ANNUAL REVIEWS

Annual Review of Environment and Resources

Measuring Global Human Progress: Are We on the Right Track?

Haripriya Gundimeda[1] and Giles Atkinson[2]

[1]Department of Economics, Indian Institute of Technology Bombay, Mumbai, India; email: haripriya.gundimeda@iitb.ac.in

[2]Department of Geography and Environment, London School of Economics and Political Science, London, United Kingdom

ANNUAL REVIEWS CONNECT
www.annualreviews.org
- Download figures
- Navigate cited references
- Keyword search
- Explore related articles
- Share via email or social media

st (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

Annu. Rev. Environ. Resour. 2024. 49:599–622

The *Annual Review of Environment and Resources* is online at environ.annualreviews.org

https://doi.org/10.1146/annurev-environ-112621-072941

Copyright © 2024 by the author(s). This work is licensed under a Creative Commons Attribution 4.0 International License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited. See credit lines of images or other third-party material in this article for license information.

OPEN ACCESS CC BY

Keywords

SEEA, System of Environmental Economic Accounting, green accounting, subjective well-being index, composite indices, wealth accounting, biophysical indicators, dashboard indicators

Abstract

As a metric for economic progress, gross domestic product (GDP) has been criticized for hiding the destruction of natural capital and failing to improve happiness/human well-being. Consequently, many studies unanimously argued for a beyond GDP approach, which led to a proliferation of ensuing metrics. However, the proliferation leads to confusion as it complicates matters for policymakers looking to these metrics to inform coherent development objectives and plans. Our article aims to assess theoretical and empirical efforts to measure human progress based on these notions of well-being and sustainability and critically analyze the strengths and weaknesses of these approaches. We explore systematic trends in indicator activity in the related literature and, in doing so, organize our discussion around the distinct and prominent perspectives that can be identified. We illustrate with a case study on India how divergent matrices, though not beyond comprehension, increase the complexity.

Contents

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

1. INTRODUCTION

Suppose decision-makers were today formulating and choosing between novel metrics to assess, compare, and track the well-being of society for the coming decades; in that case, they would be unlikely to decide on one indicator to answer this challenge. And even if a single metric were desired, it also seems questionable that this winner-takes-all indicator would be gross domestic product (GDP) per capita. The fact that this metric effectively became—and, indeed, arguably remains—the incumbent for judging current development as well as development prospects is interesting in itself (e.g., 1–3). For some, this suggests that GDP is not such a wrong answer after all, given that it continues to be so used, and according to this view, it is correlated with other significant economic and social development measures (4, 5; see also Reference 6 for an empirical investigation of this claim in the context of the Sustainable Development Goals). For others, GDP is the incumbent to dethrone or, at least, take from its existing pedestal and place alongside multiple other metrics.

GDP has been criticized for hiding the destruction of natural capital and failing to improve happiness/human well-being (see, for instance, References 4, 7, and 8 for a comprehensive review of this criticism). In this article, we review those contributions that have sought to critically reappraise the relevance of GDP as a measure of human progress. This is no easy matter; no such review can claim to be comprehensive or exhaustive. This debate is long-standing, perhaps as long as (or longer than) the formal concept of GDP itself has existed (e.g., 1). And while the approaches to, and perspectives on, this debate now coalesce under the heading of "beyond GDP," there is little straightforward comparability beyond this broad ambition. Hence, almost 500 sustainable indicators have been developed, as mentioned in the compendium of sustainable development indicators (9).

The sheer number and breadth of metrics that can be characterized under the beyond GDP umbrella is thus striking. To a large extent, this should not be a surprise. These metrics reflect, in turn, debates about what constitutes development. Given the multiplicity of perspectives on this, we should expect a comparably large array of proposals about how development will be measured. There needs to be a straightforward or agreed-upon way of compartmentalizing these efforts. These metrics are genuinely diverse, and their place in some shared endeavor (or their distinctiveness) can be sliced in many ways. That said, we identify a handful of important themes in what follows.

One starting point for thinking about what different proposals for novel metrics contribute is asking what flaws of GDP they seek to address. Generally speaking, GDP provides, at best, a very partial story of current well-being and tells us very little, if anything, about whether current well-being can be sustained. Unpacking these broad claims might suggest many different avenues for metric construction. The most comprehensive view of this is the three pillars approach to sustainability, which has economic, environmental, and social dimensions. The metrics reflecting these separate categories are typically measured in diverse physical units according to what is appropriate for measuring the development outcome (life expectancy, years of schooling, carbon dioxide emissions, and so on). There is no prima facie reason for aggregating these indicators. Composite indicators exist, with the Human Development Index (HDI) being the most prominent example. Other examples include the Canadian Index of Wellbeing (10). However, all these data are often presented as a dashboard that shows a variety of metrics. How much room there is on the dashboard is a subjective choice.

So, too, is the exact design and content of this dashboard. An overarching structure, such as the three-pillar approach described above, provides a thematic approach, albeit at a relatively high level. But biophysical indicators might be a focus of these broader dashboards—or stand-alone metrics. Metrics generally describe and distill status and trends in particular resources or the natural environment. Perhaps the ecological footprint is the most prominent of these metrics (e.g., 11), although other examples include net primary production. Interestingly, the footprint approach addresses another interesting dimension of this measurement challenge: how national well-being prospects are intertwined between countries and globally.

Of course, such metrics are not measures of well-being per se. However, they can be connected to notions about environmental sustainability, notably with planetary boundaries or global ecological risks (12). In turn, the implication here is usually that exceeding or moving too close to biophysical limits is not sustainable, and development (or well-being) opportunities are constrained as a result. Related approaches make a connection by joining up (distinct) metrics. For example, the Happy Planet Index (HPI) combines the ecological footprint—describing current resource use relative to biophysical constraints—with economic and social well-being metrics. In this instance, this well-being metric (subjective well-being) is based on the subjective assessment of those under consideration. Well-being can consist of pleasure or happiness, called hedonism (13), or it can be the actualization of human potential, and this view is called eudaimonism (14). This contrasts with objective approaches to metric construction, of which national accounting is an exemplar.

Other approaches are built around the existing system of national accounts (SNA), of which GDP emerges as a focal accounting aggregate of current economic activity. What distinguishes these approaches is the proximity of their orbit relative to the SNA. Notably, there is the System of Environmental Economic Accounting (SEEA), which—within the past decade—has published its guidance on what is known as the central framework and ecosystem accounting (15, 16). The process leading up to these publications was accompanied by many contributions in both academic and gray literature (the latter comprising unpublished but perhaps official supporting documents). The starting point for these contributions is to develop some novel extension to the SNA—i.e., accounting for ecosystems—while adhering to the constraints of existing norms and procedures of how national accounts are compiled. These practices evolve (described notably in Reference 17 and the current SNA revision), but a constant tends to be the principles established in the original SNA (18). This has specific ramifications for key issues, notably how monetary values for these novel elements are determined.

Other approaches ultimately connect to national accounting but are more experimental in deviating from the constraints of the SNA. Notably, the work undertaken by the World Bank and

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

United Nations Environment Programme (UNEP) has (separately) sought to extend how national wealth is measured, especially for the value of human and natural capital. In the latter's case, this entails using valuation procedures with a basis in economics but not necessarily in national accounting and SNA principles. An even more distant satellite of the SNA is an approach that estimates an index of sustainable economic welfare (ISEW) or a genuine progress indicator (GPI). These have a familiar accounting structure: They are monetary measures of income within a national economy. But there is a clear contrast with other approaches under wealth accounting, which stick closely to economic theory to guide what should be measured (and how) and make claims about whether development is sustainable.

At the heart of wealth accounting is the idea that sustainability can be satisfied by prudent management of an economy's assets, comprehensively defined. A key insight here is that future well-being is closely linked to current assets—or, more precisely, to changes in real asset values. The notion of asset must be broad (i.e., comprehensive), embracing produced, natural, human, and social capital. This reflects that economies depend on this wide array of assets for development. The extent of these assets—the wealth in an economy—will determine development prospects. How this asset base of the economy is changing, in turn, will determine how these prospects are changing. Given that traditional wealth and saving measures in actual national accounting systems are incomplete descriptions of these stocks and flows, this provides the impetus for comprehensive wealth accounting.

The remainder of this review is organized as follows. Section 2 discusses the results of the bibliometric analysis of studies published in human progress and sustainability, and the chosen studies are classified into various schools in Section 3. Section 4 critically synthesizes our viewpoint on the way forward and presents the case for India. Section 5 concludes with the practical implications of these measures of human progress.

2. METHODOLOGY AND DATA SOURCES

We conducted a bibliometric analysis of publications using the Web of Science and the Scopus database's advanced search functionality. Only original research papers and prominent gray literature have been included. Our search covers the period from 1987 up to July 20, 2023.

In many ways, the beginning of this period is arbitrary, although it does coincide with renewed vigor in research and practice in this measurement space. That said, it is worth acknowledging important developments before our starting point. For example, a pioneering study by Nordhaus & Tobin (19) estimated a measure of economic welfare (MEW), essentially a forerunner of the contemporary work on extending GDP. Specifically, the emphasis in MEW was on accounting—in monetary terms—for positive (or negative) flows of amenities that are not typically recorded in GDP (i.e., not included in consumption expenditure in national accounts), but which plausibly add to (or subtract) from people's broader welfare or well-being. Other notable work which extends these insights within a national accounting setting comes from Eisner et al. (20), Kendrick (21), Ruggles & Ruggles (22), and Zolotas (23) [Eisner (24) provides an excellent and comprehensive review]. The social indicators movement of the 1960s and 1970s was crucial, emphasizing broader quality-of-life metrics (25). For example, Eisner reviews and reflects on the legacy of that movement in the construction and use of contemporary metrics of quality of life and human well-being.

Regarding the specifics of this analysis, a semantic search for appropriate keywords on "measuring global human progress" gave several thousand publications. Hence, we followed a tiered approach. We first searched for literature under the level 1 variables "green national accounting," "natural capital accounting," "biophysical indicators," "social indicators," "composite indices,"

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

"wealth or well-being or sustainability," and "dashboard approaches." Based on these searchers, we identified tier 2 approaches, including further search terms "SEEA," "wealth accounting," "economic welfare," "ecosystems accounting," "environmental or resource accounting," "green accounting," "footprint analysis," "material balance," "bio-capacity," "biodiversity indicators," "social-capital," and "well-being." 13,367 English articles were identified after excluding nonacademic literature irrelevant to the study objective.

The study employed keywords from the referenced literature to develop a scientific map centered on the dynamic evolution of measuring human progress using VOSviewer. High-frequency keywords, as well as links between these keywords, were included in the co-word analysis for this study. Perhaps not surprisingly, our search confirms growing interest in this topic over the decades. For example, according to this search, 141 articles were published between the 1987 release of the Brundtland Commission report and 1997 (which coincided with the signing of the Kyoto Protocol). The decade post–Kyoto Protocol and up to the global financial crisis (1998–2008) saw 1,284 publications. Since 2009, the beyond GDP movement has arguably gained further momentum. The decade 2009–2018 witnessed 4,085 publications, and the shorter period of 2019–2023 saw 4,085 publications.

Figure 1 shows that a proliferation of ideas on finding the right metric for measuring sustainability and well-being evolved. Bio-capacity/ecological footprint articles dominated the literature, with more than 3,774 publications advocating or measuring ecological footprint. Measuring sustainability through the sustainable indicators approach saw 3,521 publications.

The idea of inclusive and comprehensive wealth became prominent after the publications of the Commission on the Measurement of Economic Performance and Social Progress, also referred to as the Fitoussi-Sen Commission; Arrow et al. (26); and the World Bank started to measure the wealth of the nations. The idea of a GPI gained ground in 1999 and saw approximately 93

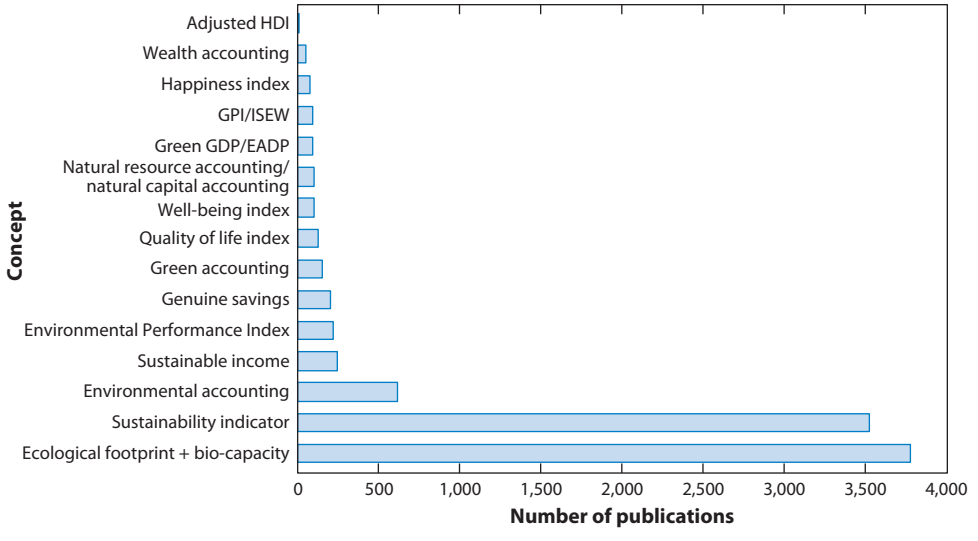


Figure 1

Number of publications indicating the dynamic evolution of the concept of human progress. Only original research papers and prominent gray literature are included for the period 1987–2023. Abbreviations: EADP, environmentally adjusted domestic product; GDP, gross domestic product; GPI, genuine progress indicator; HDI, Human Development Index; ISEW, index of sustainable economic welfare.

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

publications (of which eight papers have been published on the concept of ISEW). The economic indicators of genuine savings, green GDP, and environment-adjusted domestic product have 299 publications. Green accounting, environmental accounting, and natural resources accounting or natural capital accounting shot into prominence immediately following the 1992 Rio Conference, and 870 studies were published. The beyond GDP movement has also seen an increase in dashboard indices to measure the quality of life through the happiness index, quality of life index, social progress indicators, adjusted HDI, well-being index, etc., as seen from 546 publications. Wealth accounting saw 50 publications.

The highest number of publications mentioned China (1,605), followed by the United States, the United Kingdom, Italy, Australia, Spain, Germany, India, Brazil, Turkey, the Netherlands, and Canada, demonstrating the relative contributions of each of these countries to this topic and the substantial overall research presence (**Figure 2**). With 430 publications, India has made significant progress in the discipline and is now one of the most prominent among developing nations.[1]

Figure 3 sheds light on concepts and themes related to key overarching activity categories in indicator construction. This is important given that there is an arbitrary element to any categorization. The figure shows various clusters within each quadrant of (distinct) indicator activity (e.g., composite indicators). In each quadrant, several keywords have the same color and, as such, have been categorized as part of the same cluster of subactivity (e.g., a particular variant of, or debate within, composite indicators). The size of the circles in these quadrants indicates the words' total relationship frequency (total link strength). The sizing is relative for the set of words in each subpanel. The lines between any two circles then represent the relationship networks of these words with each other. Lastly, the position of the words in the quadrants indicates to what extent these terms are in the center or periphery of the relationship network.

The results are illustrated in **Figure 3** for all four level 1 variables. The most frequently mentioned approach is biophysical indicators, with a total strength of 5,809, followed by social indicators, with a link strength of 2,860. Composite indicators occurred 2,777 times, and green accounting/natural capital accounting occurred 601 times. Within these broad approaches, the prominent keywords are life satisfaction, ecological footprint, composite indicators, sustainability, subjective well-being, happiness, environmental sustainability, and SEEA.

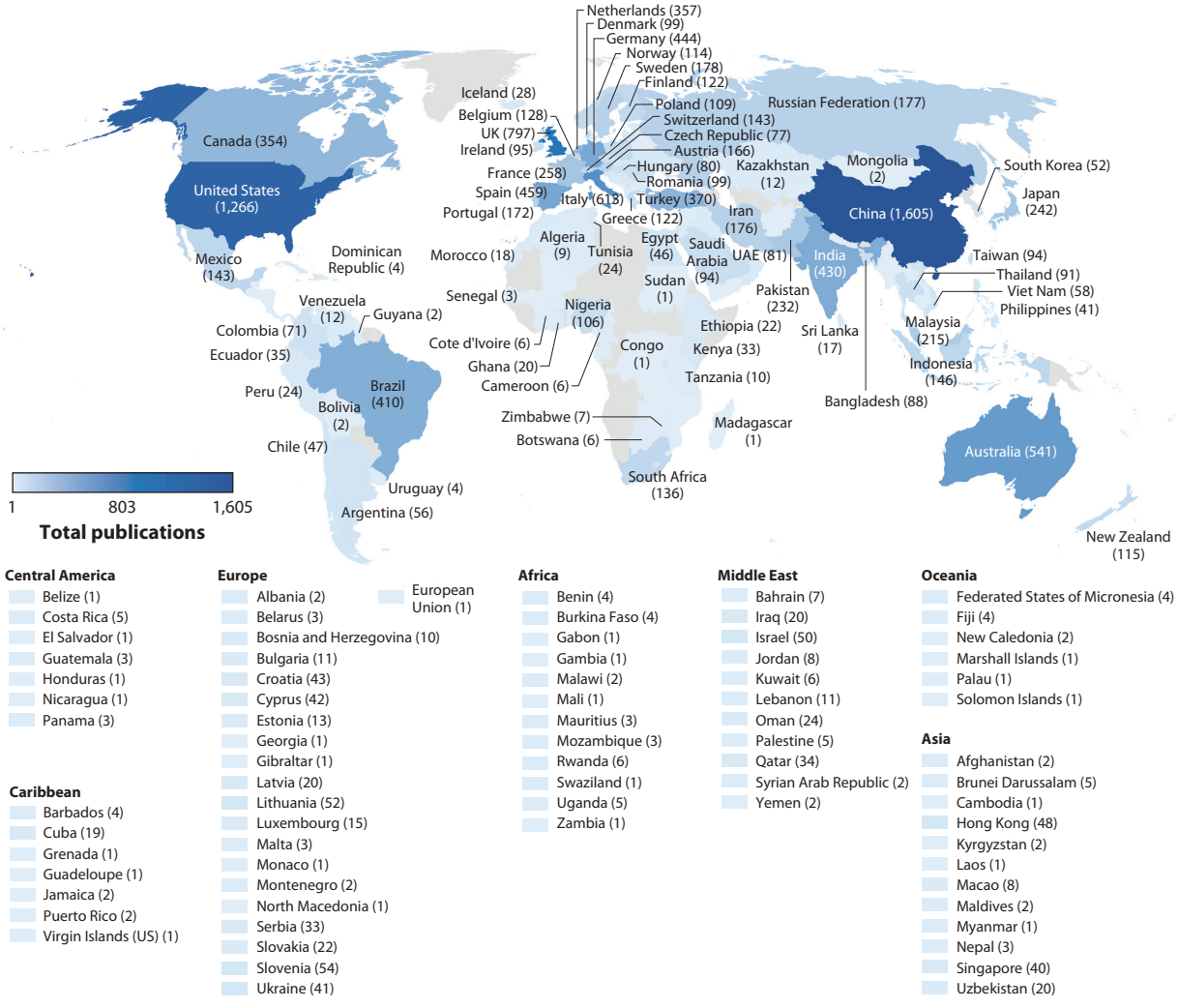
It is apparent that the quest for the right measure for human progress has evolved under various schools of thought. If there is a standard yardstick, comparing the progress achieved in various countries is meaningful. Any variation in the approach would change the country's ranking quite considerably. Though divergent on the approaches, the literature is unanimous on the fact that economic growth is necessary but depends on the environment, with possible environmental impacts. However, the indicators to measure human progress are flawed due to their nonreflection of ecological degradation and its impacts on the quality of life.

3. SCHOOLS OF THOUGHT ON DEFINING HUMAN PROGRESS

This section summarizes multiple schools of thought that emerged on measuring human progress and discusses the approaches, their strengths and limitations, and what they measure. In the next section, we discuss the usefulness of these measures for policymakers. We classified all the keywords mentioned in Section 2 into five leading schools of thought based on approach (for example, methods based on adjusting traditional indicators to the indicators that measure subjective

[1]To be counted, a study can be at the national, provincial, subnational, or even micro level. If the article refers to a particular country, it is counted for that country.

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59



Central America
- Belize (1)
- Costa Rica (5)
- El Salvador (1)
- Guatemala (3)
- Honduras (1)
- Nicaragua (1)
- Panama (3)

Caribbean
- Barbados (4)
- Cuba (19)
- Grenada (1)
- Guadeloupe (1)
- Jamaica (2)
- Puerto Rico (2)
- Virgin Islands (US) (1)

Europe
- Albania (2)
- Belarus (3)
- Bosnia and Herzegovina (10)
- Bulgaria (11)
- Croatia (43)
- Cyprus (42)
- Estonia (13)
- Georgia (1)
- Gibraltar (1)
- Latvia (20)
- Lithuania (52)
- Luxembourg (15)
- Malta (3)
- Monaco (1)
- Montenegro (2)
- North Macedonia (1)
- Serbia (33)
- Slovakia (22)
- Slovenia (54)
- Ukraine (41)
- European Union (1)

Africa
- Benin (4)
- Burkina Faso (4)
- Gabon (1)
- Gambia (1)
- Malawi (2)
- Mali (1)
- Mauritius (3)
- Mozambique (3)
- Rwanda (6)
- Swaziland (1)
- Uganda (5)
- Zambia (1)

Middle East
- Bahrain (7)
- Iraq (20)
- Israel (50)
- Jordan (8)
- Kuwait (6)
- Lebanon (11)
- Oman (24)
- Palestine (5)
- Qatar (34)
- Syrian Arab Republic (2)
- Yemen (2)

Oceania
- Federated States of Micronesia (4)
- Fiji (4)
- New Caledonia (2)
- Marshall Islands (1)
- Palau (1)
- Solomon Islands (1)

Asia
- Afghanistan (2)
- Brunei Darussalam (5)
- Cambodia (1)
- Hong Kong (48)
- Kyrgyzstan (2)
- Laos (1)
- Macao (8)
- Maldives (2)
- Myanmar (1)
- Nepal (3)
- Singapore (40)
- Uzbekistan (20)

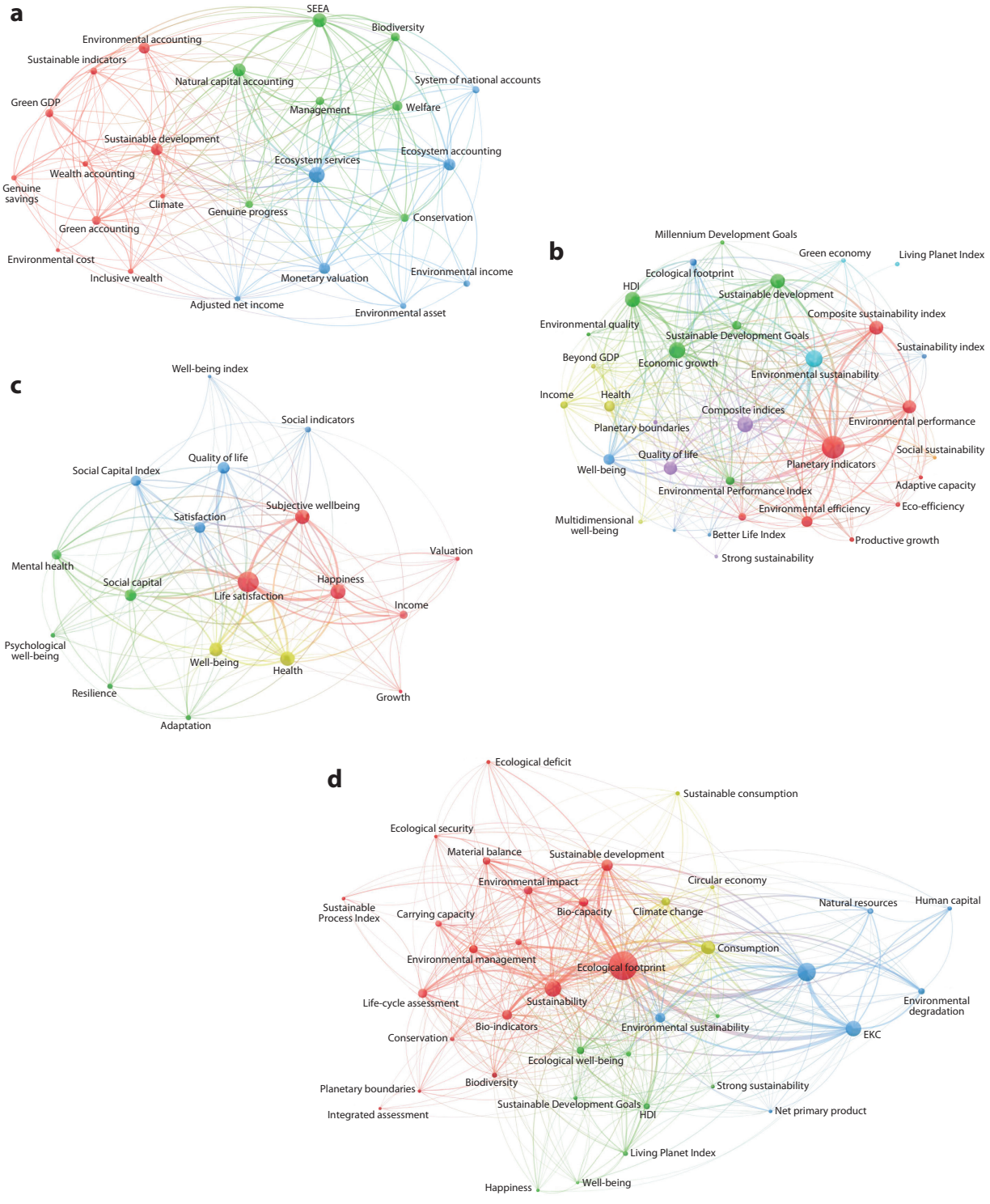
Figure 2

Proliferation of ideas on the metrics for measuring sustainability and human well-being in various countries during 1987–2023. The studies can be at the national, provincial, subnational, or micro levels. If an article refers to a particular country, it is counted for that country. In addition, the map does not show 180 publications that could not be categorized into specific regions or countries.

well-being). In the literature, researchers used multiple typologies of classification of the indicators (see 4, 27), and our classification differs, as our opinion is that this approach captures the developments in this literature quite closely.

The thought process on measuring welfare has broadly taken the form of (*a*) measures linked with sustainable consumption and income, which are built using economic foundations through adjustments to net domestic product (NDP); (*b*) sustainable wealth or well-being indicators (relying on economic prices); (*c*) subjective well-being indicators and indices; (*d*) dashboard indicators that need not necessarily be in monetary terms, which are used to inform policymakers; (*e*) biophysical indicators; and (*f*) composite indicators (aiming to capture the multiple dimensions of well-being).

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59



(*Caption appears on following page*)

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

Figure 3 (*Figure appears on preceding page*)

Full network map of key overarching activity categories in indicator construction (words associated with various indicators: green/natural capital accounting, composite indicators, social indicators, and biophysical indicators). The sizes of the circles in the quadrants indicates the words' total relationship frequency (total link strength). Abbreviations: EKC, environmental Kuznets curve; GDP, gross domestic product; HDI, Human Development Index; SEEA, System of Environmental Economic Accounting.

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

3.1. Measures of Sustainable Consumption and Income

Economic welfare is derived from consumption, while GDP, the measure of productive activities (and current income), does not indicate whether the consumption path can be sustained over time. Efforts were made to correct the gross national product (GNP) discrepancies and find a consumption path sustained over time. In optimal economies, Weitzman (28) contends that net national product (NNP) can represent the best welfare measure in the standard national incoming accounting procedure, as the capital consumption allowance separating GNP and NNP should be expanded to incorporate the additional capital consumption each year accounted for by the decline (or growth) of natural resource stocks. The result was extended by Weitzman & Ashiem (29) to show that in an optimal economy, the net income (consumption plus net saving, appropriately deflated) is proportional to the change in social welfare. Building on the approach by Weitzman, Hartwick (30) illustrated how a society using exhaustible resources should invest the rents from exhaustible resource use in reproducible capital to ensure primary sustainable consumption. Extending Hartwick's framework, Solow (31) showed that holding the aggregate stock of capital intact and treating consumption as interest on the stock would ensure a sustainable consumption pathway. However, in the case of resources whose flows of services enter the economy but are underpriced or not priced, Hartwick (32) shows that the correct strategy would be, first, to reprice the environmental services by their appropriate shadow prices and revise GNP upward, and second, net out from (or add to) NNP the value of the stock changes. For NNP to be construed as a measure of net welfare, the following amendments are suggested: (*a*) deduct the flow of environmental damages, (*b*) add the net change in the stocks of all assets, (*c*) treat investments in enhancements of stocks of natural resources as intermediary products, and (*d*) add the return on the total stock of assets to the existing wealth (33).

The initial attempt to reclassify and rearrange NNP and correct NNP for negative externalities was made by Nordhaus & Tobin (19) to correct the discrepancies of GDP and develop a MEW. The measure is primarily a rearrangement and reclassification of NNP into consumption, investment, and intermediate, imputed services of consumer capital, for leisure, and the product of household work, including correction for negative externalities from urbanization (19). The study shows that a direct relationship between NDP and economic well-being can be established and thus should constitute the framework for sustainability. However, the environmental damage was not taken into account. Though NDP includes a measure of well-being beyond a certain threshold, societies cannot further improve the quality of life due to deterioration in environmental quality. ISEW was developed to address the limitations of MEW (34). It first calculates what could be consumed given the actual extent of production (including market and nonmarket consumption). Second, economic activities that did not contribute to economic welfare but are required to maintain the welfare standard or reduce future reductions are deducted (e.g., defensive costs like filters), along with probable reductions caused by today's production or consumption (e.g., greenhouse gas emissions). Third, the result so obtained is weighted by an index for the inequality in the distribution of income and labor (see 35).

ISEW was later developed as a GPI (36) and constructed at multiple scales, from state to national to global levels. On the federal level, the GPI has been estimated for approximately 17 countries—Australia (37), Austria, Belgium, Chile, China, Germany, Italy, India, Japan, the

Netherlands, New Zealand, Poland, Sweden, Thailand, the United Kingdom, the United States, and Vietnam [Kubiszweski et al. (38) provide a detailed literature review]—and also at the subnational level, for instance, for the state of Oregon (39). GPI starts with personal consumption expenditures (a significant component of GDP) but adjusts them using 24 elements, including income distribution, environmental costs, and adverse activities like crime and pollution. GPI also adds positive aspects left out of GDP, including the benefits of volunteering and household work. Certain methodological shortcomings of GPI due to its failure to incorporate net changes in human health capital have been noted (31), as well as limitations relating to the choice and weighting of indicators, indexing, aggregating into composite indices, and the underlying data collection process. The role of the GPI is to flag the point beyond which GDP growth does not translate to increased economic welfare and needs to be used as a complementary tool along with other indicators.

Besides the above two approaches, another approach has been to exploit the relationship between net savings and sustainable development and has been conceptualized in the form of adjusted net savings (ANS) or genuine savings indicators [see Pearce & Atkinson (40), Hamilton & Clemens (41), World Bank (42–44)]. The ANS indicators are calculated for more than 120 countries and are derived from the conventional standard national accounting measure of gross saving, with the following adjustments: (*a*) consumption of fixed capital to obtain net national saving, (*b*) reclassification of expenditures on human capital as investments, (*c*) deductions for the depletion of natural resources associated with extraction and depletions, and (*d*) deductions for degradation to environmental capital due to greenhouse gas emissions and pollution. The indicators measure the extent to which changes in manufactured capital offset the returns from natural and human capital changes. The fundamental premise is that constant positive (net) savings ensure increasing consumption along the development path. In the era of technical progress, Hamilton & Hartwick (45) show that investments in knowledge capital should complement the net savings.

3.2. Wealth Accounting–Based Approaches

Since the World Commission on Environment and Development defined sustainable development in 1987 and the world leaders accepted Agenda 21 at the Earth Summit in Rio de Janeiro, Brazil, in 1992, much work has focused on how to avoid jeopardizing future generations' social well-being. Answering the question requires measuring sustainability, which requires asking tough questions: What constitutes well-being and wealth? If wealth includes four capitals, produced, human, natural and social, can these capitals be aggregated, and if so, how? Are some trade-offs accepted? If we do not allow for aggregation, how do we measure sustainability? Measuring sustainability requires answers to the most complex and persistent debates on the degree of substitutability of different forms of capital. There are two opposing paradigms for this: weak (nondeclining human well-being over time) and strong substitutability (nondeclining capital stock in all formats over time) paradigms, also referred to as environmental optimism and environmental pessimism, which cannot be synchronized to reach a conclusive decision about how to operationalize the measurement of sustainability (46).

Dasgupta and Mäler (47, 48) argued that social well-being will increase over time if the flow of consumption goods and services, plus the net investment in the economy's capital assets, is always positive. Thus, measuring well-being requires comprehensively measuring the familiar produced and financial assets and a nation's natural, human, social, and health capital. Growth in comprehensive wealth would lead to a sustainable future and an increase in well-being over time. Since the theoretical link between wealth, sustainability, and well-being has been established, comprehensively measured nondeclining wealth per capita has become synonymous with sustainability and well-being. The World Bank and UNU-IHDP & UNEP (49) have developed

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

two notable approaches to measuring comprehensive wealth. The World Bank estimates comprehensive wealth as the present value of sustainable consumption, based on the methodology of Hamilton & Hartwick (50). It publishes comprehensive wealth data categorized by major components (natural, human, and intangible capital) for 120 countries and uses the residual approach to estimate the value of intangible capital (42, 43). However, Arrow et al. (26) argue for directly evaluating as many components of wealth as possible, then aggregating them and calling these estimates inclusive wealth. In aggregation, the value is measured by the contribution of the asset to the current and future well-being (see Reference 51 for a comprehensive review). The inclusive wealth report (52, 53) separately estimates the major wealth components. It computes the inclusive wealth index using shadow prices as its weights, based on the approach suggested by Arrow et al. (see References 54 and 55 for a detailed review of both approaches). The inclusive wealth index has certain limitations due to its use of market prices rather than shadow prices (for its empirical calculations) and the scarcity of data needed to accurately assess asset value (56). There are practical challenges in computing the index, as opined by Solow (57, p. 354), namely that "the calculation of comprehensive capital is complicated and introduces many measurement uncertainties" (see References 58 and 59 for challenges to forest and ecosystem services valuation for wealth). However, the data challenges are not unique to wealth accounts, and the accounts are updated with new data analytic techniques. Despite their limitations, wealth-based approaches enable nations to measure how wealth changes compared with its economic indicators.

3.3. Biophysical Approaches Built on the Paradigm of Nonsubstitutability of Natural Capital

Ecological approaches to strong sustainability measurement view the economy as inextricably integrated and as a whole subset of the ecosphere. Since the publication of Daly (60) on sustainability principles, research has evolved to develop metrics for strong sustainability. Daly (60) suggested the following three principles for achieving sustainability: (*a*) increasing efficiency of resource consumption, (*b*) limiting the harvest rates of renewable sources to within the regenerative capacity of the resource and the waste emissions to within the natural assimilative capacity of the environment, and (*c*) exploiting nonrenewable resources at a rate equal to the creation of renewable substitutes. Human activities place demands on the planet's capacity, and development and resource use, according to this paradigm, are sustainable only if, over time, the demand stays within the planet's regenerative capacity (61–64). The resource demand (in global hectares) is measured by the ecological footprint (normalized for world average productivity), which indicates the demand exerted on biologically productive land and water areas to produce resources and absorb waste under prevailing technology and resource management in a given year (11). Thus, the footprint shrinks in the case of future reductions in resource use and expands in the cases of rising consumption or use of resources. A bio-capacity indicator has been developed on the supply side, measuring the biosphere's productive capacity and ability to provide a flux of valuable biological resources and services. An ecological deficit occurs if the country's footprint exceeds the bio-capacity, and countries are said to have ecological reserves if the bio-capacity exceeds the ecological footprint. Ecological debts are ecological deficits (known as overshoot) that have occurred over time since 1980, the year of the global overshoot (65). Ecological footprint accounts are maintained and updated by the Global Footprint Network and included in the Living Planet Report (66).

3.4. Approaches Based on Complementing National Accounting Systems

A significant way to account for all the concerns stated in the earlier sections so far regarding the right metric for measuring sustainability and well-being is to bring the environment

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

into mainstream economic discourse by expanding the SNA to include both marketed and nonmarketed natural resources. The SNA is an internationally accepted statistical standard, first released by the United Nations Statistical Commission in 1953 (revised in 1993), using double-entry bookkeeping principles based on economic principles and statistical concepts. The national income accounts are grouped under three categories: current accounts, accumulation accounts, and balance sheets. Current accounts deal with production, income, and use of income (supply and use accounts). Accumulation accounts cover changes in assets and liabilities and changes in net worth. Balance sheets present the stock of assets and liabilities and net worth. However, this system has been criticized, as the SNA views the relationship between the environment and economy from an economic perspective by covering only marketed goods and services of natural resources within the production boundary. It does not recognize the environment's nonmarket contributions or the free services various natural assets provide. For example, the air purification, carbon sequestration, and pollination services provided by forests are nonrival and nonexclusive and, hence, need well-established market values. The SNA disregards the impact of economic activity on natural assets and the subsequent decline in well-being due to their depletion or degradation. In addition, the 1993 SNA excludes natural resources from the asset accounts and includes them only if ownership rights exist and natural assets bestow economic benefits to their owners. For example, private plantations are included as produced economic assets, but forests in the wilderness are not.

The asset balances for produced and nonproduced natural assets include the opening and closing stocks of built assets (e.g., buildings, machinery), the elements explaining the change between the two (i.e., net capital formation, holding gains or losses of assets, other changes in the volume of produced assets), and the closing stocks. The value of capital formation is added to the value of nonproduced assets but separately depreciated as other changes in volume. Thus, the elements related to nonproduced economic assets are not in the NDP calculation (33). Therefore, approaches building on national accounts expanded the SNA and asset boundary's production boundary and adjusted the NDP for depletion and degradation of natural assets. The credit for developing such integrated accounts can be attributed to a variety of people and organizations, including Peskin (67), El Serafy (68), Repetto et al. (69), Bartelmus & Tongeren (70), the Norwegian system of accounts (71), the Netherlands' national accounting matrix including environmental accounts (NAMEA) (72), and the Philippines' Environmental and Natural Resources Accounting Project (ENRAP) (73) (see 74 for a review of country experiences). The UN Statistical Division and the World Bank made efforts to develop a framework for the satellite system of integrated environmental and economic accounting (SEEA). The SEEA framework comprises two parts: The SEEA central framework measures the environment and its relationship to the economy (through quantifying environment flows and stocks of environmental assets and identifying monetary flows of economic activity related to the environment). The second part is the System of Environmental-Economic Accounting – Experimental Ecosystem Accounting (SEEA EEA), formally published in 2014 as a joint publication of the United Nations, European Commission, Food and Agriculture Organization of the United Nations, Organisation for Economic Co-operation and Development, and World Bank to test the accounting framework (15, 16). Many regions, countries, and researchers have developed SEEA Central Framework and ecosystem accounts [regions and countries include southern Africa (75), India (76, 77), and Australia (78); researchers include Gundimeda (79), Cairns (80), Haripriya (81), Vincent & Hartwick (82), and Costanza et al. (83), who provide a review on ecosystem services] and their potential policy uses (see 84, 85). Readers are directed to Reference 73 for a review of how SEEA is being applied in policy and the implementation challenges.

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

3.5. Subjective Well-Being Indicators

In contrast, however, several researchers argue that well-being can be objective, subjective, or relational, and describing it requires understanding what people need to participate and flourish in society (86). Seminal work by Sen (87) challenged the traditional viewpoint of treating assets and income as welfare measures, as he believed that welfare depends on the functioning (basic life conditions) and capabilities (available opportunities) that the individual enjoys. An individual's well-being is thus relative to that of others in society. Subsequent studies defined well-being as including material and other aspects of an individual's quality of life (88). Objective well-being concerns the material conditions of life, while gauging subjective well-being is about evaluating an individual's personal circumstances and the satisfaction they experience with life. Based on the recommendations of the Commission on the Measurement of Economic Performance and Social Progress (7), various dashboard indicators that capture the multiple dimensions beyond GDP have been proposed. Gross national happiness (GNH) is a well-known measure beyond GDP, which measures a nation's collective satisfaction. The measurement domains for GNH include psychological well-being, material well-being/standard of living, good governance, health, education, community vitality, cultural diversity and resilience, balanced time use, and ecological diversity (89).

The OECD publishes a dashboard well-being index framed around four capitals (natural capital, social capital, human capital, and financial/physical capital) to organize indicators of long-term intergenerational well-being. These indicators include qualitative perception of the quality of life, subjective well-being indicators, and value judgments. The OECD Better Life Index (90, 91), New Zealand's Living Standards Framework (92), the Health 2020 WHO European policy framework (93), the HPI developed by the New Economics Foundation (94), and the United Kingdom's Measures of National Well-being are based on such a well-being framework. The UK Office for National Statistics (ONS) measure of well-being (95, 96) considers the indicators based on current well-being and indicators for future well-being. Some of the key dimensions considered under current well-being include income and wealth, work and job quality, healthy life expectancy, housing, health, knowledge and skills, environment quality, subjective well-being, safety, work-life balance, social connections, and civic engagement; resources for future well-being indicators include natural capital, human capital, social capital and economic capital. ONS publishes such dashboard indicators. The Statistics Netherlands Monitor of Well-being considers the well-being of the current generation, future generation, and people living in other countries. The World Values Survey (97) and Gallup, Inc. (98) administer the life satisfaction index and measure the overall self-reported and personal happiness (on a scale of 0 to 10).

3.6. Composite Indicators and Multidimensional Indicators

Understanding the performance of different countries requires tracking whether countries have conducive economic, social, institutional and environmental conditions to achieve macro well-being. Thus, there has been a consensus that one cannot rely on a single indicator; instead, a group of indicators are required to understand how well a country is doing. However, using multiple indicators can be challenging as they move in different directions. Several efforts have been made to develop a composite well-being index based on multidimensional indicators for easy interpretability (see Reference 99 for a detailed review of various indicators) weighted in some way to form a single index.

The first attempt to construct a composite well-being index was the Physical Quality of Life Index developed by the Overseas Development Council (100). This index combined infant mortality, life expectancy, and adult literacy. Another example is the well-known and debated HDI

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

created in 1990, based on Sen's capability approach, combining income per capita (in purchasing power parity terms), life expectancy at birth, adult literacy, and education enrollment ratio, which were normalized and aggregated into a single HDI (101). These measures are often used as a complementary measure of development along with the traditional GDP, which does not consider natural and environmental capital. An expanded version of HDI, based on unadjusted GDP per capita in the form of the Index for Human Progress, has been developed by the Fraser Institute. Additional indicators on health (consisting of life expectancy, infant mortality, mortality of children under age 5, and adult mortality rate), education (literacy rate, combined enrollment rate), technology (number of televisions, radios, and telephones per 1,000 persons), and GDP are used to compute the Index for Human Progress.

Neither of these measures considered the quality of the environment. Thus, HDI is adjusted with the planetary pressures to develop the Planetary Pressures–adjusted Human Development Index (PHDI) on an experimental basis. PHDI is the level of human development adjusted by carbon dioxide emissions per person (production-based) and material footprint per capita to account for excessive human pressure on the planet. PHDI approximates HDI when the planetary pressures are zero (102). PHDI has now been renamed the Sustainable Development Index. It measures the nations' ecological efficiency in delivering human development and divides it by two key indicators of ecological impact: carbon dioxide emissions and material footprint (103).

The Environmental Performance Index distils data on many sustainability issues into a single score for each country, providing a more disaggregated picture of specific environmental problems (104). It uses 40 indicators grouped under 11 issue categories (carbon dioxide growth rate, air quality, waste management, water and sanitation, heavy metals, biodiversity and habitat, ecosystem services, fisheries, agriculture, acid rain, and water resources) under three policy categories (environmental health, ecosystem vitality, and climate change). The Wellbeing Index developed by Prescott-Allen (105) is an arithmetic mean of a human well-being index and an ecosystem well-being index. The human well-being index is the arithmetic mean of five indices (based on 36 indicators) based on health and population, welfare, knowledge, culture, and society. The ecosystem well-being index comprises indices for land, water, air, species, and genes for resource deployment (see Reference 106 for a review of the consistency and meaningfulness of various composite indices).

4. FURTHER REFLECTIONS AND EMPIRICAL ILLUSTRATION

Despite plenty of criticism, GDP remains prominent due to its ease of interpretation and comparability across countries and time and the fact that it is likely to be correlated with many things that reflect human progress but are not measured in GDP directly. While there are many alternatives to GDP, it is important that these metrics also exhibit ease of interpretation and comparability across countries and time. But to demonstrate genuine additionality, these metrics need to focus on at least one of the following key questions: How well does the indicator add to our understanding of people's well-being, and can this well-being can be sustained in the future?

Responses to both foci involve greater creativity in augmenting (or revising) how SNA is constructed. In both cases, this creativity can occur wholly outside a national accounting framework. For example, in national accounting, proposals do exist on expanding sources of consumption [e.g., Kendrick (21), Eisner et al. (20)], of which accounting for the value of ecosystems is only the most recent incarnation. Beyond national accounts, well-being or consumption has other objective descriptors than those estimated in monetary terms. Creative approaches outside national accounts also include subjective assessments of how people—whose well-being is being considered—feel about their lives (107).

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

While sifting through and scrutinizing metrics within the beyond GDP debate might seem intractable and contentious, the task is made more manageable by recommendations such as notably that of the Commission on the Measurement of Economic Performance and Social Progress, which acknowledged that we cannot capture well-being through one indicator and that we need to monitor a plethora of indicators. A dashboard seems eminently sensible and a wiser response to the indicator debate. Put another way, this debate is not a search for one single indicator that can outcompete all of the competition. Indeed, it is hard to envisage a single indicator that credibly describes all relevant aspects of the development path. A better picture of whether countries are developing sustainably will require a judicious mix of indicators. In turn, that mix should reflect an array of perspectives.

Moreover, a range of approaches allows experimentation and new ideas. An optimistic view of the dashboard indicators is that they provide a simplified view and can withstand the critical scrutiny of rigour and usefulness, while other indicators may not survive with the passage of time. Not surprisingly, a well-identified dashboard of indicators has gained popularity among various statistical agencies and policymakers. However, it is worth noting that this approach was arguably a continuation of earlier contributions (e.g., 108).

A key point here is that if we understand a sensible response to going beyond GDP as a search for metrics to populate a dashboard, then several challenges arise. These include determining the content of what is likely to be a diverse dashboard and how policymakers can distil messages from it. But starting with the first point, the primary reason the dashboard commands some consensus is that no single metric (or even a limited suite of metrics) responds to critical facets of this debate. For example, the UN Development Programme HDI provides insights into the progress of nations in achieving human development outcomes as judged by the fulfillment of basic capabilities: a long and healthy life, access to knowledge, and a decent standard of living (101). But critically, it misses the impact of human activities on the environment and how this impact shapes prospects for human well-being (i.e., sustainability).

By contrast, measures such as ANS (i.e., genuine saving) or references to changing (inclusive or comprehensive) wealth warn about sustainability. These metrics shed light on whether the national balance sheet is growing or shrinking over time. Importantly, these assessments include what is happening to natural capital. However, a key concern is whether these metrics provide policymakers with the right signals. Specifically, a long-standing criticism is that such metrics focus on a relatively narrow array of natural capital, valued using prices that may be overly optimistic about the implications of a shrinking natural asset base. What is being asked here is whether such metrics convey to policymakers the appropriate biophysical or ecological realities (see the discussion of Daly's principles in Section 3). In economic terms, this is a debate about whether natural capital values reflect critical factors such as substitution possibilities between various types of wealth.

It is not implausible to anticipate progress that might address this apparent shortcoming in an indicator such as ANS or comprehensive wealth itself. As an illustration, Reference 109 provides valuable pointers for valuation in wealth accounting by making explicit estimates or assumptions about substitutability (or complementarity) between ecosystem services and produced goods. This focuses on a relative price effect: $\frac{1}{\sigma}[g_C - g_E]$. The first component of this term reflects substitution possibilities, with σ representing the elasticity of substitution (between produced goods, C, and ecosystem services, E). The second component is the per capita growth rates of these respective goods or services. Estimates for the former build on a body of empirical work and theory (e.g., 110, 111) that equates $1/\sigma$ to the income elasticity of willingness to pay for ecosystem services.[2]

[2]That income elasticity is estimated for a number of ecosystem service or ecosystem categories via statistical analysis of a database of empirical studies that have used the contingent valuation method.

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

Estimates for the latter equate g_C to the per capita growth in GDP, while g_E is calculated based on available data on changes in a range of physical metrics describing ecosystems or their service flows.

In the work of Heckenhahn & Drupp (109), the depletion and degradation of ecosystem assets appear to be the key drivers of the relative price effect. For the data in their paper, this translates into a substantial uplift required on the ecosystem service values used in Reference 44 in the region of 39 to 84%. That can be interpreted as a conservative estimate. More pessimistic assumptions about substitutability indicate uplift values of almost 300%. Such contributions do indicate that particular metrics are not based on static methods. That said, until practical accounting on these lines can genuinely be more routine, adding existing biophysical metrics into the dashboard mix is probably warranted.

This indicator debate refers to a somewhat different question when discussing well-being. This tradition in the beyond GDP debate thus emphasizes better measurement of current well-being. The claim that GDP does not achieve this is plausibly uncontroversial. That said, a less-than-perfect correlation between GDP and well-being does not mean the absence of correlation. So, defenders of GDP sometimes seek solace in that portion of other determinants of people's well-being it explains rather than what it does not explain. However, the subjective well-being debate takes this critical thinking in another direction. The key insight is that objectively measured income is imperfectly correlated with subjective assessments of people's well-being, notably life satisfaction. Furthermore, the emphasis on subjective assessment provides further insights, such as evidence showing that the rank and distribution of income of one's peer (or reference) group, rather than absolute income per se, matters most for life satisfaction (112).

In some respects, the focus on subjective well-being appears disconnected from most indicator debates. If that is the case, it continues a long-standing trend observed by Land & Michelis (25), who note this in the context of the social indicators debate more generally. That said, this divergence in the case of subjective well-being can be overstated. That is, subjective assessment measures well-being differently than do previously discussed indicators. However, clearly, the key is understanding well-being determinants (and thus changes), and many of these are connected to objective means of measuring development (e.g., 113, 114). Moreover, some of these determinants are presumably assets. So, there is a connection to other realms, although the surface of this has yet to be much scratched.

While there appears to be some agreement around the reasonableness of developing several indicators on a dashboard, how can policymakers distil development signals from these indicators? To illustrate this, we piece together the information available for India on some indicators that consider environmental impacts along with development (see **Figure 4**).

What do these numbers indicate in terms of descriptive content? India's per capita income has increased since 1990, and it is one of the fastest-growing economies in the world. Specifically, per capita income (based on purchasing power parity with 2017 USD) increased roughly threefold from 2,078 in 1995 to 6,681 in 2019. Savings rates are relatively strong and growing, with gross national savings almost a third of gross national income by the end of the period. Of course, the genuine picture for saving must also account for what is happening to the asset base via depreciation, including natural capital. However, while the ANS rate is lower than gross saving, it remains strongly positive in this respect. This is reflected by increasing total wealth over the period.

A point to make here is how this economic performance is distributed across India. A state-level analysis indicates that the overall change in the value of natural capital in India from 2004 to 2010 was negative. However, total wealth and investment are increasing as the human capital outweighs the natural capital depletion. Thus, India showed sustainable growth using a weak sustainability approach (115). The SEEA framework adjustments also provide interesting insights despite the

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

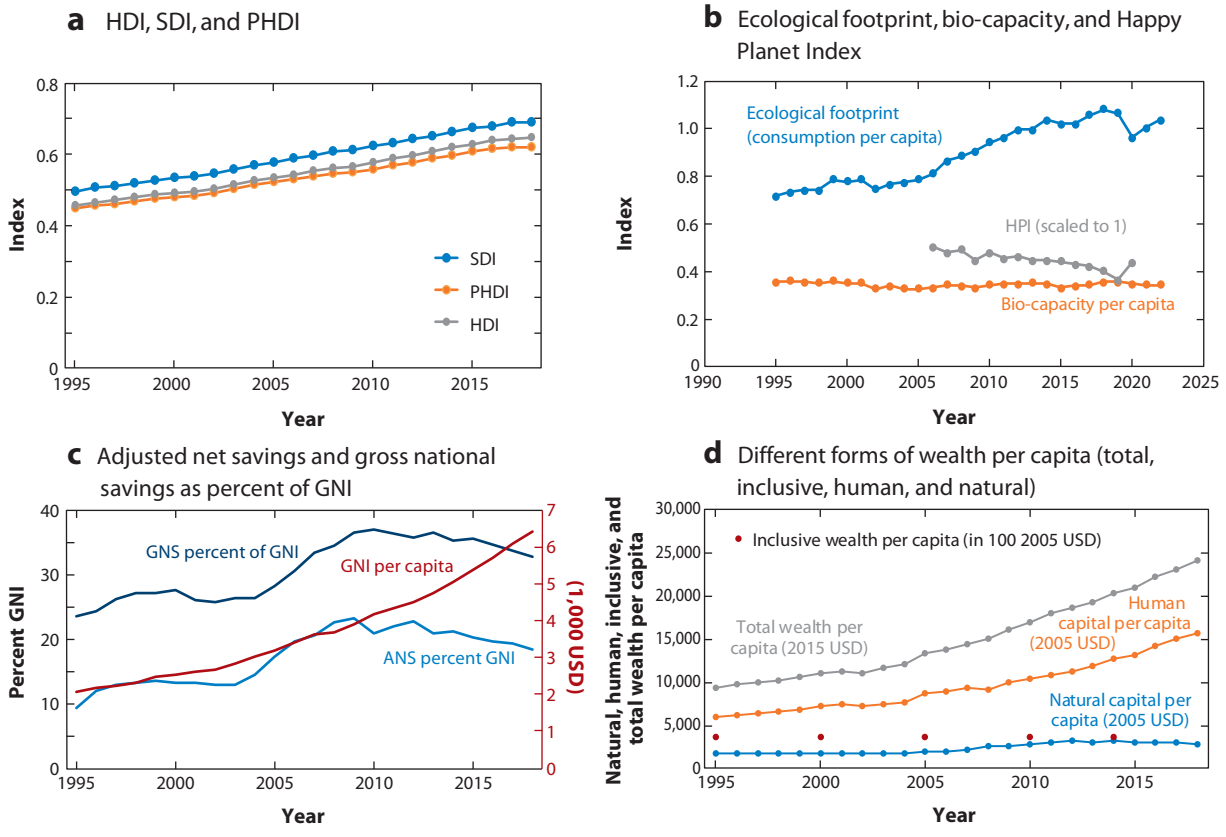


Figure 4

Comparing and contrasting the information conveyed by various approaches for India. (*a*) HDI, SDI, and PHDI. (*b*) Ecological footprint, bio-capacity, and HPI. (*c*) ANS and GNS as a percentage of GNI and GNI per capita. (*d*) Different forms of wealth per capita. Values in panel *d* are World Bank estimates. Abbreviations: ANS, adjusted net savings; GNI, gross national income; GNS, gross national savings; HDI, Human Development Index; HPI, Happy Planet Index; PHDI, Planetary Pressures–adjusted Human Development Index; SDI, Sustainable Development Index.

unavailable time series estimates. This drawing down of natural capital results in a reduction of environment-adjusted NDP by 0.1% of the 2001 net state domestic product (NSDP), as illustrated in Reference 76 for the wood-based values of forest resources, and if biodiversity values are considered, it reduces NSDP by additional 0.2% of the 2001 NSDP (see 116). The impact of unsustainable activities on agriculture and pasture shaves off 0.12% of the 2001 NSDP (117).

While encouraging, this picture is incomplete regarding broader human development and the implications of this development for environmental constraints. **Figure 4*a*** describes an improvement in India's HDI score from 0.458 in 1995 to 0.645 in 2019. India was ranked 120th on HDI in 1995 but slipped to 129th in 2019. The biophysical picture is more complex. For example, the PHDI improved from 0.449 in 1996 to 0.621 in 2018. However, India ranked 111 in 2019 on PHDI. The PHDI discounts the conventional HDI for pressures on the planet (by considering carbon dioxide emissions per capita and material footprint per capita) to reflect concerns for intergenerational inequality. Another composite indicator is the HPI, which considers a country's well-being (subjective life satisfaction based on data collected from the Gallup World Poll) with the life expectancy divided by ecological footprint (from the Global Footprint Network). On the

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

HPI, intended to measure well-being and environmental impact, India moved from 50.3 to 43.7 (on a scale of 100) and is ranked 128th out of 152 countries in 2021.

These composite indices are used to develop a normalized metric for biophysical constraints and social (or economic) metrics. It is important, too, to consider these biophysical indicators as stand-alone metrics. According to the data, the ecological footprint per capita (measured in global ha) increased from 0.71 in 1995 to 1.06 in 2019, while underlying bio-capacity is more or less constant for India (**Figure 4*b***). India, however, ranks relatively highly on the ecological footprint metric (30 out of 152 countries). Of course, the trajectory, given the trend and unless economic growth is green growth, is perhaps less encouraging.

5. CONCLUSIONS

Around 500 metrics are mentioned in the compendium of sustainable development indicators. This single illustration of the legacy of the ongoing GDP debate illustrates great strengths and weaknesses. The main weakness is perhaps apparent: Such a voluminous compendium risks being a source of confusion for policymakers, and in response to this, the temptation of such actors to resort to a single metric is perhaps understandable. The breadth and depth of the beyond GDP debate provide a welcome source of experimentation in developing metrics. This article focuses on various indicators that better measure well-being and/or whether that well-being can be sustained. We began by framing this discussion concerning trends in the literature based on search terms explored within, for example, scientific databases of published papers. The characterizations of the literature can be sliced in many ways. We identified some themes that formed the basis of our subsequent discussion in this review.

Wealth accounting is one prominent theme here. While this approach does have a narrower definition (i.e., estimating national balance sheets) than some others, it reflects a variety of contributions that focus not just on wealth but also on saving (and investment) as well as income and consumption. The beyond GDP dimension here is that the focus is on metrics that better reflect what is happening to well-being along a development path. By contrast, the conventional national accounts can only be viewed as informing economic activity.

Much of this work in wealth accounting has been preoccupied with measuring how natural wealth is changing and how it supports human well-being and development. Yet biophysical indicators also constitute a distinct area of activity in this debate. The emphasis here is not on better measuring well-being but on accounting for elements that might impose constraints on that well-being. Put another way, the claim is that development is unsustainable if those constraints are breached. Moreover, these metrics relate to concerns about environmental sustainability, notably with, e.g., planetary boundaries. The notion of an ecological footprint is the most prominent example of such an indicator.

Social indicators, by contrast, often deal directly with the measurement of well-being. Traditionally, this involved searching for so-called objective measures. Still, an interesting development for over a decade has been well-being metrics based on the subjective assessment of those under consideration, i.e., subjective well-being.

Of course, any such array of ensuing metrics requires methods to aggregate, summarize, or group these indicators. Again, there are different means of answering this. Aggregation in wealth accounting is a matter of adding components in comparable metrics, i.e., monetary values, where these values reflect the importance of the components in economic (or well-being) terms. Composite indicators achieve this aggregation via normalizing metrics originally measured in diverse units.

Few even argue that the endgame beyond GDP entails alighting on one highly aggregated indicator. A growing consensus is coalescing around the more pragmatic goal of assembling

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

such metrics within a dashboard. This complicates the cognitive task for policymakers seeking to understand the development challenge. Whether this complication is truly an artifact of the dashboard is debatable. Even if one summary metric is a realizable goal, policymakers must still understand its constituents to appreciate its policy implications properly. We provide an illustrative dashboard comprising aggregated metrics, composite indices, and single or stand-alone metrics for India. While it is not the last word on what such a dashboard might look like for this national economy, the indicators we assemble paint a compelling picture of past development and illustrate future development prospects' challenges.

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

SUMMARY POINTS

1. The beyond GDP debate concerns measuring human progress (or well-being). Striking progress has been made, although the breadth of this measurement agenda is just as striking. We distil several themes based on search terms as the starting point for our review.
2. Key themes include wealth accounting, biophysical indicators, and social indicators. Some of these themes work within the existing national accounts (e.g., augmenting and extending concepts related to GDP), while other approaches work outside of this framework (e.g., offering very different alternatives to GDP).
3. Dashboards of these metrics are an understandable response to this diversity in measurement and the accompanying policy challenges. We illustrate a dashboard for India's case. Critically, any such dashboard must be capable of telling a coherent story about human progress and its sustainability, elucidating trade-offs and complementarities between dashboard contents.

FUTURE ISSUES

1. Our candidate dashboard for India is only one illustration. Work remains to be done to establish the breadth and depth of any indicator dashboard. Whether it should include everything (e.g., the Sustainable Development Goals) or some narrower subset of metrics is an important question to ask as a starting point.
2. Meaningful connections are made between the metric themes we identify, all suggestive of work in progress. The evolving integration of insights from biophysical metrics to wealth accounting (i.e., natural capital) is imperative.
3. Research within a theme can inform research in others. Social indicators commonly make little explicit reference to wealth and how social progress or well-being is being sustained over time. Wealth-based approaches say little currently about inequality in wealth (beyond broad cross-country insights).

DISCLOSURE STATEMENT

The authors are unaware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

AUTHOR CONTRIBUTIONS

H.G. was invited to lead this article, conceived the overall framing, including the approval of the technical abstract, and invited G.A. to coauthor. H.G. wrote Sections 2 and 3, the India case

analysis in Section 4, and the initial draft of Section 1, and handled overall article editing, formatting, and bibliography. G.A. contributed to Section 1; wrote most of Section 4, the Conclusions section, Future Issues, Summary Points, and abstract; and contributed to the article's overall editing. The article writing and revisions were completed in a mutually consultative and coordinated process.

ACKNOWLEDGMENTS

The authors would like to thank Aditi Samant Singar for her help with the network map of keyword indicators.

LITERATURE CITED

1. Coyle D. 2014. *GDP: A Brief but Affectionate History*. Princeton, NJ: Princeton Univ. Press. Rev. ed.
2. Philipsen D. 2015. *The Little Big Number: How GDP Came to Rule the World and What to Do About It*. Princeton, NJ: Princeton Univ. Press
3. Masood E. 2021. *GDP: The World's Most Powerful Formula and Why It Must Now Change*. London: Icon. 4th ed.
4. Bleys B. 2012. Beyond GDP: classifying alternative measures of progress. *Soc. Indic. Res.* 109:355–76
5. Bleys B. 2015. Barriers and opportunities for alternative measures of economic welfare. *Ecol. Econ.* 117:162–72
6. Agarwala M. 2020. *Natural capital accounting and the measurement of sustainability*. PhD Thesis, London Sch. Econ. Political Sci., London
7. Stiglitz JE, Sen A, Fitoussi JP. 2009. *Report by the Commission on the Measurement of Economic Performance and Social Progress*. Rep., Comm. Meas. Econ. Perform. Soc. Prog., Paris
8. Van Den Bergh J. 2009. The GDP paradox. *J. Econ. Psychol.* 30(2):117–35
9. Pintér L, Hansen H. 2008. Compendium of sustainable development indicator initiatives: a global directory of comprehensive indicator systems. *Environ. Health* 8(2):88–111
10. Canadian Index of Wellbeing. 2016. *How are Canadians Really Doing? The 2016 National Report*. Faculty Appl. Sci., Univ. Waterloo, Waterloo, ON, Can.
11. Wackernagel M, Rees W. 1996. *Our Ecological Footprint: Reducing Human Impact on the Earth*. Philadelphia: New Soc.
12. Barbier E. 2022. *Economics for a Fragile Planet: Rethinking Markets, Institutions and Governance*. Cambridge, UK: Cambridge Univ. Press
13. Kahneman D, Diener E, Schwarz N, eds. 1999. *The Foundations of Hedonic Psychology*. New York: Russell Sage Found.
14. Waterman A. 1993. Two concepts of happiness: contrasts personal expressiveness (eudaimonia) and hedonic enjoyment. *J. Personal. Soc. Psychol.* 64:678–91
15. United Nations. 2012. *System of Environmental-Economic Accounting 2012: central framework*. Manual, UN, New York
16. United Nations. 2018. *Introduction to SEEA ecosystem accounting*. Rep., UN, New York. **https://seea.un.org/Introduction-to-Ecosystem-Accounting**
17. United Nations. 2009. *System of national accounts*. Rep., UN, New York
18. United Nations. 1953. *A system of national accounts and supporting tables*. Rep., UN, New York
19. Nordhaus WD, Tobin J. 1972. Is growth obsolete? In *Economic Research: Retrospect and Prospect*, Vol. 5, *Economic Growth*, ed. WD Nordhaus, J Tobin, pp. 1–80. Cambridge, MA: NBER
20. Eisner R, Simons E, Pieper P, Bender S. 1982. Total incomes in the United States, 1946–76: a summary report. *Rev. Income Wealth* 28(2):133–74
21. Kendrick JW. 1976. *The Formation and Stocks of Total Capital*. Cambridge, MA: NBER
22. Ruggles R, Ruggles ND. 1982. Integrated economic accounts for the United States 1947–90. *Survey Curr. Bus.* 62:1–53
23. Zolotas X. 1981. *Economic Growth and Declining Social Welfare*. New York: NYU Press

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

24. Eisner R. 1988. Extended accounts for national income and product. *J. Econ. Lit.* 25(4):1611–84
25. Land K, Michelis A. 2018. Fifty years after the social indicators movement: Has the promise been fulfilled? An assessment and agenda for the future. *Soc. Indic. Res.* 135:835–68
26. Arrow KJ, Dasgupta P, Goulder LH, Mumford KJ, Oleson K. 2012. Sustainability and the measurement of wealth. *Environ. Dev. Econ.* 17(3):317–53
27. Afsa C, Blanchet D, Marcus V, Pionnier P-A, Rioux L, et al. 2008. *Survey of existing approaches to measuring socio-economic progress*. Rep., Comm. Meas. Econ. Perform. Soc. Prog., Paris
28. Weitzman M. 1976. On the welfare significance of national product in a dynamic economy. *Q. J. Econ.* 90:156–62
29. Weitzman M, Ashiem G. 2001. Does NNP growth indicate welfare improvement? *Econ. Lett.* 73(2):233–39
30. Hartwick J. 1977. Intergenerational equity and investing of rents from exhaustible resources. *Am. Econ. Rev.* 67(5):972–74
31. Solow R. 1986. On the intergenerational allocation of natural resources. *Scand. J. Econ.* 88(1):141–49
32. Hartwick J. 1990. Natural resources, national accounting and economic depreciation. *J. Public Econ.* 43(3):291–304
33. Gundimeda H. 2014. Forest resource accounting. In *Handbook of Forest Economics*, ed. S Kant, J Alavalapati, pp. 504–20. London: Routledge
34. Daly H, Cobb JB. 1989. *For the Common Good.* Boston: Beacon
35. Stockhammer E, Hochreiter H, Obermayr B, Steiner K. 1997. The index of sustainable economic welfare (ISEW) as an alternative to GDP in measuring economic welfare. The results of the Austrian (revised) ISEW calculation 1955–1992. *Ecol. Econ.* 21:19–34
36. Cobb C, Halstead T, Rowe J. 1995. *The Genuine Progress Indicator: summary of data and methodology*. Rep., Redefining Progress, Washington, DC
37. Kenny DC, Costanza R, Dowsley T, Jackson N, Josol J, et al. 2019. Australia's Genuine Progress Indicator revisited (1962–2013). *Ecol. Econ.* 158:1–10
38. Kubiszweski I, Costanza R, Franco C, Lawn P, Talberth J, et al. 2013. Beyond GDP: measuring and achieving global genuine progress. *Ecol. Econ.* 93:57–68
39. Kubiszweski I, Costanza R, Gorka NE, Weisdorf MA, Carnes AW, et al. 2015. Progress indicator (GPI) for Oregon from 1960–2010 and recommendations for a comprehensive shareholder's report. *Ecol. Econ.* 119:1–7
40. Pearce DW, Atkinson GD. 1993. Capital theory and the measurement of sustainable development: an indicator of "weak" sustainability. *Ecol. Econ.* 8:103–8
41. Hamilton K, Clemens M. 1999. Genuine saving rates in developing countries. *World Bank Econ. Rev.* 13:333–56
42. World Bank. 2005. *Where Is the Wealth of Nations?* Washington, DC: World Bank
43. World Bank. 2011. *The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium*. Washington, DC: World Bank
44. World Bank. 2021. *The Changing Wealth of Nations 2021: Managing Assets for the Future*. Washington, DC: World Bank
45. Hamilton K, Hartwick J. 2014. Wealth and sustainability. *Oxf. Rev. Econ. Policy* 30:170–87
46. Neumayer E. 2013. *Weak Versus Strong Sustainability: Exploring the Limits of Two Opposing Paradigms*. Cheltenham, UK: Elgar Online. 4th ed.
47. Dasgupta P, Mäler KG. 2000. Net national product, wealth, and social well-being. *Environ. Dev. Econ.* 5(1/2):69–93
48. Dasgupta P. 2001. *Human Well-Being and the Natural Environment*. Oxford, UK: Oxford Univ. Press
49. Duraiappah AK, Munoz P. 2012. Inclusive wealth: a tool for the United Nations. *Environ. Dev. Econ.* 17(3):362–67
50. Hamilton K, Hartwick JM. 2005. Investing exhaustible resource rents and the path of consumption. *Can. J. Econ.* 38(2):615–21
51. Polasky S, Bryant B, Hawthorne P, Johnson J, Keeler B, Pennington D. 2015. Inclusive wealth as a metric of sustainable development. *Annu. Rev. Environ. Resour.* 40:445–66

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

52. UNU-IHDP (UN Univ. Int. Hum. Dimens. Prog.), UNEP (UN Environ. Prog.). 2014. *Inclusive Wealth Report 2014: Measuring Progress Towards Sustainability*. Cambridge, UK: Cambridge Univ. Press
53. UNEP (UN Environ. Prog.). 2018. *Inclusive Wealth Report 2018: Measuring Progress Towards Sustainability*. Cambridge, UK: Cambridge Univ. Press
54. Hamilton K. 2012. Comments on Arrow et al., 'Sustainability and the measurement of wealth.' *Environ. Dev. Econ.* 38(2):256–61
55. Engelbrecht HJ. 2016. Comprehensive versus inclusive wealth accounting and the assessment of sustainable development: an empirical comparison. *Ecol. Econ.* 129:12–20
56. Roman P, Thiry G. 2016. The inclusive wealth index: a critical appraisal. *Ecol. Econ.* 124:185–92
57. Solow R. 2012. A few comments on 'Sustainability and measurement of wealth.' *Environ. Dev. Econ.* 17:354–55
58. Gundimeda H, Atkinson G. 2014. Forest wealth of nations. See Ref. 52, pp. 137–58
59. Barbier E. 2014. Challenges to ecosystem service valuation for wealth accounting. See Ref. 52, pp. 159–78
60. Daly H. 1991. Towards an environmental macroeconomics. *Land Econ*. 67(2):255–59
61. Rees W, Wackernagel M. 2004. Ecological footprints and appropriated carrying capacity: measuring the natural capital requirements of the human economy. *Sustain. Sustain. Indic.* 4:151–81
62. Moran DD, Wackernagel M, Kitzes JA, Goldfinger SH, Boutaud A. 2008. Measuring sustainable development - nation by nation. *Ecol. Econ.* 64:470–74
63. Hoekstra AY, Wiedmann TO. 2014. Humanity's unsustainable environmental footprint. *Science* 344:1114–17
64. Steen-Olsen K, Wood R, Hertwich EG. 2016. The carbon footprint of Norwegian household consumption 1999–2012. *J. Ind. Ecol.* 20(3):582–92
65. Kitzes J, Galli M, Baglianic J, Barrett G, Dige S, et al. 2009. A research agenda for improving national ecological footprint accounts. *Ecol. Econ.* (68):1991–2007
66. WWF (World Wildl. Found.). 2020. *Living planet report 2020 - bending the curve of biodiversity loss*. Rep., World Wildl. Found., Gland, Switz.
67. Peskin HM. 1989. *Accounting for natural resource depletion and degradation in developing countries*. Environ. Dep. Work. Pap. 13, World Bank, Washington, DC
68. El Serafy E. 1989. The proper calculation of income from depletable natural resources. In *Environmental Accounting for Sustainable Development*, ed. Y Ahmad, S El Serafy, E Lutz, pp. 10–18. Washington, DC: World Bank
69. Repetto R, Magrath W, Wells M, Beer C, Rossini F. 1989. *Wasting assets: natural resources in the national income accounts*. Rep., World Res. Inst., Washington, DC
70. Bartelmus P, Tongeren V. 1994. *Environmental Accounting: An Operational Perspective*. New York: UN Stat. Off.
71. Alfsen K, Greaker M. 2007. From natural resources and environmental accounting to construction of indicators for sustainable development. *Ecol. Econ.* 61(4):600–10
72. Keuning S, van Dalen J, de Haan M. 1999. The Netherlands' NAMEA; presentation, usage and future extensions. *Struct. Change Econ. Dyn.* 10(1):15–37
73. Bartelmus P. 1999. Green accounting for a sustainable economy: policy use and analysis of environmental accounts in the Philippines. *Ecol. Econ.* 29:155–70
74. Hamilton K, Lutz E. 1996. *Green national accounts: empirical uses and policy experiences*. Environ. Dep. Pap. 039, World Bank, Washington, DC
75. Lange GM. 2014. An approach to sustainable water management in Southern Africa using natural resource accounts: the experience in Namibia. *Ecol. Econ.* 26(3):299–311
76. Gundimeda H, Sukhdev P, Rajeev SK, Sanyal S. 2007. Natural resource accounting for Indian States – illustrating the case of forest resources. *Ecol. Econ.* 61(4):635–49
77. Atkinson G, Gundimeda H. 2007. Accounting for India's forest wealth. *Ecol. Econ.* 59(4):462–76
78. Vardon M, Lenzen M, Peevor S, Creaser M. 2006. Water accounting in Australia. *Ecol. Econ*. 61(4):650–59
79. Gundimeda H. 2000. Integrating forest resources into the system of national accounts in Maharashtra, India. *Environ. Dev. Econ.* 5:143–56
80. Cairns R. 2005. Accounting for resource depletion - a microeconomic approach. *Rev. Income Wealth* 46(1):21–31

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

81. Haripriya GS. 1998. Forest resource accounting: preliminary estimates for the state of Maharashtra. *Dev. Policy Rev.* 16(2):131–51
82. Vincent JR, Hartwick JM. 1997. *Accounting for the benefits of forest resources*. Rep., Food Agric. Organ. UN, Rome
83. Costanza R, de Groot R, Braat L, Kubiszweski I, Fioramanti L, et al. 2017. Twenty years of ecosystem services: How far have we come and how far do we still need to go? *Ecosyst. Serv.* 28:1–16
84. Smith R. 2014. *Users and Uses of Environmental Accounts: A Review of Selected Developed Countries*. Washington, DC: World Bank
85. Ruijs A, Vardon M, Bass S, Ahlroth S. 2018. Natural capital accounting for better policy. *Ambio* 48:714–25
86. Boarini R, Kolev A, McGregor A. 2014. *Measuring well-being and progress in countries at different stages of development: towards a more universal conceptual framework*. Work. Pap., Organ. Econ. Co-op. Dev., Paris
87. Sen A. 1984. The living standard framework. *Oxf. Econ. Pap.* 36:74–90
88. Nussbaum MC, Sen A. 1993. *The Quality of Life*. Oxford, UK: Clarendon
89. Ura K, Akire S, Wangdi K, Zangmo T. 2023. *Gross National Happiness 2022*. Thimpu, Bhutan: Cent. Bhutan and GNH Stud.
90. Durand M. 2015. The OECD Better Life Initiative: *How's life?* And the measurement of well-being. *Rev. Income Wealth* 61(1):4–17
91. Koronokas G, Smirilis Y, Sotiros D, Despotis DK. 2020. Assessment of OECD Better Life Index by incorporating public opinion. *Socio-Econ. Plan. Sci.* 70:100699
92. The Treasury. 2021. *The Living Standards Framework (LSF) 2021*. Work. Pap., Treas., N. Z. Gov., Wellington, NZ
93. World Health Organ. Reg. Off. Eur. 2013. *Health 2020: a European policy framework and strategy for the 21st century*. Rep., World Health Organ. Reg. Off. Eur., Copenhagen, Den.
94. Marks N, Abdallah S, Simms A, Thompson S. 2006. *The Happy Planet Index: an index of human well-being and ecological impact*. Rep., New Econ. Found., London
95. Off. Natl. Stat. 2015. *Measuring national well-being, personal well-being in the UK: three year data 2011/14*. Rep., Off. Natl. Stat., London
96. Tinkler L. 2015. The Office for National Statistics experience of collecting and measuring national well-being. *Stat. Trans. New Ser.* 16(3):373–96
97. World Values Survey. 2020. *World Values Survey*. World Values Survey Assoc., Vienna, Austria. **https://www.worldvaluessurvey.org/wvs.jsp**
98. Deaton A. 2008. Income, health and well-being around the world: evidence from the Gallup World Poll. *J. Econ. Perspect.* 22(2):53–72
99. Bérenger V, Verdier-Chouchane A. 2007. Multidimensional measures of well-being: standard of living and quality of life across countries. *World Dev.* 35(7):1259–76
100. Morris MD. 1978. A physical quality of life index. *Urban Ecol.* 3(3):225–40
101. UNDP (UN Dev. Progr.). 2024. *Human Development Index (HDI)*. Database, UN, New York. **https://hdr.undp.org/data-center/human-development-index#/indicies/HDI**
102. UNDP (UN Dev. Progr.). 2001. *Planetary Pressures–adjusted Human Development Index*. Rep., UN, New York
103. Hickel H. 2020. The sustainable development index: measuring the ecological efficiency of human development in the Anthropocene. *Ecol. Econ.* 167:106331
104. Esty DC, Levy MA, Srebotnjak T, Sherbinin A, Kim CH, Anderson B. 2006. *Pilot 2006 Environmental Performance Index*. Rep., Yale Cent. Environ. Law Public Policy, New Haven, CT
105. Prescott-Allen R. 2001. *The Wellbeing of Nations: A Country by Country Index of Quality of Life and Environment*. London: Island
106. Böhringer C, Jochem PE. 2007. Measuring the immeasurable – a survey of sustainability indices. *Ecol. Econ.* 63(1):1–8
107. Gough I, McGregor JA, eds. 2007. *Wellbeing in Developing Countries: From Theory to Research*. Cambridge, UK: Cambridge Univ. Press
108. Dep. Environ. Transp. Reg. 2000. *Quality of life counts*. Handb., Dep. Environ. Food Rural Aff., London
109. Heckenhahn J, Drupp MA. 2024. Relative price changes of ecosystem services: evidence from Germany. *Environ. Res. Econ.* 87:833–89

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59

110. Ebert U. 2003. Environmental goods and the distribution of income. *Env. Resour. Econ.* 25:435–59
111. Baumgärtner S, Drupp MA, Meya JN, Munz JM, Quaas MF. 2017. Income inequality and willingness to pay for environmental public goods. *J. Environ. Econ. Manag.* 85:35–61
112. Kahneman D, Krueger AB. 2006. Developments in the measurement of subjective well-being. *J. Econ. Perspect.* 20:3–24
113. Boarini R, Comola M, Smith C, Manchin R, de Keulenaer F. 2012. *What makes for a better life? The determinants of subjective well-being in OECD countries – evidence from the Gallup World Poll*. Work. Pap., Organ. Econ. Co-op. Dev., Paris
114. Ngamaba KH. 2017. Determinants of subjective well-being in representative sample of nations. *Eur. J. Public Health* 27(2):377–82
115. Gundimeda H. 2016. How equitable and sustainable is the growth in India? *Sarvekshana* 31(3–4):22–34
116. Gundimeda H, Sukhdev P, Sinha R, Sanyal S. 2006. *The Value of Biodiversity in Indian Forests*. New Delhi: TERI. 3rd ed.
117. Gundimeda H, Sukhdev P, Sinha R, Sanyal S. 2005. *Estimating the Value of Agricultural Cropland and Pastureland in India*. New Delhi: TERI

Downloaded from www.annualreviews.org. Guest (guest) IP: 81.97.182.89 On: Thu, 24 Oct 2024 10:47:59