriate definition of sustainable development is the one that Griggs et al. (2013) propose based on the widely accepted definition of Brundtland (1987, p. 41): "a development that meets the needs of the present while safeguarding Earth's life-support system, on which the welfare of current and future generations depend."

Following the success of the Rio Earth Summit in 1992, in the following years, the United Nations (UN) maintained a global effort to keep the conversation on sustainable development at the highest political level. In September 2000, member states of the UN adopted the Millennium Declaration at the Millennium Summit, which led to the elaboration of eight Millennium Development Goals (MDGs) with the main goal of reducing extreme poverty by 2015. This was the first time the planet had a set of global goals that would ideally guide the development paths of nations. The MDGs, and mainly the mobilization of resources and actions from all stakeholders that supported them, yielded unprecedented results for sustainable development, such as the proportion of undernourished people in the developing regions falling by almost half since 1990, the number of people living in extreme poverty declining by more than half, terrestrial and marine protected areas in many regions increasing substantially since 1990, and worldwide 2.1 billion people gaining access to improved sanitation, among other successes (United Nations, 2015).

To continue the global efforts to implement sustainable development, in September 2015, the UN adopted the 2030 Agenda for Sustainable Development, which has at its core 17 Sustainable Development Goals (SDGs) that superseded the MDGs:

1. End poverty in all its forms everywhere.
2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
3. Ensure healthy lives and promote well-being for all at all ages.
4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5. Achieve gender equality and empower all women and girls.
6. Ensure availability and sustainable management of water and sanitation for all.
7. Ensure access to affordable, reliable, sustainable, and modern energy for all.
8. Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.
9. Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
10. Reduce inequality within and among countries.
11. Make cities and human settlements inclusive, safe, resilient, and sustainable.
12. Ensure sustainable consumption and production patterns.
13. Take urgent action to combat climate change and its impacts.
14. Conserve and sustainably use the oceans, seas, and marine resources for sustainable development.
15. Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels.
17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.

The UN 2030 Agenda and the SDGs represent an unprecedented step forward to achieve global sustainable development. Unlike the MDGs, they apply to all countries and represent universal goals and targets that articulate the need and opportunity for the global community to build a sustainable and desirable future in an increasingly interconnected world. The SDG framework addresses key systemic barriers to sustainable development such as inequality, unsustainable consumption patterns, weak institutional capacity, and environmental degradation that the MDGs neglected.

The Sustainable Development Report 2020 reveals that even though important progress has been made in different social, economic, and environmental sectors, the world is not on track to achieve the SDGs by 2030. Moreover, the COVID-19 pandemic is further threatening the implementation of many SDGs, and in some cases has even turned back decades of progress (United Nations, 2020). For example, the world was off track to end poverty by 2030, and COVID-19 is causing the first increase in global poverty in decades. Progress in many health areas continued, but the pandemic has interrupted childhood immunization programs in around 70 countries. Progress toward inclusive and equitable quality education was slow, and more than 200 million children will still be out of school in 2030. The pandemic school closures kept 90% of all students out of school, reversing years of progress on education. Three billion people worldwide still lack basic handwashing facilities at home—the most effective method to fight COVID-19. Global commitments to reverse the climate crisis have been insufficient, with 2019 as the second warmest year on record; and more than 31,000 species are threatened with extinction, which represents 27% of more than 116,000 of the assessed species in the International Union for the Conservation of Nature (IUCN) Red List.

The global health crisis caused by COVID-19 has been a strong hit to a vulnerable development system, exacerbating many of the challenges that humanity faces in the Anthropocene. The pandemic has touched all segments of the global population and all sectors of the economy, with the world’s poorest and most vulnerable people the most affected. As with all crises, this could be a hard lesson on how humanity should redefine development, changing priorities and enhancing the strategies that are already working in that direction.

Taking a Closer Look at the SDGs Framework

Looking at the general approach of the SDGs, a first concern is that there is not an “overarching goal” and consequently a clear path on how the SDGs would achieve their ultimate end (Nilsson & Costanza, 2015). From our systems thinking discussion, this translates to creating a system without knowing its purpose. Furthermore, the SDGs are addressed as separate elements (Nilsson & Costanza, 2015), ignoring also the key principle from system thinking that elements under a system interact, and that is exactly what defines the state of the system, which in this case would be a successful or unsuccessful implementation of the goals.

Failing to acknowledge the overarching purpose and interactions of the system poses significant challenges to achieving the 2030 Agenda. Therefore, countries should avoid focusing on targets one by one, instead focusing on enhancing the interconnections and synergies among the goals, as well as minimizing the trade-offs between them (Nilsson et al., 2016).

Lim et al. (2018) argues that the SDGs have four specific problems that should be addressed in order to achieve the desired sustainable development. First, they have a narrow conceptualization of poverty (SDG 1), treating it as equal wherever it occurs, as well as lacking a clear vision on redistribution and restructuring of wealth to address poverty at a global scale. Second, the SDGs mention the United Nations Framework Convention on Climate Change (in SDG 13), the United Nations Convention on the Law of the Sea (in SDG 14), and the Framework Convention on Tobacco Control (in SDG 3), but it does not mention any of the agreements on biodiversity or human rights, creating an imbalance regarding the multilateral agreements that ultimately could affect the implementation of the Goals. Third, the SDGs do not incorporate key actors for their implementation, mainly corporations, which are only mentioned in Target 12.6 but which undoubtedly play a key role in achieving the majority of the goals. Finally, the authors question the feasibility of economic growth (despite being “inclusive” or “sustainable”) proposed by SDG 8 while conserving natural capital (SDGs 13 and 14), an issue that can be catalyzed by the industrialization focus of SDG 9 instead of creating a more diverse set of sustainable activities and livelihoods.

It is worth taking a more in-depth look at economic growth as it is embedded in the SDGs. Target 8.1. reads: “Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7% gross domestic product growth per annum in the least developed countries.” Hickel (2019) argues that GDP per capita between the end of the financial crisis in 2010 and the publication of the 2030 Agenda and the SDGs in 2015 grew an average of 1.85% per year, a rate that if it is sustained as SDG 8 suggests in the 2030 Agenda period, then global GDP would increase 32% by 2030. Furthermore, taking into consideration that the global population is projected to grow to 8.5 billion in 2030 at a mean rate of 1.11% per year, then in order to sustain 1.85% per capita growth, GDP would need to grow at a rate of 2.96% per year. Moreover, SDG 8 also aims for an increase of GDP at a rate of 7% per year in the least developed countries, which would represent an aggregate global growth of 3% per year.

The results from the analysis of Hickel (2019) demonstrate that a global GDP growth of 3% would mean that the global material footprint would grow from 87 billion tons to 167 billion tons by 2030, which is three times what some scholars have defined as a planet boundary for the material footprint (Dittrich et al., 2012). The only option to achieve the rate of economic growth proposed by SDG 8 while reducing material footprint is to achieve absolute decoupling, which would require efficiency improvements that could be as high as six times faster than has ever been achieved in human history. An absolute decoupling of GDP from material footprint is not feasible if the economy continues growing at the rate that SDG suggests (Ward et al., 2016). Hickel also assessed the compatibility of SDG 8 in light of SDG 15, and he found that in order to decarbonize the global economy to avoid warming the planet in 2°C in comparison to pre-industrial times, the global carbon footprint would need to be

reduced by 4%, which would require decoupling at a rate of 7% per year to achieve an economic growth of 3%, which is six times faster than historical rates and therefore very unlikely.

Although SDG 8 could be seen as the basis to achieve other SDGs, such as the ones related to poverty (SDG 1), hunger (SDG 2), health (SDG 3), and education (SDG 4), sustained growth globally as described before would been transgressing some planetary boundaries that could put the Earth System on a path toward an undesirable state, which could be temporal or permanent, or at least a state that would make social progress much more difficult to achieve. Economic growth should be seen as a means to an end, but not the end goal or purpose itself. Furthermore, it is necessary to differentiate where more growth is needed from where it is not. For example, Bali Swain and Yang-Wallentin (2020) state that developed countries should focus on the environmental and social factors that would lead to a sustainable development, such as SDG 1, SDG 2, SDG 3, SDG 10, SDG 13, and SDG 14. On the other hand, the authors suggest that for developing countries the economic factor is the most significant for achieving sustainable development, since in many of these countries satisfying inhabitants' basic needs is still a challenge; therefore, SDGs 1–6 as well as SDG 8 can be considered priorities.

Focusing on certain SDGs of course does not mean that the rest of the goals should be neglected, since many or all of the priority goals depend on the rest. For example, in developed countries, to address increasing energy consumption (SDG 12) at the same time that climate change is mitigated (SDG 13), the level of innovation and implementation of renewable energy will need to be accelerated significantly (SDG 7), which in turn depends on high-quality education in science and technology (SDG 4). In the case of developing countries, the elements of the socioecological systems are perhaps easier to visualize since people depend in a very direct way on natural resources, which in turn are negatively affected due to the unsustainable management caused by social factors. For example, fisheries in some of these countries are being degraded due to the use of destructive fishing gear (SDG 14), which leads over time to reduced yields and consequently less income for fishermen (SDG 1 and 2), a poverty trap that could be avoided with higher financial support to this sector (SDG 8) (Cinner, 2009).

Therefore, understanding the interdependence between SDGs is a key area of research and policy, which will require novel approaches to assess and implement systemic global strategies to achieve the 2030 Agenda.

SDGs Through an Ecological Economics Lens

Taking into consideration the brief analysis provided, it is evident that in order to address the multiple and complex challenges to sustainable development, global society requires a new vision of the economy, one in which the economy is viewed as a subsystem of the broader Earth System (a single complex system with reasonably well-defined states and transitions between them), instead of viewing nature as just another source of resources and sink for wastes. This approach will require recognizing the value of nature, which has been ignored, because for many decades, the ecological footprint of humans was low and natural resources were abundant. Therefore, it was difficult to think that society could significantly impact the environment in the ways it has. The field of ecological economics addresses this research and

policy gap. It is a transdisciplinary field of study that examines the relationships between ecological and economic systems (Costanza & Daly, 1992), with the goal to represent a new approach to both interconnected systems. It recognizes the need to make economics more aware of ecological dependencies and impacts, and to make ecology more sensitive to economic forces (Costanza, 1989).

Ecological economics is not intended to be an alternative to existing disciplines; it is instead a new lens through which to view and evaluate sustainability challenges. It views conventional economics as one of many inputs to a broader transdisciplinary framework with the following interdependent goals: (a) present a shared vision of how the world works and the sustainable development we aspire to achieve, (b) provide a relevant methodology to assess the new questions and challenges of this shared vision, and (c) design the institutions and instruments needed to implement this vision (Costanza et al., 1991). Costanza and colleagues argue that neoclassical economics is focused mainly on allocation. Distribution is secondarily addressed and scale is left out completely. In contrast, ecological economics address the problems in the opposite order. First, it determines the ecological limits of sustainable scale and creates the policies to assure that the throughput of the economy stays within these limits. Then, it establishes a fair and just distribution of resources through property rights and transfer mechanisms. Finally, mechanisms (including the market) allocate the resources efficiently (Costanza et al., 1991). The reason for addressing scale in the first place is of major importance, from a conceptual point of view, redefining the foundations of society's current development which supposes that economy can grow indefinitely.

In order to recognize the relation between the ecology and economics systems, the concepts of natural capital and ecosystem services emerged more than two decades ago (Ehrlich & Mooney, 1983; Gómez-Baggethun & de Groot, 2010; Westman, 1977). First, it is important to have a clear understanding of the concept of capitals and the types of capitals on which, in a broad way, development is based. Capital can be defined as a "stock of materials or information that exists at a point in time" (Costanza et al., 1997), or moreover as "a stock of something that yields a flow of useful goods or services" (Costanza, Cumberland et al., 2014, p. 119).

Classical economics identifies three economic factors of production: land, labor, and human-made capital. Neoclassical economics tends to focus primarily on labor and human-made capital in its production functions, omitting land, as it was stated before. Corresponding to these three traditional economic factors of production, three types of capital can be defined: natural, human, and manufactured or built capital (Costanza & Daly, 1992, p. 38; Prugh, 1995, p. 53). Moreover, Ekins et al. (2003) proposes a disaggregation of the capital stock, adding a fourth type of capital, social capital. Costanza, de Groot, et al. (2014) states that these four types of capital are necessary to support the economy and its goal of providing human well-being, describing each one of them as follows:

- **Natural capital:** The natural environment and its biodiversity, it is the planet's stock of natural resources, the ecosystems that provide benefits to people (i.e., ecosystem services). It is important to note that natural capital degradation has occurred because it has not been widely recognized by decision-makers as stated before, and also because neoclassical economists tend to consider only nonrenewable natural capital (e.g., oil and coal) in policy design and business strategies.

- **Social capital**: The web of interpersonal connections, social networks, cultural heritage, traditional knowledge, and trust and the institutional arrangements, rules, norms, and values that facilitate human interactions and cooperation between people.
- **Human capital**: Human beings and their attributes, including physical and mental health, knowledge, and other capacities that enable people to be productive members of society.
- **Built capital**: Buildings, machinery, transportation infrastructure, and all other human artifacts and services (Costanza, Cumberland, et al., 2014, pp. 129–130).

Following the definition of capital cited before, natural capital can be defined as "a stock of natural resources (i.e., ecosystems) that yield a flow of goods and services (i.e., ecosystem services)," as in the case of a mangrove forest that provides food and water filtration to communities. Costanza and Daly (1992) explain the flow of goods and services as the "natural income" and the stock that yields the flow as the "natural capital." Sustainability is therefore focused on the wise use of income; depleting the stocks is called capital consumption (Prugh, 1995, p. 51) and is the reason for ecosystems' loss and degradation.

Berkes and Folke (1992) state that natural capital and built capital are fundamentally complementary; it is not possible to create built capital without support from natural capital. Moreover, to provide sustainable human well-being (which in a broad sense is the overarching goal of the 2030 Agenda), all four capitals need to interact (Costanza, de Groot, et al., 2014). In this sense, to understand the integration between the SDGs approach and the capital approach, each SDG can be assigned to each type of capital as follows. Natural capital, which is the system that contains the rest of subsystems, is related to SDGs 6, 13, 14, and 15; social capital with SDGs 4, 8, 16, and 17; built capital with SDGs 7, 9, 11, and 12; and human capital with SDGs 1, 2, 3, 5, and 10 (fig. 1).

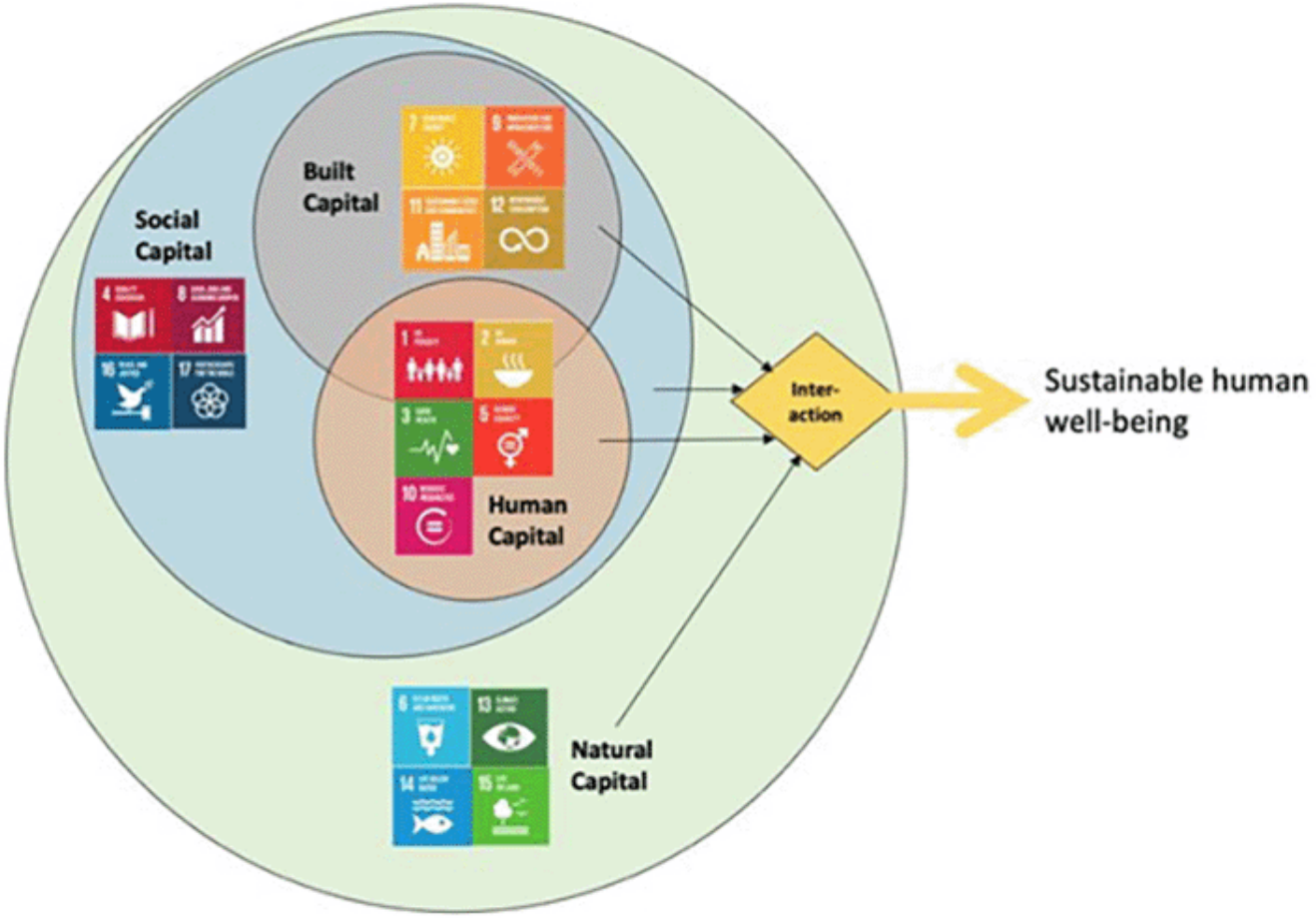

Figure 1. Interaction of the four type of capitals (and SDGs) to produce sustainable human well-being.

Source: Costanza, de Groot, et al., 2014)

It is key to understand the relation between sustainability and the maintenance of capital stocks from a systems perspective. Ekins et al. (2003) explain that if sustainability depends on the maintenance of the capital stock, then there are two possibilities: (a) maintaining the total stock of capital, allowing substitutions between its components; or (b) whether certain components of capital, mainly natural capital, are non-substitutable. Ekins and colleagues continue elaborating on these two possibilities by framing them under two types of sustainability: (a) weak sustainability, which considers that natural capital can be replaced completely by built capital under the perception that welfare is not dependent on a specific form of capital; and (b) strong sustainability, which considers complete substitution of natural capital by built capital to be impossible since natural capital provides a unique contribution to welfare, and ultimately is the input for built capital and the basis of critical life support systems (Franceschi & Kahn, 2003; Stern et al., 1996).

Therefore, assessing the role of natural capital as the basis of development becomes more relevant than ever, especially considering the scope of Agenda 2030 and its SDGs and the fact that the world has been evolving faster than ever in both positive and negative ways. In a pre-industrialized planet, society developed in what some scholars call an empty world, empty of humans and their artifacts (i.e., built capital), and full of natural resources (i.e., natural capital). In the Anthropocene, society is full of humans and their artifacts, with an

increasingly reduced natural environment. In the former world, the limiting factor was built capital; although natural capital and social capital were abundant, in today's world the case is quite the contrary.

Recognizing natural capital as the main limiting factor for sustainable development, and therefore the urgency of its conservation, restoration, and sustainable use, requires a different vision of the interaction between the economic and ecological systems. A social-ecological systems approach considers people, society, and the economy as parts embedded in the biosphere (Folke et al., 2016), in a co-evolving relationship where people depend on the benefits (i.e., ecosystem services) that the biosphere (i.e., natural capital) provides to people, as well as the ways in which people impact nature negatively or positively (Fenech et al., 2003, p. 5). This is an interconnection that is one of the pillars of the conceptual analysis presented earlier on the interaction between the types of capitals.

The concept of ecosystem services becomes essential to better understand socioecological systems as well as to provide policy solutions for sustainable development. Ecosystems services are defined as "the benefits that people obtain from ecosystems" (Millenium Ecosystem Assessment, 2005), which has been the definition used throughout this article. Nevertheless, a more complete definition of ecosystem services under a systems approach is "the benefits people derive from functioning ecosystems, the ecological characteristics, functions, or processes that directly or indirectly contribute to human well-being" (Costanza et al., 2011, p. 1). Although these definitions of ecosystem services are very straightforward, they have been the subject of debate for two decades, and therefore some clarification is needed. First, it is important to distinguish between ecosystem processes and functions on the one hand and ecosystem services on the other. Ecosystem processes and functions refer to biophysical relationships that exist regardless of whether or not humans benefit from them. The opposite is the case with ecosystem services, which only exist if they contribute to human well-being (Braat, 2013).

This human-dependent definition of ecosystem services has led some scholars to argue (Gagnon Thompson & Barton, 1994; McCauley, 2006) that the concept represents an anthropocentric, utilitarian, or instrumental view of nature, that nature only exists to service humans. This is a misconception. The goal of the concept of ecosystem services is not to be anthropocentric; it is to recognize the interdependence of humans on the rest of nature for their well-being and their survival and to visualize *Homo sapiens* as an integral part of the current biosphere. Moreover, instead of implying that humans are the most important and only thing that matters, the concept of ecosystem services implies that the whole system matters, both to humans and to the other species with which we are interdependent.

The consideration of the economy as part of the ecosystem, therefore, demands acknowledgement of the limits to growth of the economy since the ecosystem is finite. Costanza and Daly (1992) state that growth is related to throughput increase, which is destructive of natural capital, with the negative consequence of having higher costs in the medium and long term than the benefits gained in the short term. This cost-benefit analysis for natural capital is often ignored by economic interests, undervaluing natural capital, and only recognizing its value when it is lost (Ehrlich et al., 2012, p. 70). Development, on the contrary, means an increase of efficiency and quality improvement, and therefore does not necessarily reduce natural capital.

From the natural capital perspective, development under this framework would mean that natural income must be sustainable, which should be at least the case for renewable natural capital. Since nonrenewable natural capital is reduced with use, income can be constant only if the total natural capital (renewable natural capital plus nonrenewable natural capital) is constant, which implies a certain level of reinvestment of the non-renewable natural capital consumed into the renewable natural capital (Costanza & Daly, 1992, p. 43). This is relevant, especially for low-income countries, since they have a higher dependency on natural capital both for growth and development (Pearce, 1988). Unfortunately, natural income has been used in an unsustainable way, threatening the achievement of sustainable development, and more specifically the 2030 Agenda. For example, the global assessment report on biodiversity and ecosystem services from IPBES found that current impact on natural capital will undermine progress toward 80% of the assessed targets of goals related to poverty, hunger, health, water, cities, climate, oceans, and land (SDGs 1, 2, 3, 6, 11, 13, 14, and 15). Furthermore, the report found positive synergies between nature and the goals related to education, gender equality, reducing inequalities, and promoting peace and justice (SDGs 4, 5, 10, and 16) (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 2019).

Recent Economic Approaches That Contribute to the 2030 Agenda

This vision of an integrated system of capitals that provides sustainable human well-being is currently being implemented in many parts of the world through several schemes that are having a positive impact in addressing the 2030 Agenda and its SDGs. For example, the green economy approach has been gaining momentum, especially since the Rio+20 Summit. The United Nations Environment Programme (UNEP) defined green economy as “one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities.” This means an economy with a low-carbon emissions, efficient in resource use, and socially inclusive, as well as one that maintains, enhances, and restores natural capital as a critical economic asset and a source of public benefits, especially for poor people who depend on it in a more direct way for their livelihoods and security (United Nations Environment Programme, 2011, p. 9).

Green economy is mostly associated with terrestrial socioecological systems. From the coastal-marine perspective, a sister concept has also emerged, the blue economy, defined as “an economy that is in balance with the long-term capacity of ocean ecosystems to support this activity and remain resilient and healthy” (Economist Intelligence Unit, 2015, p. 7). Both green and blue economies aim to provide a substitute framework to our current “brown economy,” which disregards the limits of the Earth System to provide the resources on which development is based, as well as ignoring social imperatives under the assumption that economic growth will fix them. The bottom line, which is the main argument of the previous section, is that society needs a new lens or compass that can give direction to sustainable development.

The Safe and Just Space for Humanity

One of those compasses to help guide sustainable development is “doughnut economics.” This model provides two sets of indicators that address environmental and socioeconomic pillars and challenges. It combines the planetary boundaries “ceiling” with the economic and social “floor” to define a safe and just space for humanity (Raworth, 2012).

The first set of indicators are the planetary boundaries ceiling. In the context of the 2030 Agenda, these boundaries are related to the “more environmental” SDGs, such as SDG 13 (planetary boundary for climate change), SDG 15 (planetary boundaries on land-system change and biosphere integrity), SDG 6 (planetary boundary on freshwater use), SDG 14 (planetary boundary on ocean acidification), and SDG 12 (planetary boundaries on stratospheric ozone depletion, atmospheric aerosol loading, and biochemical flows and novel entities). The planetary boundaries approach is the ecological ceiling that humanity should not transgress in order to protect Earth’s life-supporting systems.

The second set of indicators relates to the social and economic aspects of development that provide the floor. They employ the social priorities defined for Rio+20 in the national and regional submissions by governments, revealing 11 social priorities grouped in three clusters focused on enabling people to be (a) well (through food security, adequate income, improved water and sanitation, and healthcare); (b) productive (through education, decent work, modern energy services, and resilience to shocks); and (c) empowered (through gender equality, social equity, and having political voice) (Raworth, 2012). These social priorities are directly related to the SDGs, as shown in table 2.

Table 2. Social Foundations of the Doughnut Economics and Its Relationship with the SDGs

Social foundation	Extent of global deprivation (illustrative indicators)	Main SDG related to each social foundation
Food security	Population undernourished	1, 2, 3
Income	Population living below $1.25 (PPP) per day	1, 8, 10
Water and sanitation	Population without access to an improved drinking water source Population without access to improved Sanitation	6
Healthcare	Population estimated to be without regular access to essential medicines	3
Education	Children not enrolled in primary school Illiteracy among 15–24-year-olds	4
Energy	Population lacking access to electricity Population lacking access to clean cooking	7

	Facilities	
Gender equality	Employment gap between women and men in waged work (excluding agriculture) Representation gap between women and men in national parliaments	5
Social equity	Population living on less than the median income in countries with a Gini coefficient exceeding 0.35	10
Voice	Population living in countries perceived (in surveys) not to permit political participation or freedom of expression	16
Jobs	Labor force not employed in decent work	8
Resilience	Population facing multiple dimensions of poverty	1, 9, 11

Source: Raworth (2012).

The model can be represented by two concentric rings, with social foundations as the inner circle and the planetary boundaries as the outer one or ceiling; the area between them is a doughnut-shaped area that is both ecologically safe and socially just (Doughnut Economics Action Lab, 2020), an area that defines sustainable well-being.

The Doughnut Economics Action Lab (DEAL) created the Doughnut Principles of Practices to help decision-makers and other stakeholders to implement the overarching goal of the model. These principles are:

- Embrace the 21st-century goal, by aiming to meet the needs of all people within planetary boundaries.
- See the big picture, by recognizing the role of the different sectors and stakeholders, as well as their synergies, in transforming the current traditional economic model.
- Nurture human nature, by promoting an active participation and collaboration among a diverse group of people.
- Think in systems, by experimenting, learning, adapting, and evolving for continued improvement, making sure that feedback loops and tipping points are considered.
- Be distributive, by working under an open design logic where power is distributed among stakeholders.
- Be regenerative, by working with and within the cycles of nature.

- Aim to thrive rather than to grow, by eliminating the obsession of the current economic model on growth and instead aiming for true development and to thrive as a society instead.

This last principle has been one of the core messages of this article. The next section addresses this issue in detail, challenging the idea of infinite economic growth as well as providing options to measure real human progress and well-being.

Beyond GDP and the Way Forward

One of the main critiques of the SDGs framework is that the goals are treated as separate elements in isolation from each other and from any overarching goal (i.e., purpose of the system) to which they might contribute. Still, the SDGs along with their targets and indicators provide a detailed dashboard for the transition to sustainable development. Some would argue that a dashboard approach is sufficient and the only feasible option. Nevertheless, dashboards and aggregate indicators are not mutually exclusive—in fact, they are both essential. For example, having a well-instrumented dashboard in a car is essential, but so is knowing where the driver is going and whether they are making progress toward their destination. Therefore, society first must decide the direction of development—the overarching goal—in order to measure progress toward it, while also keeping track of the operation of the vehicle needed to get there.

There is broad emerging agreement about this overarching goal. There are many ways of expressing this goal, but the essence is “a prosperous, high quality of life that is equitably shared and sustainable” (Costanza et al., 2016, p. 353). There are three elements to this goal that cover the usual three components of sustainable development: economy (a high quality of life or well-being), society (equitably shared), and the environment (sustainable, staying within planetary boundaries). This overarching goal can be summarized as “sustainable well-being,” which has been mentioned before in this article (e.g., interaction between capitals). Therefore, the SDGs can be considered “subgoals” contributing in different ways, in different times, and different places to this overarching goal.

To achieve the overarching goal and the SDGs, policymakers, scientists, and practitioners will have to clarify how the goals and targets interconnect, including trade-offs and synergies, and develop three additional elements: (a) an aggregation of metrics of human and ecosystem well-being, (b) dynamic models of the integrated system of humans and the natural world, and (c) innovative ways to build broad public consensus on the desired future—the details of a world in which the SDGs have been implemented. Regarding the first element, an aggregate metrics of human and ecosystem well-being is needed to replace growth in gross domestic product (GDP) as the primary development goal for nations. Again, it could be argued that aggregating targets for the individual SDGs is not necessary (or possible) and that the pursuit of the individual goals is sufficient to achieve sustainable development. This might be true if the goals were independent of each other and they all contributed to the overarching objective equally. In reality, however, there are multiple interconnections and clear trade-offs and synergies across and within the goals, especially in how the environmental, social, and economic goals and targets interact. For example, the single-minded focus on GDP growth that has prevailed since the middle of the 20th century has exacerbated inequality and environmental damage in many countries.

Regarding the second element, the new metrics should therefore incorporate insights from ecology and psychology to describe how natural, social, human, and built capital assets interact to contribute to sustainable well-being, based on the idea that the best system is one that achieves the overarching goal of a world that is simultaneously prosperous, equitably shared, and ecologically sustainable. There is compelling new research relating ecosystem services and natural and social capital to human well-being, which can be integrated with new indicators such as the Genuine Progress Indicator (GPI) (Kubiszewski et al., 2013) to produce an expanded version that connects more directly with the SDGs. Nevertheless, this will not be enough on its own.

GDP has been successful in part because it is linked to the overall System of National Accounts (SNA), which is based on a static, linear, input–output model of the market economy. Although this approach was the best available when the SNA and GDP were developed in the 1930s and 1940s, academics in the 21st century understand much more about how complex, dynamic systems involving interacting human and natural systems function. Accordingly, there is a need to replace the static, linear model with more dynamic, integrated, natural, and human system models that incorporate the dynamics of stocks, flows, trade-offs, and synergies among the full range of variables that affect the SDGs and human and ecosystem well-being.

Finally, humanity needs to explore and develop innovative methods to build broad consensus around the characteristics of desirable futures—the kind of world that would result if all the SDGs were achieved. This can be accomplished through the integration of scenario- planning exercises, extended to include public opinion surveys, with the metrics and modeling mentioned here. Scenario planning has been used successfully in a range of contexts. For example, Hernández-Blanco et al. (2020) estimated the value of ecosystem services by 2050 in Latin America and the Caribbean under four development scenarios, showing that the provision and value of ecosystem services can change radically between scenarios. Furthermore, the authors found that following a developing path like the one that the 2030 Agenda envisions, the value of ecosystem services in the region could increase by $19 trillion/year in comparison with the value in 2011.

The SDGs will only be achieved if humanity chooses a development path focused on thriving rather than growing, a future where society reconnects with nature and develops within its limit, recognizing at the same time that natural capital must be maintained and restored under a true sustainable development path. This will require us to put into place the visions and strategies described in this article, all aimed to achieve our shared global goal.

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