Chapter

Biodiversity Conservation, Economic Growth and Sustainable Development

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Abstract

A growing economy has long been regarded as important for social and economic progress. And indeed, much of what we value in society is the product of economic growth. It is becoming increasingly clear, however, that growth cannot continue forever and that there is a price to pay for our failure to chart a more sustainable path. This chapter examines the conflict between our global obsession with growth and the conservation of biological diversity. The chapter begins with a discussion of what growth means and why it is the focus of global economic policy. We then review the connection between economic growth, sustainable development and the conservation of biological diversity and examine issues surrounding the quest for sustainable development, including how growth is measured and why there is a need to develop alternatives measures of growth and alternatives to a focus on perpetual growth. The chapter concludes with a discussion of the role that economic incentives can play in helping to catalyze necessary change and the importance of a commitment to cost-effectiveness in the choice of policies to promote conservation action.

Keywords: Biological diversity, economic development, Sustainability, GDP, Genuine Progress Indicator, conservation agreements, carbon taxes

1. Introduction

Since its introduction during World War II most countries have come to view gross domestic product, or GDP, as their main measure of economic progress. Growth in GDP is widely seen as essential for advancing human welfare, even as the implications of this growth ever more clearly present us with existential threats, including a rapidly changing climate and dire impacts on biodiversity. With record growth have come record droughts and heatwaves. The last seven years, in fact, have been the warmest since records began in 1880 and last year, 2020, tied 2016 as the warmest year ever [1]. Wildfires across the planet are growing larger and more frequent and ever more evidence accumulates that ecosystems around the globe are collapsing [2–10].

Each day's news it seems underscores the fact that there is a price to pay for our global obsession with growth and limits to what the biosphere can provide to an ever-larger global economy. As a result, the pressure for growth is increasingly

being met with calls for greater sustainability. How these two things can be reconciled may be the most urgent and important challenge of our time.

This chapter will summarize the debate over the limits to economic growth beginning with a discussion of how growth is defined and why it is the focus of national economic policy. We will then review the connection between economic growth, sustainable development, and the conservation of biodiversity and examine issues surrounding the quest for sustainable development, including alternative measures of growth and alternatives to a focus on perpetual growth. We will end the chapter with a discussion of policies to help move the world onto a safer, saner trajectory focusing on the role that economic incentives can play in catalyzing necessary change and the importance of a commitment to cost-effectiveness in the design of policies to promote conservation action.

2. What growth means

The standard definition of economic growth is a sustained increase in a nation's real (inflation adjusted) gross domestic product (GDP). GDP is the monetary value of all goods and services produced in a country each year. In recent years, real GDP growth in the U.S. has averaged around 2% which means that the economy doubles in size every 36 years [11].

2.1 Why grow?

Proponents of economic growth focus on its many benefits, including higher standards of living and the ability to devote more resources to things like health care and education. Increases in sanitation, nutrition, and longevity have all been possible due to economic growth. Since 1800, life expectancy has grown from less than 30 years to more than 70 with eradication of childhood disease and improvements in medicine and nutrition [12]. Vast changes in material abundance have also been possible due to economic growth allowing many the things that only the wealthy could aspire to in the past.

Though something we now take for granted economic growth is a very recent phenomenon. Widespread economic prosperity (as measured by GDP per capita) has only been achieved in the past couple hundred years and as shown in **Figure 1**, has only really taken off in the past 50 years [13].

The incidence of extreme poverty over this period has fallen dramatically, in rich countries and poor alike [14]. Since 1990 alone the number of people living in extreme poverty has fallen by more than 1 billion [15]. The reasons for this reduction are many but one essential element has been the increase in crop yields achieved due to massive public investments in modern agricultural research. According to IFPRI [16], the case of English wheat is typical. Whereas it took nearly a millennium for yields to go from 0.5 to 2.0 metric tons per hectare it took only 40 years to rise from 2.0 to 6.0 metric tons per hectare. Yield increases such as these for wheat, rice and other crops have led to unprecedented levels of food security for many developing countries, despite large and continuing increases in population [16].

2.2 The downsides to growth

Given its many benefits, it is little wonder that economic growth is a focus of global economic policy. Growth, however, has its costs. Environmental destruction and impacts on biodiversity are perhaps the most obvious, but there are also

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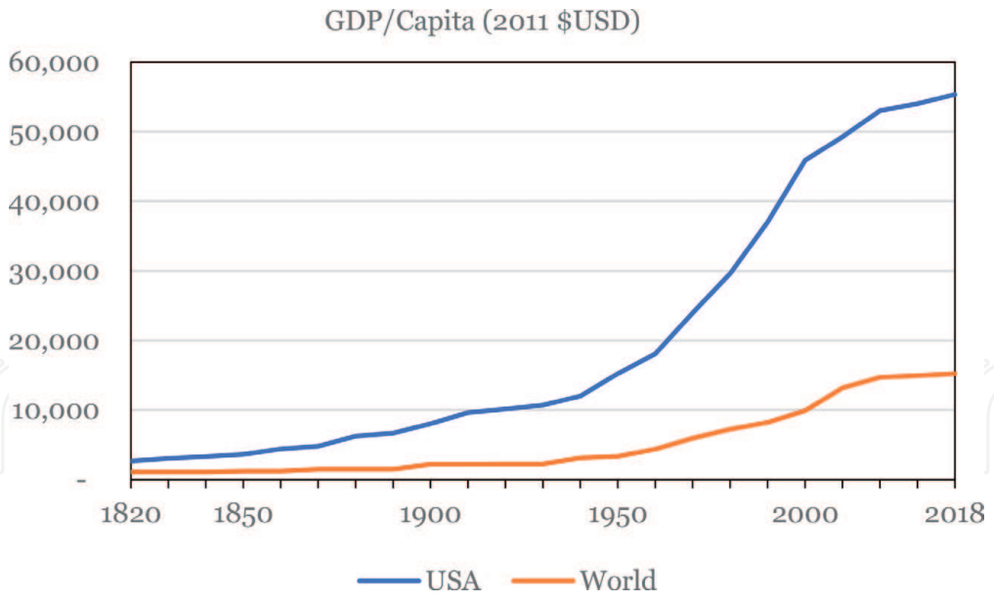

Figure 1.
The history of Economic growth: GDP/capita, 1820–2018 [13].

conflicts between economic growth and national security and international stability, and ultimately, economic sustainability itself.

Growing economies consume natural resources and produce wastes. This results in habitat loss, air and water pollution, climate disruption, and other environmental threats, threats which are becoming more apparent as economic activity encounters more and more limits. The depletion of groundwater and ocean fisheries are examples as are shortages of fresh water, and the global spread of toxic compounds such as mercury, chlorofluorocarbons, and greenhouse gases.

These conflicts are in part the result of the inescapable impact of an ever-growing human population. They are, however, exacerbated by market failures, including externalities and open-access resources, and in the case of biodiversity, the lack of markets altogether.

Externalities are the side-effects of commercial activities that impact third parties and are not reflected in the costs of production, and for this reason are "external" to the decision-making of both producers and consumers. Pollution from a factory is a negative externality. Intertemporal externalities (e.g., from climate change) impose costs on those in the future that are external to current generations. Externalities of all sorts undercut the ability of markets to produce sustainable outcomes.

Resources that are open to all without restriction, such as ocean fisheries, also invite unsustainable outcomes as is evidenced by the currently depleted state of the world's open-access fisheries.

Biodiversity suffers from a third market failure, the fact that it is generally not traded in formal markets. Though the popular conception of overexploitation is of resources plundered by the forces of markets, the absence of a market can be equally problematic. Things with no price end up being treated as if they have no value. Such is the fate of endangered species, tropical rainforests, coral reefs, and indeed much of wild nature.

Environmental impacts, of course, are not unconnected to society at large. Things like climate change and the extinction crisis have economic impacts and these in turn can threaten national security and international stability. Such threats are often made worse by inequality. Not everyone benefits equally from growth and some have arguably not benefitted at all. The problem of growing inequality is certainly an issue in the U.S. where the nation's top 10 percent now average more

income than the bottom 90 percent [17]. But it is also clearly a problem globally. Sub-Saharan Africa is a case in point (see also, **Figure 1**). Although the poverty rate there has fallen in percentage terms since 1990, it has not fallen fast enough to keep pace with population growth [18]. As a result, the number of poor in that region continues to rise and now accounts for nearly two thirds of the world's total population in extreme poverty [18].

Climate change, resource scarcity, and environmental degradation generally are certain to accentuate such inequalities in the future with unavoidable impacts on social unrest, national security, and international stability. The national security implications of these issues were starkly presented in a recent report commissioned by the U.S. Army [19]. According to the study, America could face a grim series of events triggered by climate change involving drought, disease, failure of the country's power grid and a threat to the integrity of the military itself, all within the next two decades. The report also projects that sea level rise in the future is likely to "displace tens (if not hundreds) of millions of people, creating massive, enduring instability" and the potential for costly regional conflicts [19]. The report cites in particular the role that drought has played in sparking the civil war in Syria and the potential for tensions stemming from sea level rise and large-scale human displacement in Bangladesh.

All of the above issues have clear implications for economic sustainability – a healthy environment and international stability, after all, are the foundations for a healthy economy. We need healthy soils for agriculture, healthy oceans for fisheries, clean air and water and a stable political environment for international trade, all of which are threatened by unrestrained growth [20].

3. The quest for sustainable development

Increasing awareness of the limitations of growth has led to much discussion of sustainable development. This concept is most commonly associated with a report published by the World Commission on Environment and Development in 1987. In that report sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [21]. Since the publication of this report, the idea of sustainable development has gained a solid footing in the popular imagination. An important landmark in this regard is the signing of the so-called Rio Declaration at the Earth Summit in 1992 in which 192 nations committed themselves to a detailed agenda for sustainable growth and development [22].

Despite its popularity, the precise meaning of sustainable development is somewhat elusive. From an economic perspective a simple definition might be that growth should proceed so long as the marginal benefits exceed the marginal costs (**Figure 2**). Marginal cost is the cost of a small increase in an activity and marginal benefit is the additional benefit from that increase. **Figure 2** shows the marginal costs and benefits of growth in GDP. Since the benefits tend to decline and the costs to rise with additional GDP growth, the sweet spot is to grow until the marginal costs are exactly equal to the marginal benefits. Any increase in GDP up to this point is "economic growth" whereas growth in GDP past this point, where costs rise above benefits is uneconomic [20].

3.1 The problems with GDP

Such definitions are all well and good, but problems arise in discerning when and where costs begin to exceed benefits. This, in turn, is made more difficult by

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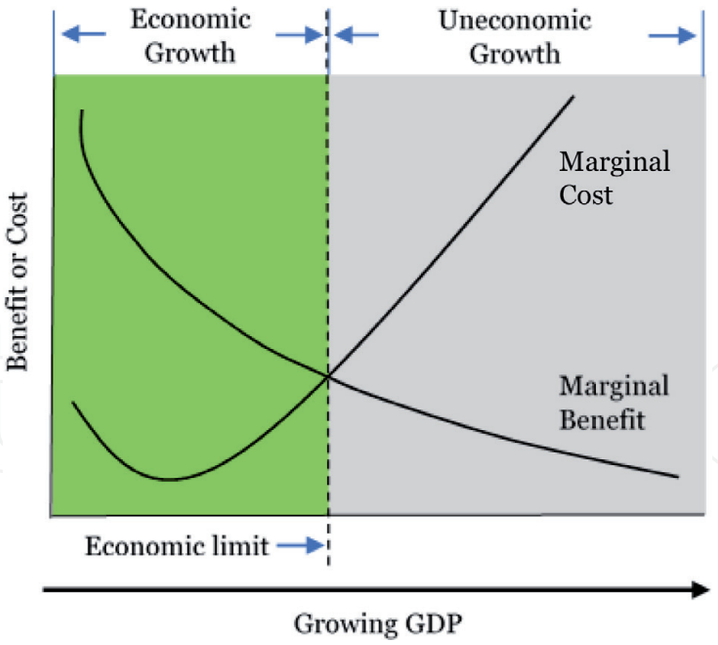

Figure 2.
Economic and uneconomic growth in GDP [20].

the way in which we measure growth. Ironically, GDP, our global standard measure of growth, was never intended as a measure of costs and benefits. Instead, it is simply a gross tally of market output with no distinction made between output that adds to well-being and output that diminishes it. Instead of separating costs from benefits GDP assumes that all monetary transactions by definition add to social welfare [23].

GDP also excludes everything that happens outside formal markets and therefore ignores many things that clearly benefit society such as volunteer work and unpaid work in households like childcare and elder care. Much of the value of environmental services is ignored as well.

As shown in **Box 1**, this method of accounting leads to some very counterintuitive results, including the fact that GDP increases with polluting activities and then again with clean-ups, crime and natural disasters are treated as economic gain, and the depletion of natural capital is treated as income [23].

The shortcomings of GDP are particularly significant with regard to biodiversity. As shown in **Box 2**, biodiversity underpins virtually all economic activity. Yet, it is not explicitly accounted for anywhere in GDP. In many cases, biodiversity is an unvalued input (e.g., crop and livestock genetics) into an output (food) whose value is counted in GDP. And while the connection between the two is clear in a general sense, the impact of added growth on the unvalued input is not. Worse, to the extent that further growth depletes the biodiversity we depend on it is counted as adding to national income. And since the benefits of avoiding the depletion of biodiversity often accrue to others (either in full or in part) there is little incentive for individuals or governments to invest in its conservation.

3.2 Moving beyond GDP

Faced with the obvious limitations of GDP, many countries are now looking for alternative ways of measuring social and economic health, including adjustments to measures like GDP and the development of alternative indicators.

GDP treats crime, divorce, and natural disasters as economic gain.
GDP counts all monetary transactions as positive. So, crime, divorce, and natural disasters, like fires and hurricanes, are all counted as economic progress.

GDP ignores the non-market economy of households and communities.
GDP ignores all activities that take place outside the market economy, including volunteer and home-based work such as childcare and elder care.

GDP treats the depletion of natural capital as income.
GDP treats the depletion of both natural and man-made capital as income rather than depreciation. So the more a country depletes its natural resources the more it adds to GDP.

GDP increases with polluting activities and then again with clean-ups.
GDP counts pollution as a double benefit to society by first including the economic activity that leads to pollution and then the cost of clean-ups.

GDP takes no account of income distribution.
GDP ignores income inequality. In the U.S. GDP has grown more than seven-fold since 1980 [24]. GDP presents this growth as a benefit to all, yet the country's three richest men now own more wealth than the bottom half of the country combined [25].

Box 1.
What's wrong with GDP? [23].

3.2.1 GDP adjustments

A basic problem with GDP and other conventional measures is that they are measures of output, not welfare. A true measure of welfare would rise when societies are better off and decline when they are worse off [26]. One of the limitations of GDP as a welfare indicator is that it does not take account of the depletion of either natural or man-made capital. As a result, spending to replace worn-out machinery is treated as income even though it adds nothing to the existing stock of machinery. Similarly, consumption and pollution that depletes society's store of natural capital is also incorrectly treated as income.

Food Security and Global Nutrition – Food production depends on biodiversity for plant and animal varieties, pollination, pest control, and disease regulation [27]. Indigenous produce adapted to local conditions in countries around the world serve as a basis for improved plant varieties and as a buffer against a changing climate [28, 29].

Disease Regulation – Lowered biodiversity and habitat fragmentation can lead to increased disease transmission and higher healthcare costs [30, 31]. Medicinal plants and manufactured pharmaceuticals rely on biodiversity. The diversity of plants and animals is an essential source of molecular compounds needed for future drug discovery [32].

Business and Livelihoods – More than half the world's GDP is moderately or highly dependent on nature, including nature-based tourism and recreational hunting and fishing [28, 33]. Fisheries, forestry and agriculture provide trillions of dollars annually in economic activity [34].

Protection and Replenishment – Biodiverse ecosystems provide natural buffers against storms and floods, water purification, soil formation and organic waste disposal [28]. Biodiversity underpins forests, grasslands, and agricultural systems essential for carbon storage and climate regulation [28].

Box 2.
Biodiversity underpins Economic activity, human health and wellbeing.

The former limitation can be addressed by simply subtracting an estimate of capital depreciation from GDP. This is now done as a matter of course in many countries, including the U.S. in what is called net domestic product (NDP) [35]. Adjusting for GDP's treatment of natural capital, however, is more complicated since there are uncertainties about precisely which cost items to deduct from GDP as well as how these items should be valued [36].

Nevertheless, in an effort to redress this shortcoming, economists have developed an alternative measure called the genuine progress indicator (GPI) which subtracts the value of natural capital used in production as well as the costs of negative externalities from GDP [37].

GPI also attempts to address other limitations of GDP by broadening the conventional accounting framework to include the benefits of volunteering and household labor as well as the impact of a variety of other factors, including crime, health care, income distribution, and leisure [37]. In effect, the GPI aims to serve as an indicator of sustainable welfare by focusing on the value of two basic things: activities that actually make us better off and those that are likely to be sustainable over the long term [37, 38].

Not surprisingly, GPI tells a rather different story than GDP of the recent history of economic growth. In an exhaustive study of the difference between the two indicators Kubiszewski, et al. [39] looked at 17 countries for which GPI data are available over the period 1950–2005. As shown in **Figure 3**, whereas GDP/capita rises continuously over this period, GPI/capita levels off in the late 1970s and begins to decrease slightly thereafter.

3.2.2 Alternative indices

Despite the theoretical appeal of the GPI, it too has limitations. Uncertainties about what costs and benefits to include and how they are valued tend to make these kinds on indices ill-defined. There are also unavoidable problems with trying to summarize how well a society or economy is doing using a single number.

These issues have given rise to specialized indices (e.g., of ecological health or happiness) as well as a dash-board approach involving selected indicators that allow societies to better track the things they really aspire to.

One specialized index (the Living Planet Index) measures the state of global biodiversity based on population trends of vertebrate species from around the world. As shown in **Figure 4**, the most recent index shows an average 68% decline in the abundance of 4,392 mammal, bird, fish, reptile, and amphibian species from 1970 to 2016 [40]. Some groups are doing much worse. Freshwater populations have declined by an average of 84%, with regional declines as high as 94% (in Latin America). These startling reductions underscore the extent to which GDP as a standalone indicator is masking the impacts of economic growth.

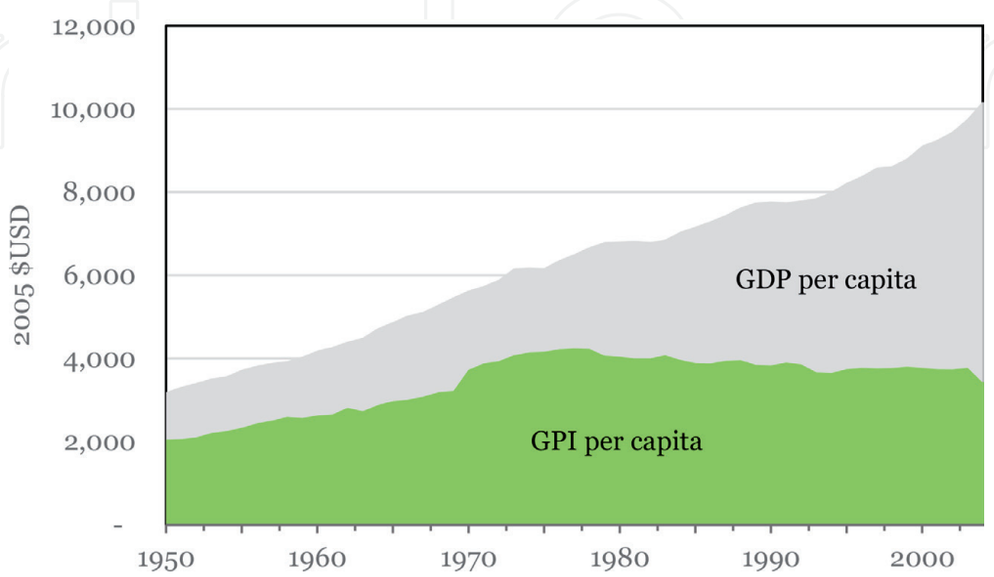

Figure 3.
GDP vs. GPI (genuine Progress indicator), 1950–2005 [39].

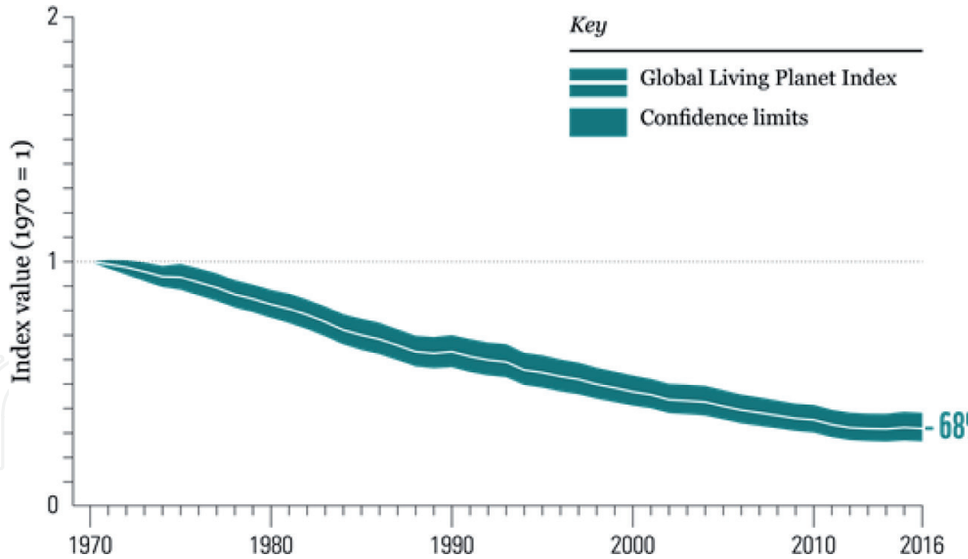

Figure 4.
The global living planet index (LPI) shows a 68% average decline between 1970 and 2016 [40].

An alternative to using a single index is the so-called dash-board approach, involving what are sometimes called sustainable development indicators. This approach seeks to go beyond measuring simply material wealth to focus on a broad range of indicators of the quality of life and environmental health.

One example of this approach is the Better Life Initiative [41] developed by the Organization for Economic Cooperation and Development (OECD), a group of 37 mostly rich countries. This initiative recommends 11 indicators that the OECD suggests as essential to well-being in terms of material living conditions (housing, income, jobs) and quality of life (community, education, environment, governance, health, life satisfaction, safety and work-life balance) [http://www.oecdbetterlifeindex.org/#/45555545544].

At present, these indicators – which have been developed for all 37 OECD member countries – reflect only current well-being but in the future the organization expects to complement these with indicators describing the sustainability of well-being over time.

3.2.3 Concepts over numbers

A common shortcoming of all the above indicators is complexity. One reason for the power of GDP, despite its flaws, is simplicity. Up is good, down is bad, and even though a single, modified index like the GPI shares in this advantage, its usefulness as a measure of progress (or peril) is much diminished if it is unlikely to be accepted as a standard.

In response to this dilemma, some have opted for advancing concepts rather than numbers to help inspire and guide in the development of policies that will ultimately be needed to move us in the right direction. Two ideas worth mentioning in this regard are the steady state economy and doughnut economics.

The idea of a steady state economy is most closely associated with the work of economist Herman Daly, one of the co-founders of the journal *Ecological Economics*. According to Daly, a steady state economy seeks to respect the bounds of sustainability by keeping GDP and resource use stable [42]. As measured by GDP, an economy is either growing, stable or in recession. Since neither economic growth nor recession is sustainable, a steady state economy is the only sustainable prospect and is therefore the "only appropriate policy goal for the sake of sustainability" [42].

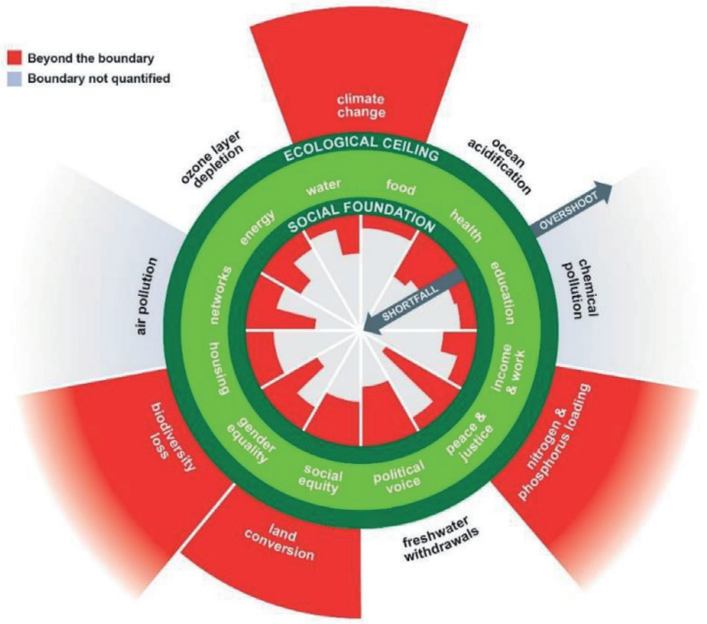

Figure 5.
The doughnut of social and planetary boundaries [image credit: Kate Raworth and Christian Guthier] [44].

Proponents of the steady state emphasize that it should not be confused with economic stagnation which, they say, is the result of a failed growth economy whereas a steady state economy seeks to balance the lack of traditional growth with efforts to distribute wealth so as to broaden economic security [43].

Doughnut economics, the creation of economist Kate Raworth, is in many ways a popularized version of Daly's steady state economy. Both authors reject the idea that perpetual growth is a viable option and instead call for maximizing social welfare within the physical and ecological limits of the planet. According to Raworth, the goal of economic activity should be to "meet the needs of all" while respecting planetary boundaries [44]. Raworth uses a doughnut, i.e., a disc with a hole in the middle, as her visual framework in which the inner ring represents society's social foundation and the outer ring its environmental ceiling (**Figure 5**). Between the two is what Raworth calls an "environmentally safe and socially just space in which humanity can thrive" [44].

4. Policies to take us there

The above discussion of how we define and measure sustainability, of course, begs the question of how we get from here to there. Clearly, a part of the answer lies in the measures and definitions themselves. We cannot correct problems if our measures conceal them, and we will never achieve sustainability if we do not define it as an explicit objective.

Nevertheless, this still leaves the difficult work of developing policies to help promote more sustainable outcomes. Experience and the existence of market failures suggests that we cannot leave solutions to the market alone. That said, it would be a mistake to underate the potential for productively using market forces in our search for solutions. Policies based on economic incentives in particular offer an extremely powerful and effective set of options.

Two examples in areas that matter to biodiversity are conservation agreements and carbon pricing. Both illustrate how incentive-based policies can help provide simple, cost-effective, and scalable solutions to environmental problems.

4.1 Conservation agreements

Conservation agreements are performance-based agreements in which resource owners commit to a concrete conservation outcome – usually the protection of a particular habitat or species – in exchange for benefits designed to give them an ongoing incentive to conserve [45]. The type of benefits provided vary but can include technical assistance, support for social services, employment in resource protection, or direct cash payments.

One of the great advantages of this approach is that the terms of agreements are flexible and can therefore be tailored to a particular setting. This flexibility makes conservation agreements a very scalable approach that can be implemented on private and indigenous lands outside traditional protected areas as well as on lands managed by national governments. In addition, whereas the creation of a traditional park or protected area requires a long, complex political process, conservation agreements, as a market-based approach, make park creation more akin to a standard business transaction, and this, in turn, makes park creation much more rapid and efficient.

Since conservation agreements are a voluntary approach that addresses the underlying costs of conservation they are more politically acceptable than forced buyouts or eminent domain and are also often less expensive than other approaches since they focus on opportunity cost which in many cases is extremely low, particularly in developing countries [46].

Conservation agreements were first piloted in 2001 in the context of a timber concession in Guyana [45]. Since then, they have been implemented in a wide variety of settings in roughly 20 countries around the world [47]. Examples include agreements focused on particular species as well ecosystems such as coral reefs, mangroves, and in the Solomon Islands, the largest uninhabited island in the South Pacific [47, 48].

4.2 Pricing carbon

Carbon pricing is another example of an incentive-based policy that relates to biodiversity. While this approach does not target biodiversity directly, it is perhaps the most important single policy affecting all life on Earth. When it comes to conservation, and so much else, unless we effectively tackle climate change very little else will matter.

Although there are many ways of putting a price on carbon, by far the simplest and most effective is a tax imposed on fuel suppliers (e.g., oil and gas producers). Once taxed, fuel suppliers raise their prices and in this way the higher prices ripple through the whole economy. There is no way to evade the tax and there is nothing to monitor or enforce (other than whether energy producers pay their taxes). Across the economy the cost of energy-intensive goods and services would rise giving both businesses and consumers an incentive to conserve.

One of the many advantages of a carbon tax is that it ensures that emission reductions are achieved at least cost to society. The reason is that unlike regulations that require everyone to adopt a particular technology or reduce their emissions by a certain amount, carbon taxes allow for the fact that some entities can reduce their emissions at a lower cost than others. This flexibility offers the opportunity for substantial cost savings.

Regulations alone, for example, can be twice as expensive as a carbon tax per ton of carbon abated while reducing far fewer emissions [49]. Similarly, subsidies (e.g., for electric vehicles) are unavoidably wasteful since they cannot target those who will only be motivated to buy because of the subsidy. If a tax credit of $7,500

convinces only one in four people to buy a hybrid electric vehicle, for example, the effective cost of the incentive is four times the subsidy or $30,000 – more than the price of many plug-in hybrids [50]. Such subsidies also tend to disproportionately benefit high-income households and while hybrids themselves emit less carbon than conventional cars, if the source of power used to charge them comes from coal they will raise carbon emissions rather than reduce them [51].

In addition to being less expensive, carbon taxes have several other important advantages. To begin, the cost of the tax is clearly known ahead of time. If the cost varies, as is true with cap and trade – the program used in several U.S. states – it makes it difficult for business (and consumers) to plan and therefore undercuts incentives to make long-term investments in efficiency.

Other options for pricing carbon are also more administratively burdensome and less transparent and often address only a subset of emissions. Cap and trade, for example, typically covers only electric utilities, which in the U.S. leaves out nearly three-quarters of total carbon emissions [52].

Most carbon tax proposals also now involve offsetting rebates so they do not disadvantage the poor who spend a larger percentage of their income on energy. Many proposals, in fact, would leave the majority of households better off with the tax than without it. In effect, such a "tax" would pay people for doing the right thing.

An important adjunct to a carbon tax is a UN program called REDD – Reducing Deforestation and Forest Degradation. REDD is a global effort designed to break with historic trends of increasing deforestation and greenhouse gas emissions by offering countries a financial incentive for forest conservation [53]. Since deforestation is the second largest anthropogenic source carbon emissions any realistic plan for addressing climate change must include efforts to halt the loss of tropical forests [54].

REDD takes advantage of the fact that reducing emissions anywhere on the globe has the same beneficial impact on slowing climate change. Reducing emissions through REDD therefore offers a means for offsetting emissions of industries that have no other option for meeting their climate commitments. For this reason, airlines around the world who have committed to being net-zero emitters in coming decades are expected to be major future funders of forest conservation through REDD [55].

Happily, protecting tropical forests is one of the least cost ways of reducing carbon emissions [56, 57]. REDD therefore has the potential for simultaneously reducing the cost of fighting climate change while providing a powerful incentive for protecting biodiversity.

4.3 A lack of environmental support

Given their advantages for conservation one might well expect that the three policies discussed above would be popular with environmentalists. In fact, all three policies have faced significant environmental opposition. Conservation agreements have received a great deal of favorable media attention but apart from modest investments by the organization that first developed them, they have largely been ignored by the international conservation community. This is in part a reflection of the fact that "paying for conservation" is regarded by many as a foreign concept, or worse, a dangerous precedent that "commodifies" nature and risks making all conservation efforts more expensive.

But it also reflects an important underlying incentive that shapes the conservation establishment. After years of strong popular support, the budgets and staff of all the major international conservation organizations have grown to the point where conservation has become an extremely expensive undertaking, one that

depends critically on continued success in fundraising. And that, in turn makes for resistance to changes in tactics that would funnel money away from existing staff (even to laudable objectives like providing resource owners with an ongoing incentive to conserve). In the language of economics, the opportunity cost of supporting this kind of incentive-based conservation is the funding not going to current operations.

Carbon taxes have suffered from a similar lack of support. Part of the problem in this case is that taxes in general are an unpopular approach. But they have also suffered from competing agendas and a basic lack of understanding as illustrated by the fate two carbon tax bills in the U.S. state of Washington. The first was a revenue neutral bill that included tax cuts and rebates to offset the impact of higher prices from the carbon tax. This bill was defeated by an unusual coalition of oil interests and environmentalists. The later felt that the money collected by the government should be used to offset the impact of the tax on the poor (even though that is exactly what the rebates would have done) and to fund investments affecting climate, communities, and racial equity [58].

To accommodate these concerns, the second bill included no offsetting rebates and instead called for using the tax revenue to support a dedicated fund focused on the environment and social justice. In addition, the bill called for reducing the carbon tax by half to lessen its impact on prices. In effect, these changes made the revised bill both more regressive and less effective in reducing carbon emissions. Despite these "improvements", this bill was also defeated, this time by voters who objected to the added tax and the fact that it was being used to fund what the Seattle Times called a grab bag of "special interest payouts" [59].

The UN REDD program has also faced environmental objections, in this case based on concerns over the long-term security of emission reductions in developing countries and the fact that offsets allow polluters to avoid reducing their own emissions by paying for cheaper emission reductions elsewhere [60].

5. Summary and conclusion

The past two centuries of economic growth have provided the world with many benefits. Our lives are longer and healthier with more leisure and shorter workweeks. Childhood diseases that afflicted our parents are largely a thing of the past. The creative explosion of the last few decades has yielded advances in medicine, the arts, technology and more. All these things are the benefits of economic growth.

There are, however, downsides to economic growth that put our past progress and the future of life in jeopardy. Although global economic policy is still strongly wedded to growth in GDP there is increasing recognition that this is not a sustainable situation. Blindly promoting ever more growth without seeking to address market failures and impacts on the environment is clearly a prescription for trouble. The question is how to moderate these impacts while still maintaining a focus on advancing economic security and the quality of life.

Part of the answer to this question is in developing better indicators of how economic activity is affecting the things we care about. Having a global standard measure like GDP that ignores the value of nature and counts both pollution and clean up as progress is certain to steer us in the wrong direction. Dethroning GDP and work on replacements are worthy endeavors. Measures of impact, though, even at their best, are better at informing us of the need for change than in incentivizing specific changes. They still leave us with the hard work of developing appropriate policies for the future.

How we proceed in this regard will make a difference. Unconstrained markets are not likely to produce a happy ending, but this does not mean that we should ignore the potential for using markets and incentives in our search for solutions. The same forces that are driving us in the wrong direction can be harnessed and channeled in directions that will greatly enhance the potential for sustainable outcomes.

This is particularly true in the case of policies designed to address threats to biodiversity. Indeed, in the case of two important policies, carbon taxes and conservation agreements, ignoring this potential is likely to come at a price. Compared to a carbon tax, standards and subsidies could double the cost of dealing with climate change and rejecting the use of incentives in conservation agreements and REDD could jeopardize whether forests are saved at all.

The good news is that we have some extremely simple and powerful tools at our disposal. A single, small change in the tax code can reorient the entire economy away from carbon. And conservation agreements and REDD can be flexibly implemented almost everywhere they are needed. While funding these efforts will not be inexpensive there is ample global willingness and ability to pay for conservation and no shortage of those in a position to conserve who are willing to accept payment.

The challenges are great, but many of the tools needed to address them are at hand. We need only choose to put them to use.

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