

1. Introduction

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Sustainable development is a concept that almost everybody has heard of but few understand. That so many people are familiar with the term is quite remarkable considering it was virtually unknown until the release of the Brundtland Report by the World Commission on Environment and Development in 1987 (WCED, 1987). Indeed, it was not until the 1992 Earth Summit in Rio de Janeiro and the widespread promotion of the United Nations' Agenda 21 that sustainable development became firmly established as a desirable policy objective (UN, 1993). Since this time, many national governments have introduced a range of new policy measures in an attempt to steer their economies along a more sustainable path. On the surface, at least, this appears to be a positive trend. But should we be scratching the surface and asking whether nations have been successful in moving toward the sustainable development goal? Is it possible that we have focused too heavily on policy measures and have forgotten to supplement the means to achieving sustainable development with a suitable range of indicators to assess a nation's sustainable development performance? Or, alternatively, do we now have appropriate sustainable development indicators at our disposal but the policies implemented to achieve sustainable development have been horrendously conceived and/or inadequately implemented? Either way, we could be aimlessly moving along a catastrophic pathway or, as Costanza (1987) describes it, be caught in a 'social trap' because of a reliance on misleading signals or a failure to heed the warning signs revealed by recently established indicators.

Given the questions asked above, the main aim of this book is to provoke academics, policy-makers, civil servants, business leaders, and activists to think more seriously about: (1) the importance of sustainable development indicators; (2) the potential value and shortcomings of the sustainable development indicators already in use; and (3) how sustainable development indicators can be improved so as to better inform us of the impact of past policies and what is required to avoid past failings. The book contains chapters on indicators that have been specifically designed to measure sustainable development. Each invited contributor is either a practitioner in

the field of sustainable development indicators or has intimate knowledge of sustainable development indicators given their research and/or professional background.

The range of contributions and the means by which the book is presented is designed to allow readers to make their own mind up about the policy-guiding value of sustainable development indicators. Despite the weaknesses of some indicators, the consistent message revealed by the contributors suggests, if nothing else, that the quest for appropriate sustainable development indicators is critically important. But the need to refine and improve upon existing sustainable development indicators remains acute. So, too, is the responsibility of the advocates of sustainable development indicators to discard an unworthy or misleading indicator.

The book is divided into six sections of which the chapters contained in each of the four main sections – Parts II, III, IV and V – share a common theme. Part I, as the introductory section of the book, includes a foundational chapter on the sustainable development concept and sustainable development indicators (Chapter 2). The aim of this chapter is to employ a linear throughput model in the context of a coevolutionary worldview to establish a broad definition of sustainable development. Narrower definitions of sustainable development are then put forward to serve as the theoretical and philosophical justification for each of the sustainable development indicators discussed in the book.

Part II, on green national accounting, focuses on how conventional macroeconomic indicators can be adjusted to provide a more accurate assessment of a nation's sustainable development performance. In Chapter 3, Salah El Serafy argues that the aim of green national accounting should be the proper estimation of a nation's sustainable output for economic policy purposes. It should not, according to El Serafy, be used to estimate the welfare generated by a nation's economic activity or serve as a guide to environmental policy. El Serafy particularly warns against the 'strong sustainability' practice of fully expunging the value contributed by the resource extraction sector. Only when national accounting adjustments involve a deduction of the 'user cost' of natural resource depletion – which constitutes a portion of all resource extraction losses – do we obtain a proper measure of national income that can help policy-makers to steer national economies in the right direction.

As for welfare, El Serafy argues that national welfare assessment is an entirely different exercise to national product calculations. As such, national accounts should not be adjusted in the false hope of obtaining better indicators of the welfare generated by a nation's economic activity. Although El Serafy does not explicitly argue against national welfare assessments, he is adamant that welfare calculations – such as the Index of

Sustainable Economic Welfare – should remain outside the conventional national accounting framework.

In the following chapter (Chapter 4), John Lintott points out that successful policy-making requires a source of statistical information to assist in the planning for and assessment of policy outcomes. Since environmental accounts provide a valuable statistical framework in the case of policies that affect the natural environment, Lintott argues that environmental accounts should be elevated to the core of the overall statistical system.

Since this raises issues as to what type of statistical framework can contribute to more appropriate policy-making, Lintott questions the development and use of consumption-based indicators – particularly given the tenuous link between consumption and welfare once a certain level of affluence is reached. Lintott therefore believes it is efficacious to combine accounts in physical units with a set of social and environmental indicators and to make a coherent connection between these and the existing monetary-based accounting system.

In Chapter 5, Asbjørn Aaheim, in demonstrating how green national accounts can incorporate natural resource and environmental valuations, discusses some of the problems associated with the numerical assessment of values. According to Aaheim, a major problem arises because although traditional national accounts are based on readily observable prices and quantities, the prices applicable to environmental standards and natural resources are rarely apparent. Aaheim therefore focuses on the role of prices and the fundamental differences in the valuation techniques used.

To arrive at an appropriate set of prices for green national accounting, Aaheim believes that one must first take account of any reallocation of initial endowments that may result from environmental stress. According to Aaheim, this can be achieved through the use of general equilibrium models whereby prices can be calculated endogenously. By considering some of the potential impacts of climate change on forest productivity, and personal demand for various transport modes in Norway, Aaheim shows how assessments of environmental change can be used to establish relationships between environmental stresses and economic activities. Aaheim concludes that the indirect macroeconomic effects of climate change are not only significant, but an assessment of this type can itself provide a far richer understanding of the economic consequences of climate change.

In Chapter 6, Simon Dietz and Eric Neumayer critically appraise the Genuine Savings (GS) approach to sustainability assessments. Dietz and Neumayer reveal some of the weaknesses inherent in GS estimates and, consistent with El Serafy's conclusions regarding green adjustments to GDP, show that GS measures are only meaningful with respect to the weak

sustainability paradigm. Despite this, Dietz and Neumayer believe that existing GS estimates are sufficiently robust to indicate that many resource-dependent countries are already failing to invest sufficiently in the establishment of suitable replacement assets. This, they argue, undermines their capacity to sustain current income levels.

Part III deals with two sustainable development indicators designed to measure sustainable economic welfare at the national level – namely, the Index of Sustainable Economic Welfare (ISEW) and the Genuine Progress Indicator (GPI). In Chapter 7, Philip Lawn addresses three of their perceived weaknesses: (1) the lack of a sound theoretical foundation; (2) the shortcomings associated with the valuation methods used in their construction; and (3) the dubious interpretation of ISEW and GPI results. By focusing on the individual items of which the ISEW and GPI are comprised, Lawn demonstrates that both indexes are, theoretically at least, soundly based on Fisher's (1906) concept of income and capital. While agreeing with many of the criticisms relating to (2) and (3), Lawn believes the ISEW and GPI are more reliable measures of sustainable economic welfare than mainstream macroeconomic indicators, such as GDP. Notwithstanding this, Lawn urges all ISEW and GPI advocates to establish a more consistent and robust set of valuation methods to increase their mainstream acceptance.

In Chapter 8, Matthew Clarke presents the results of an ISEW study of Thailand. By incorporating systems analysis into the calculation of the ISEW, Clarke shows that the threshold point at which macroeconomic growth begins to lower economic welfare need not be confined to industrialised countries. Moreover, Clarke believes the ISEW demonstrates why there is a need to broaden the policy prescriptions beyond the current predilection with continuing economic growth. Clarke concludes his chapter by highlighting the strengths and weaknesses of the ISEW and what is required to increase its policy appeal.

In Chapter 9, Simon Dietz and Eric Neumayer warn of the potential pitfalls when interpreting studies involving the ISEW and GPI. Given the inadequate nature of some of the valuation methods and assumptions used to calculate the ISEW and GPI, Dietz and Neumayer believe the two indexes can misleadingly support the 'threshold hypothesis' put forward by Max-neef (1995) and respectively referred to by Lawn and Clarke in Chapters 7 and 8.

Few would doubt the critical role played by the natural environment in achieving ecological sustainability. Because of it, Part IV is devoted to natural capital accounting. In Chapter 10, Richard W. England employs classical thermodynamics and ecological principles to establish a conceptual framework for theorising about economy–environment interactions.

England uses this framework to outline three useful definitions of natural capital. By showing that the capitalised value of natural capital can vary significantly depending, firstly, on how natural capital is defined, and secondly, on how the future stream of benefits it generates is discounted, England believes a high research priority should be given to improving the ISEW discussed in Part III of the book. Having said this, England stresses that the sheer magnitude of the capitalised value of natural capital – irrespective of how much estimates have tended to vary – is sufficient to indicate that its continued depletion will have tragic consequences for humanity.

In Chapter 11, de Groot et al. show how natural capital can be classified and measured to facilitate ecological sustainability. Using the concept of ‘critical natural capital’, they present a framework to select indicators that can be used to systematically assess the criticality of ecosystems in terms of their ecological, economic and cultural importance. The framework is developed on the basis that since ecological indicators exist in a variety of forms, common denominators need to be found to describe (1) the *threat* to natural capital (pressure–state–impact), and (2) the *importance* of natural capital in terms of ecosystem services and values.

Following the presentation of a European-based study involving the calculation of a natural capital index (NCI), four individual case studies are revealed as examples of how the proposed indicator framework can assist in determining the criticality of natural capital. Finally, de Groot et al. conclude by stressing that critical natural capital indicators must take account of the important environmental services provided by natural capital as well as the link between these services and the overall condition of the natural capital that generates them.

A different approach to natural capital accounting is outlined by Wackernagel et al. in Chapter 12. Using the well-known ecological footprint concept, Wackernagel et al. provide evidence to suggest that humankind is eroding the natural resource base upon which it depends (i.e. per capita ecological footprint is exceeding the planet’s per capita biocapacity). Following a brief explanation of what the ecological footprint means in terms of ecological ‘overshoot’, Wackernagel et al. focus on the limitations of their estimates and respond to some of the criticisms levelled at the ecological footprint concept. Wackernagel et al. then give an interpretative account of their ecological footprint estimates to illustrate how the concept can guide policy-makers to institute the reforms necessary to achieve ecological sustainability.

In Chapter 13, the final chapter on natural capital accounting, David Rapport and Ola Ullsten respond to the lack of readily communicable information on the state of the environment by proposing a forest capital

index (FCI). Although the FCI would be designed to assess the ecological sustainability of forest ecosystems, Rapport and Ullsten believe the FCI represents an opportunity to develop indices for communicating the status of other critical environmental assets.

Following a discussion on such concepts as ecological footprints, ecological integrity, and ecosystem health – each with its own unique focus and particular strengths and weaknesses – Rapport and Ullsten describe, in considerable detail, how the FCI might be constructed. According to Rapport and Ullsten, critical factors to consider include: (1) the selection of existing forest-related indicators; (2) the development of ecological thresholds and targets upon which to base the FCI; (3) an explanation as to how the chosen indicators can be suitably aggregated; and (4) how changes in the FCI should be interpreted. In addition, Rapport and Ullsten believe the FCI, in order to be of value, must be capable of reaching an appropriate audience and, most importantly, have the capacity to be linked to existing indices of sustainable development at both the national and international levels.

Part V of the book moves onto indicators of human–environment interaction, whereby the second and third chapters of this section focus specifically on measures of eco-efficiency. In Chapter 14, Janne Hukkinen demonstrates how alternative sustainability scenarios can serve as interpretive frameworks for indicators of human–environment interaction. Hukkinen adopts this approach on the basis that scenarios of the future can provide a series of reference points against which specific indicator values can be assessed.

According to Hukkinen, many existing sustainability indicators are deficient because the framework from which they emerge is often based on a specific sustainability scenario. Yet, as Hukkinen points out, there are many possible ecologically sustainable states as well as different socio-cultural dimensions to the sustainability issue. Should policy-makers assess sustainability indicators from the perspective of a single sustainability scenario, they run the risk of adopting a partisan position as to what constitutes ecological sustainability.

By employing the Pressure–State–Response (PSR) framework with reference to reindeer management in Finland, Hukkinen outlines a new set of indicators designed to measure the technological, institutional and path-dependent nature of the conditions influencing reindeer management. Hukkinen concludes that the incorporation of alternative scenarios into the indicator framework can signal the increased vulnerability and/or reduced resilience of the interdependent systems under analysis and therefore assist policy-makers to design adaptive policies to cope with surprising events.

Moving onto eco-efficiency indicators, Nigel Jollands (Chapter 15) argues that the policy-guiding value of eco-efficiency indicators rests on the resolution of four theoretical issues: (1) properly defining the eco-efficiency concept; (2) determining what is meant by an eco-efficiency indicator; (3) establishing appropriate criteria for choosing suitable eco-efficiency indicators; and (4) recognising the strengths and weaknesses of eco-efficiency indicators, particularly as they relate to policy-making. Unless these issues are adequately resolved, Jollands believes the likelihood of the eco-efficiency concept being corrupted by poorly conceived and constructed indicators is extreme. This, Jollands adds, has the potential to condemn the eco-efficiency concept to policy oblivion.

Mindful of the caveats posited by Jollands, Lawn puts forward a range of eco-efficiency indicators as a means of assessing the effectiveness with which a country transforms natural capital to human-made capital. The eco-efficiency indicators outlined by Lawn in Chapter 16 are developed on the understanding that: (1) natural capital and human-made capital are complements not substitutes; (2) humankind cannot overcome its dependence on the natural environment by 'dematerialising' economic activity; and (3) since humankind cannot control the evolutionary pathway of the global system, eco-efficiency solutions must be in keeping with a coevolutionary view of the world. By calculating the outlined eco-efficiency indicators for Australia, Lawn shows that Australia's use of its natural capital assets has progressed very little since the mid-1960s – a consequence of Australia's failure to embrace the notions of sufficiency, equity and natural capital maintenance.

In echoing the message stressed by the majority of the contributors, Stefan Giljum (Chapter 17) argues that new approaches to environmental governance must take a systemic view of the economy–environment relationship where, importantly, recognition needs to be given to the fact that current environmental problems are as much a consequence of the overall scale of resource use as they are individual micro-activities. As such, Giljum believes that any monitoring of eco-efficiency policies requires appropriate information on the relationship between socio-economic activities and their subsequent environmental impact.

Although a number of approaches have been developed to provide the necessary relational information in biophysical terms, Giljum emphasises that one particular approach – namely, economy-wide material flow accounting and analysis (MFA) – allows for the direct integration of monetary and physical information within one particular accounting framework. In doing so, the MFA facilitates the compilation of consistent databases for policy-oriented analyses of economy–environment interactions.

With the above in mind, Giljum focuses on the policy relevance of the MFA approach and the derived material flow indicators. Giljum undertakes this task by presenting selected examples to reveal how the MFA indicators can be used for the evaluation of sustainability-oriented policies. Finally, Giljum discusses the main deficiencies of the MFA approach and introduces possible extensions to the current MFA framework to overcome them.

Part VI, the concluding section of the book, begins with a chapter by John Peet focusing on the importance of ‘goal-setting’ when determining an appropriate set of sustainable development indicators (Chapter 18). In particular, Peet places great emphasis on the issue of *need*, pointing out that needs are not just confined to individual people, but extend to communities, economies, humanity and nature as a whole. In keeping with an holistic worldview, Peet explains why society’s over-arching goal must be based on satisfying the needs of each and every interconnected system. Furthermore, Peet believes these needs must be consistent with a community-based ethic of how to best move towards the goal. According to Peet, the adoption of this approach facilitates the emergence of ‘red-light’ indicators that can: (1) reveal a society’s failure to satisfy the critical needs of each system, and (2) indicate the need for urgent action that must be taken before attention can be directed to less critical areas of concern.

Peet’s chapter is a sobering reminder that existing sustainable development indicators may not satisfactorily reveal whether the critical needs of each interconnected system are being adequately satisfied. I have deliberately positioned Peet’s chapter in Part VI in the hope that each reader will not only be better equipped to make a judgment about the policy-guiding value of each sustainable development indicator discussed in the book, but of sustainable development indicators generally.

The final chapter, Chapter 19, is specifically aimed at evaluating the policy-guiding value of some of the sustainable development indicators covered in the book. By reflecting on New Zealand’s search for headline indicators, Murray Patterson begins with a short summary of the history and rationale for sustainability indicators. Then, having considered what constitutes a headline indicator, Patterson surveys the theoretical basis of sustainability indicators from ecological, economic, thermodynamic, and public policy perspectives.

With the various sustainability interpretations in mind, Patterson puts forward an eight-point criteria for evaluating the following indicators:

- the ‘ecological footprint’;
- the Environmental Sustainability Index (ESI);

- green GDP, including the Index of Sustainable Economic Welfare (ISEW) and Genuine Progress Indicator (GPI);
- the Genuine Savings (GS) index;
- Material Flows indicators;
- the Consumption Pressure Index (CPI);
- a Living Planet Index (LPI);
- a Composite Environmental Performance Index (CEPI) based on the aggregation of various environmental themes;
- and a Composite Sustainable Development Index (CSDI) that integrates economic, social, and environmental performance.

Since the ecological footprint and the GPI rank highest across the eight evaluation categories, Patterson suggests that both indexes offer the greatest potential in terms of measuring a nation's sustainable development performance. Drawing from the evaluation results, Patterson makes the following recommendations:

1. The ecological footprint should be implemented as a stand-alone headline indicator of ecological sustainability.
2. A more comprehensive indicator of ecological sustainability – existing in the form of a composite index – should be established to supplement the ecological footprint indicator and, in so doing, encapsulate a greater range of ecosystem functions and services.
3. A nation-specific GPI should be calculated to encompass the economic, social, and environmental dimensions of sustainable development into a single index number.
4. A composite index of sustainable development – involving the aggregation of three already existing indicators – should be established explicitly to measure the economic, social, and environmental aspects of a nation's progress.

Patterson concludes by suggesting that the evaluation and recommendations he presents can provide lessons that are invaluable and applicable to all nation states.

As this Introduction suggests, this book covers a wide but not exhaustive range of sustainable development indicators. Exactly what policy-guiding value these indicators possess will no doubt continue to be debated regardless of how successful the book is in clarifying the ambiguities surrounding them. However, should this book broaden people's knowledge of sustainable development indicators and contribute to indicators that are both increasingly informative and policy-relevant, it will have served a very useful

purpose at a time when the need for policy redirection is more urgent than ever.

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