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# 1 Introduction

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## A HANDBOOK OF SUSTAINABLE DEVELOPMENT

The demand that countries pursue policies aimed at achieving ‘sustainable development’ or ‘sustainability’ has built over more than 25 years. A number of key events can lay claim to establishing this principle in the international policy landscape. Among these are the Brundtland Report (WCED, 1987), the Earth Summit in 1992 and, more recently, the UN Conference on Sustainable Development (UNCSD or ‘Rio+20’) in 2012. Although this latter event marking the twentieth anniversary of the ground-breaking Earth Summit dissatisfied many in terms of the proportion of rhetoric to concrete actions, one promising development was the announcement of a process to determine, for the first time, Sustainable Development Goals (SDGs). This is especially interesting as it begins to put content on what it is that policy makers, who publicly state their commitment to the goal of sustainable development, believe they have signed up to. Running parallel to these events is a now huge body of literature that has sought to flesh out these issues with regard to what is sustainable development and how it can be achieved. Exploring progress in understanding this intricate debate was the primary purpose of our previous volume of the *Handbook*. It remains, in updated form, our main objective now. This, we argue, is important not only in making general sense of what sustainable development is but also in distilling these messages into a sensible interpretation for the construction of SDGs.

Our guiding principle, in this new edition of our *Handbook*, also remains the same. Thus we continue in the spirit that it would be quite wrong to claim there is a unified theory of sustainable development. Indeed, interest in sustainable development always has been drawn from a broad church. For example, the Brundtland Report viewed sustainable development as serving many different (and possibly competing) goals: economic development, a better environment and a particular concern for human wellbeing both now and in the future. In fact, the debate has become far broader since then. Hence we have continued to deliberately reflect this diversity, in terms of the contributions in this volume, rather than impose a narrow and rigid (but ultimately misleading) interpretation of the issues. One of the virtues of a new volume is not only that it enables an update of existing contributions, but also that it allows the addition of topic areas that were not sufficiently covered before. Just as importantly, it enables us to cover issues and debates that have emerged since our first edition. We still do not claim to have been exhaustive. Even so, we remain confident there is a strong and coherent story about sustainable development permeating this volume. It is the purpose of this introductory chapter to summarize what we understand this story to be.

## FUNDAMENTALS OF SUSTAINABLE DEVELOPMENT

We begin by asking whether sustainable development can be defined in relatively succinct terms. A number of definitions can be found in almost all contributions to this volume. Several authors cite the famous Brundtland Report definition: 'development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs' (WCED, 1987, p.43). Others have provided a change of emphasis perhaps by stressing that it is wellbeing or opportunities and options that should be sustained. Additionally, some chapters impose further requirements or perhaps riders about particular actions that meeting the stated goal of sustaining development might require. Nevertheless, and despite these apparent differences, at the heart of almost all of these definitions is a common concern about the way in which the fruits of development are shared across generations.

The opening section of this new and updated volume therefore starts by considering what determines the development prospects of different generations. As Kirk Hamilton and Esther Naikal make clear in Chapter 2, the most fundamental element is the wealth possessed by any generation. And this is arguably so whether it is needs, wellbeing or options that we want to sustain. Hamilton and Naikal construe wealth, however, in a particular way: it is the potential wellbeing possessed by people within a particular generation. A more tangible description of these prospects is given by the stocks of assets that comprise, for example, the wealth of a nation or the planet itself. This includes produced capital (machines and physical infrastructures) as well as the human capital that is embodied in people themselves. Crucially, it also includes those assets which have been provided 'free of charge' by the natural world. It is this idea of natural capital that has become a key concept in thinking about what distinguishes concern about *sustainable* development from previous debates about the long-term development challenge.

More generally, this 'capital approach' to sustainability, which can be traced back to seminal contributions such as Pearce et al. (1989), is now ubiquitous. There are at least two reasons for the widespread use of this approach. First, it has an intuitive appeal and chimes with popular notions of 'not eating into one's capital' or 'not selling the family silver'. Second, Hamilton and Naikal make it clear that this capital or wealth-based approach has proved to be critical in working out core theoretical notions about what sustainability means and how it might be achieved. Sustaining development, in this framework, becomes a process of sustaining wealth and, in turn, maintaining and enhancing assets or capital.

Importantly, this has also laid the foundations for empirical insights in what has become known as (comprehensive) wealth accounting. Hamilton and Naikal, in illustrating this point, provide a summary of a rich array of insights about development that has emerged from applying this accounting at the World Bank. For example, while it is perhaps unsurprising that as a proportion of total wealth, natural capital is smaller in higher-income countries than in lower or middle-income countries, in absolute dollar terms, these values are truly substantial in the former. Moreover, a distinction must be made between different higher-income countries, given that for some of these at least the proportions are high too. One message seems clear here: natural capital is a significant portion of total wealth in practically all countries.

Although the capital approach does not require particular assumptions to be made about the relative importance of different assets, such speculation is inevitable and, indeed, is desirable. In fact, it drives one of the great sustainability debates, characterized in terms of whether development should be weakly sustainable or strongly sustainable.<sup>1</sup> For *weak sustainability*, as long as the real value of society's total asset portfolio is held constant, it matters little that its constituent parts change over the development path. *Strong sustainability*, by contrast, requires that our focus is more on what is happening to the constituents and natural capital in particular. There are a number of variants to this position but essentially all accord so-called critical forms of natural capital explicit and special protection. Strong sustainability should hence represent the greater challenge, because current human actions would be significantly more constrained (as certain development paths would be effectively 'off-limits').

This theme cuts across a number of chapters in this volume. However, in particular, it is the focus of the remainder of our opening section. While a great deal of actual development policy seems to be implicitly predicated on weak sustainability,<sup>2</sup> the 'real' world corresponds neither to one polar extreme nor the other. Jeroen van den Bergh reminds us of this in Chapter 3. There he notes that the theory underlying weak sustainability was developed in the context of an economy dependent on a non-renewable resource such as oil. By following the 'Hartwick' rule (or sometimes the 'Hartwick–Solow' rule: Hartwick, 1977; Solow, 1986), sustainable development could be achieved by 'covering off' the liquidation of a finite resource with investment in other assets. Arguing that such rules always can be extended across *all* natural wealth would require an extraordinarily large leap of faith.

Hence, a major challenge lies in a fuller understanding of the diversity of natural capital and different ways in which these assets influence human wellbeing. As van den Bergh discusses, establishing the building blocks for this has long been the province of ecological economics. Indeed, viewed now through the lens of recent history, this exercise can perhaps be seen as the single most important contribution of this sub-discipline. An important idea in this respect is that of critical resources that are both crucial for human development and have no substitutes. A middle-ground in discussions about sustainable development could then centre on identifying critical assets and managing these resources accordingly. Unfortunately, the practical problem is that there exists considerable uncertainty about which natural assets are critical. Hence there is corresponding uncertainty about the location of this middle-ground and how to assess sustainability as well as make better decisions in the light of this ambiguity.

It is fair to say that ecological economists have championed strong sustainability. Chapter 4 by Paul Ekins on 'Strong sustainability and critical natural capital' thus naturally follows from van den Bergh's assessment of the role of sustainable development in ecological economics. Ekins makes a persuasive case that many forms of natural capital are likely to be critical, either already or soon to be so. Uncertainty coupled with the long-term nature of many environmental issues, irreversibility of destruction of natural capital as well as their broad impact on every aspect of human life should make us cautious, he argues, in adopting the optimistic assumptions about substitutability. He explores analytical methods for identifying these critical forms of natural capital that are in need of preservation and conservation for development to be sustainable.

While what comprises these critical assets is a matter for debate, many would include ecosystems and biodiversity in this crucial portfolio. Putting substance on such claims requires a deeper reflection on the way in which these ecological resources can be construed as capital and how ecosystem characteristics and functions need to be understood. In Chapter 5, Edward Barbier sets out on this important task. His starting point is that, while ecosystems are assets, these assets are special in the sense of not only providing multiple critical services but also providing these services in perpetuity if the underlying ecological asset is left relatively undisturbed.

Of course, ecosystem assessments are increasingly confronting us all with evidence that, in practice, this is far from the norm. Indeed, depreciation is widespread through ecosystem destruction and degradation as well as biodiversity loss. Barbier shows how this loss of natural capital can be brought within the realm of economic theory and, in doing so, provides a crucially important underpinning to natural capital accounting and efforts to understand better the value of nature in decision-making. This is, by necessity, a complex task. Yet our analytical and policy needs will be poorly served if the complexity of ecosystems is not captured in these models. In particular, as Barbier shows, ecosystem depreciation carries the risk of (unexpected and) possibly irreversible collapse. This irreversibility is likely to a matter of degree. In some cases, ecosystems can be restored, which is akin to an investment in natural capital. In other cases, this might not be possible. More generally translating these insights from theory to practice is urgently needed and Barbier traces the progress on valuing ecosystems.

One way of moving towards this end is to explore further this idea that natural capital is often subject to thresholds; that is, beyond a particular stock size, the asset can collapse and perhaps cease to provide anything like the services it was previously capable of. In reality, what might be expected is that, as the threshold is approached, the probability of this adverse change in state grows (see, for example, Ferguson and Gleeson, 2012). Nor might these thresholds be known, in practice, with any precision (*ex ante*). However, the essential point remains that diminishing the size of the resource stock erodes the asset's resilience. In Chapter 6, Neil Adger and Jennifer Hobdod focus on advances in knowledge about the concept of resilience. As they explain, resilience is central to sustaining ecosystem functions in the face of external pressures and perturbations. That is, too little resilience means that there is a greater chance that continued pressure or some unexpected event will result in precipitous natural capital loss. To the extent that this natural capital underpins economic and social activity, this loss of resilience translates into less resilient economic growth or human development more generally.

Resilience has importance as a descriptive concept, helping us make clearer what happens when ecosystems are lost and why this matters. Adger and Hobdod emphasize that it is a prescriptive idea too. That is, putting aside for a moment the question of how much resilience exactly is needed, natural capital management in this view should be guided by an interest in conserving or enhancing resilience. One reason for this is that maintaining resilience is akin to a type of natural insurance which could help the current generation fulfil moral obligations to the future and especially those vulnerable groups who might be particularly affected by less resilient development.

## EQUITY ACROSS GENERATIONS

Underpinning calls to manage society's assets, in particular natural capital, sustainably are ethical motivations. Therefore it is fitting that this volume devotes significant space to the ethics of sustainable development. Unsurprisingly, there is no unified ethical theory of sustainable development, rather a diversity of approaches. Concerns about unsustainable development patterns can stem from their consequences for future generations of humans, current humans, and/or nature for its own sake. Moreover, these consequences and their implications for resource management can be seen in many different ways.

In the field of environmental ethics, there has been a traditional focus on whether moral considerability – the moral reference class – extends beyond humans to the natural world, that is, is there intrinsic value in nature? For Bryan Norton and Allen Thompson (Chapter 7), however, this focus has had limited practical purchase, not least because it is difficult to verify claims of intrinsic value. Furthermore, it has blocked the integration of environmental philosophy and environmental economics, the latter of which rests on the anthropocentric theory of welfarism and hence has no space for intrinsic value in nature. Fans of neither approach, Norton and Thompson point to two alternative approaches in environmental ethics, which might transcend the debate. One is environmental pragmatism, which as its name suggests seeks to avoid a priori theoretical discussion of sources of value, in favour of learning the value of natural assets in the course of their management. The other is environmental virtue ethics, an application of virtue ethics to environmental protection that gives priority to goodness of human character in evaluating our management of natural capital. Norton and Thompson go on to offer a unification of these latter two approaches through an expanded notion of 'adaptive management'.

Despite the diversity of ethical approaches to sustainable development, most would accept the importance (but some not the exclusivity) of human wellbeing and how to sustain it over time. Tension occurs when there is conflict between the wellbeing of, or opportunities for, present and future people. Much of this volume is concerned with the reasons why such tensions might arise and how they might be resolved. In Chapter 8, Geir Asheim summarizes an important perspective on this problem of allocating scarce resources across generations, which is offered by the field of intertemporal social choice. This is a field that sits at the intersection of economics and philosophy and focuses on deriving rules for evaluating different development paths – intergenerational equity criteria – from nothing more than a set of basic axioms. For example, the 'Strong Pareto' axiom requires that one development path (formally a stream of human wellbeing) is strictly better than another if at least one generation is better off and no generation is worse off. It can be regarded as the most basic efficiency principle across generations. Since human existence can potentially extend far into the future, and thus the number of people in all future generations far exceeds the number currently alive, Asheim advances a fundamental tenet of this literature – that development paths should be treated as *infinite* streams of wellbeing. Therefore the task becomes to evaluate different development paths that continue into perpetuity. At the heart of intertemporal social choice is a series of well-known impossibility results, which show that basic principles of efficiency and equity cannot simultaneously be satisfied by any intergenerational equity criterion that allows all paths to be compared. Something has to give then, and Asheim takes us through the alternatives.

For most intergenerational equity criteria, a crucial issue in real-world applications is how much to discount the future. This is especially so in standard economic appraisal, which takes the form of cost–benefit analysis (CBA, based on a criterion that Asheim terms: Time Discounted Utilitarianism). Conventional ways of discounting future costs and benefits typically give very low weight to what happens in the far-off future (that is up to and beyond two centuries from now). Concerns about this ‘tyranny of discounting’ are longstanding and, indeed, since our first volume they have received fresh impetus with the publication of *The Economics of Climate Change: The Stern Review* (Stern, 2006) and the debate that ensued about the way in which distant climate-change impacts are discounted (see, for example Nordhaus, 2007; Weitzman, 2007). In Chapter 9, Cameron Hepburn and Greer Gosnell bring us up to date with the discounting debate, noting several interesting developments in recent years. Some of these originate from beyond the field of economic appraisal, narrowly construed, and offer alternatives to discounting, while others suggest discounting future costs and benefits in new ways, for instance using *declining* discount rates. Such approaches could reassert the relevance of CBA in understanding the social worth of policies affecting the far-off future.

The broad thrust of policy decision-rules intended to deal with threats to sustainable development, in a world with critical resources, is explored in detail by Alan Randall in Chapter 10. Randall’s starting point is that simplistic and overly general stories about weak sustainability require far too much optimism about facilitating factors such as the ability of technology to get round impending constraints and the ability of markets to provide the correct signals about emerging scarcities. As a result, decision rules need to adapt to these ecological realities when needed. What Randall discusses is a two-tier approach, involving a combination of safe minimum standards (SMS) for critical resources and standard cost–benefit rules (markets augmented by public policies that pass cost–benefit tests). With regard to the latter, Randall situates this economic approach within a broad array of considerations: cost–benefit thinking subject to moral constraints rather than allowing the economist’s notion of (social) efficiency to trump all else. Thus threats to sustainability, perhaps brought about by the likely loss of a critical resource, could justify a strict conservation rule (although this can be overridden if its costs are ‘intolerable’). There is no single or unifying rationale for observing SMS. Instead, Randall presents a simple but compelling case that SMS in a broad range of conservation policy contexts has ethical legitimacy as well as pragmatic appeal.

## EQUITY WITHIN GENERATIONS

Sustainable development has always been about more than just a sophisticated articulation of concern for future generations. Another prominent theme has been intragenerational equity; that is, the distribution of income and wealth, environmental burdens and other relevant factors within the present generation. This tradition owes much to the Brundtland Commission, for whom reducing current poverty was arguably a higher priority than the wellbeing of future generations. Explanations vary as to why present generation inequities might make development unsustainable. Perhaps it is a logical parallel to concern for *intergenerational* equity (for example Solow, 1992). Others have put forward mechanisms whereby a development path is unsustainable, because there are

disparities in wellbeing or opportunities *within* the current generation. A few have simply asserted that greater intragenerational equity is intrinsically desirable and ‘by hook or by crook’ must be relevant to sustainable development. All this suggests that sustainable development could involve a more specific requirement to prohibit current development that further widens the gap between, say, rich and poor as well as development that comes at the expense of the future in the aggregate. Four chapters in this volume outline distinct elements of the case for integrating intragenerational equity in the sustainable development story.

In Chapter 11, Geoffrey Heal and Bengt Kriström make a link between building current distributive considerations into analyses of sustainable development and the welcome resurgence in economic interest around distributive issues in cost–benefit analysis and policy appraisal more generally. This highlights an array of interesting issues. But perhaps the key message is a reminder that policy creates winners and losers and knowledge of how the cards fall is important.<sup>3</sup> There is probably no escape from making hard choices in achieving sustainability. However, in order to ensure that such policies are socially acceptable, identifying the potential obstacles that undesirable distributive impacts present is crucial.

In Chapter 12, Julian Agyeman reminds us that concern for social justice in the here and now has always been at the heart of the environmental justice movement. Indeed, it is arguable that some of the credit for the recent emergence of *environmental* equity concerns in economic analysis (for example Serret and Johnstone, 2005) must go to this movement. It began as a grassroots campaign, originating outside of (and sometimes in opposition to) the mainstream environmental movement in the US. In this respect, it has evolved in parallel rather than together with the sustainable development debate. However, as Agyeman notes, environmental justice proponents have identified much in common with the sustainability agenda. Emphasis is placed on the burden of pollution and how that burden is distributed across communities with different socioeconomic characteristics. Within the US, particular interest has surrounded the incidence of such burdens by ethnic origin. In each example, the implication is that an unequal distribution of some environmental burden along a socioeconomic axis is unjust. In turn, policy should strive for a more equal distribution of burdens, although how this might be achieved depends on a proper understanding of the dynamic process whereby environmental burdens and risks are assigned (see also Chapters 7 and 14). Finally, Agyeman also notes that international disparities – in terms, say, of how global environmental burdens are distributed – might also be characterized as environmental justice problems.

All of this highlights a crucial point. Certain groups will be affected more than others by *unsustainable* development. For example, there is concern about how vulnerable certain socioeconomic groups or populations within certain countries are to climate-related risks. The link between disparities in living standards and differences in human ‘vulnerability’ to environmental (and other) stresses is increasingly, as noted in Chapter 13 by Neil Adger and Alexandra Winkels, part of the vocabulary of sustainable development. The emphasis on vulnerability predicts that those living in chronic poverty, without access to the resources necessary to live a decent life, are those least able to cope or adapt. In this context, links are forged with key contributions from the poverty literature, notably the writings of Amartya Sen (1981, 1984).

Since the social pillar of sustainability plausibly demands we work to minimize poverty

worldwide, Adger and Winkels argue the vulnerability perspective constitutes a valuable analytical tool, offering a multidimensional explanation of how the distribution of resources in society presses those least fortunate into unsustainable livelihoods and vice versa. In this way, not only is vulnerability reduction a legitimate sustainable development goal, but because it is instrumental in reducing poverty it can also contribute to fostering sustainable livelihoods among those sections of society least capable of pursuing them. All other things being equal, this could contribute to the attainment of sustainable development goals society-wide.

The examination of both environmental justice and vulnerability shines light on the role that social relationships play in achieving sustainable development. In Chapter 14, Allister McGregor explores further the relationships between society and what is meant, or indeed what could or should be meant, by the ‘development’ aspect of sustainable development. Grounded in Aristotelian philosophy and economic treatises ranging from Adam Smith and Jeremy Bentham to the more recent Amartya Sen and Daniel Kahneman, McGregor identifies human wellbeing as the ultimate goal of development. This perspective emphasizes both the ability to pursue one’s goals and the maintenance of good relationships – with other people, society, institutions, norms and the natural environment – as important components of (sustainable) development.

As in Chapters 12 and 13, inequality and vulnerability feature prominently: they impact relationships and determine the context in which wellbeing (or indeed, development) objectives can be achieved, or lost. McGregor challenges us to think beyond the *needs* of present and future generations to consider as well their capabilities and potential for achieving good levels of wellbeing. He uses, as an illustrative example, development in India’s coastal fisheries over the past 70 years. This case study elucidates how social and government institutions determine both the distribution of wellbeing gains and losses, and how these affect human–environment interactions.

## GROWTH, CONSUMPTION AND NATURAL CAPITAL

The question of how to sustain development paths is, of course, intrinsically linked to enduring questions about the character of long-term growth and socioeconomic development. In connecting these two themes in our volume, the chapters in this section provide a more detailed analysis of the interaction between natural capital, growth and development.

Increasingly, interest in the relationship between growth and the environment is focusing on the concept of ‘green growth’, as Alex Bowen explains in Chapter 15. This interest, arguably driven by policy-makers, stems from the recent economic crisis, which has underscored for many the imperative of growth, alongside rising concerns about natural capital depletion, especially the impacts of climate change and possible resource scarcities in the near future. Yet despite confidently taking its place in the public policy lexicon, Bowen explains that it is unclear what green growth actually means. Moreover, the leading definitions bear a strong similarity to earlier definitions of sustainable development, in that they usually reference the three pillars: economic, environmental and social; albeit with the emphasis unapologetically on economic growth.

However, this does not give the green growth agenda enough credit, Bowen argues, for

having brought new issues to the table, or at least for having reminded those committed to sustainable development of the importance of well-known issues. These issues include the fact that environmental problems, notably climate change, involve not just environmental externalities, but also externalities and market failures in the innovation of clean technologies and beyond. Looking at these problems as systems of market failures, the as yet unproven prospect is held out that regulation and other forms of intervention in markets may be beneficial not just to the environment but to growth as well. Another issue that green growth has emphasized is the relevance to the environment and sustainability of short-term macroeconomic fluctuations, of which the recent global recession is the prime example. Hence Bowen concludes that 'green growth is very close to older notions of sustainable development and offers considerable promise as an organizing principle for economic policy-makers focused on macroeconomic performance'.

Cross-country empirical studies in the early 1990s seemingly showed that, for certain pollutants, as the economy grows, so environmental quality first deteriorates, but then actually improves. This is the so-called Environmental Kuznets Curve (EKC). Matthew Cole and Andrea Lucchesi, in Chapter 16, review the evidence from EKC studies for local and global pollutants. While these studies have seen their fair share of criticism on a variety of grounds as discussed by the authors, Cole and Lucchesi note that recent developments in the literature have sought to provide a more thorough explanation of the process of economic change driving the EKC (where it exists). At least two interesting implications emerge. First, a combination of environmental effects accompany economic growth that work in opposite directions. Certain effects diminish environmental quality (for example scale effects) while other effects enhance it (for example technical effects). Second, initial conclusions that countries might simply grow out of their environmental problems were – as many had suspected – far too simplistic. The environment-growth paths described by EKCs often reflect policies which, even if facilitated by rising incomes, do not arise automatically. Cole and Lucchesi draw particular attention to the role that energy consumption and energy policies play in reducing environmental pollution as countries grow their economies.

Social scientists have not only analysed the effect of economic growth on the environment, but have also sought to understand how forms of natural capital – and the natural resource base in particular – in turn affect economic outcomes. Attempts to understand the determinants of poor economic performance have found, and sought to explain, an apparently negative and significant relationship between natural resource abundance and economic growth. This is the so-called 'resource curse hypothesis' or 'paradox of plenty'. It is a paradox, because common-sense suggests resource-rich countries have distinct long-term economic advantages over their (otherwise similar) resource-poor counterparts. How can being blessed with natural resource assets turn into a curse? As Richard Auty shows in Chapter 17, the fact that a large number of countries in the former category appear not to have benefited in this way has led to considerable effort being expended in seeking to understand why the resource curse arises and, more importantly, whether it can be avoided. This has included the unintended economic effects of resource booms as well as observations about the political economy of resource-rich countries. As Auty points out, there is likely to be a vicious circle at work here. Resource windfalls, for example, encourage rent-seeking among interest groups and permit governments to prolong 'bad' policies. While notable examples of sound resource management

do exist, transforming countries that habitually dissipate resource rents is far from easy. Since poor economic performance is a sure recipe for low priority given to sustainable development, the resource curse is not marginal to the sustainable development project and overcoming the bad policy equilibria discussed by Auty is thus of great importance.

Equally important for sustainable development as poor economic performance are the high and rising material consumption levels that come with strong economic performance. Raising consumption is one objective of policy around the world. For a large number of countries, where poverty is widespread, this is a necessity. In wealthier countries, recent economic crises have led to a desire to return to the (apparently) happier days of higher consumption. However, in such countries there has also been a fair degree of soul-searching about the desirability of progress driven by ever-increasing consumption, not least in terms of the extent to which this has been, in the words of Graham (2012), 'unhappy growth'.

Tim Jackson takes up this challenging issue in Chapter 18. He explains that much of the sustainable consumption literature, especially (and without any great surprise) at the political level, has shied away from whether to reflect more fundamentally on overconsumption, instead restricting itself to how to achieve incremental shifts in consumption towards 'greener' products. Yet Jackson argues that this reticence might constitute a missed opportunity. Not only does it conflate the issues of production and consumption, the inability to engage with *how much* we consume in absolute terms runs the risk of ignoring scale effects. He asks: what is the true purpose of consumption? In doing so, he outlines a number of theories as to why ever-increasing material consumption may actually be something of a social pathology. All this leaves a question mark over whether or not consumption is actually making people in the world's richest nations any happier. While such accounts pose tremendous challenges to established theories – sustainable development theories included – there are a number of useful and immediate policy implications, not least the futility of naive appeals to 'stop consuming so much'.

In many countries and for the world as a whole, any development path will have to sustain wealth over a considerably larger population than currently prevails. In turn, unless per capita impacts can be sufficiently reduced, population growth will further threaten sustainability as human populations place added pressure on natural capital. A world population peaking somewhere between 8 and 10 billion people will also leave considerably less space for all non-human living beings. In Chapter 19, Geoffrey McNicoll sets out this integral part of the sustainable development story, which itself has roots in historical debates about the relationship between population and development. Recent interventions have, in McNicoll's view, generated more heat than light, focusing on elusive (and perhaps even futile) questions about 'how many people the world can support' and arriving at extreme prognoses whereby population levels can increase without limit (for example Simon, 1981) or resource constraints will result in dramatic population collapse or collapse in living standards (for example Meadows et al., 1972).

McNicoll shows that, away from such extreme debate, there is a wealth of useful analyses, which neither dismisses the possibility that population change increases pressure on natural assets nor blithely assumes this relationship can be straightforwardly disentangled from other factors. Indeed, the population–environment nexus is unlikely to be carved in stone. As with so many other issues in the sustainable development area, it is mediated to a large extent by institutions and policy regimes. Put another way, bad policies or

poor institutional arrangements can exacerbate the environmental impacts of population pressure. A key question then is what is the appropriate balance of policy between, on the one hand, interventions aiming to directly influence migration and fertility decisions and, on the other hand, efforts to create or strengthen institutions? As part of this debate, McNicoll offers an interesting account on the origins of China's one child policy.

Set against concern about the consequences of population growth lie questions about the ability of technological change to deliver sustainable development. The claim that current behaviour is unsustainable implies possibly strong judgements about how well-being or opportunities will be generated in the (far-off) future. Examples abound where concerns about impending sustainability threats have been rendered obsolete, with historical hindsight, by technological advances. Moreover, as Chapter 15 points out, much of modern growth theory has been predicated on the primacy of technological change in driving economic development. A timely reminder of the relevance of these discussions was made by Weitzman and Löfgren (1997). They presented the theory and illustrative calculations (for the US) behind the claim that even a moderate but predictable flow of technological change might mean that, not only would such productivity advances play a significant role in determining prospects for sustainable development, this could play the decisive role.

The proposition that technological change can be relied on to take care of the future is somewhat out of kilter with the more cautious approach generally advocated by those concerned about sustainable development. One reason for this is that contemporary sustainability threats often relate to the loss of natural assets that are tangibly different from those referred to in any number of reassuring historical examples. Ultimately, history will prove the protagonists in such debates right or wrong, but, in terms of decision-making in the here and now, there is mounting suspicion that losses of critical assets could entail substantial losses in wellbeing comparable or greater in magnitude to those increases attributable to technological improvements. At the very least, significant losses in natural capital may mean that technological progress must work harder to sustain development in the future. To this end, ensuring a reliable stream of technological improvement requires a policy climate conducive to innovation effort (Aghion and Howitt, 1998). As Chapter 15 makes clear, new knowledge must be created. One primary way of doing so is through inputs to the research and development (R&D) sector, but this is itself a costly process influenced by a variety of incentives.<sup>4</sup>

It could be argued that innovation has shown a long-term tendency towards greener technologies that drive the material or energy intensity of economic production downwards (see Chapter 15). Does it follow that this positive technology effect is simply a spontaneous by-product of innovative activity? Interpreting how knowledge is created and how new and cleaner innovations diffuse into production (and consumption) is discussed by Timothy Foxon in Chapter 20. He makes it clear that there are important lessons to be learned from, in effect, 'backward engineering' the actual adoption of new technologies and thereby understanding the technical and economic circumstances under which change occurred. In doing so, examples are uncovered of existing technologies that have become 'locked-in', even though possibly 'superior' technologies exist. Identifying the reasons for such phenomena is also important. A prominent environmental example is the pervasiveness of carbon-based technologies in modern economies. Proponents of the lock-in notion argue that not only can technological-economic systems, which otherwise might be

harnessed to foster change, become constrained to serving the status quo, so too can social and political institutions. Indeed these systems can be thought to co-evolve, giving rise to a set of principles that Foxon proposes for sustainable innovation policy.

## PROGRESS IN MEASURING SUSTAINABLE DEVELOPMENT

Consumption, economic growth and environmental degradation impact sustainable development in complex and often contradictory ways. The question is: how do we know whether overall we are on a sustainable development path? If the rhetoric of policy makers committed to sustainable development is to be judged against the reality of performance, the means to measure and monitor sustainable development must be found.

A number of chapters in this volume propose and scrutinize a wide variety of proposals that respond to this measurement challenge. Broadly speaking, these fall into two camps. First, there are those approaches seeking to extend or 'green' the existing national accounts to better reflect what is happening to natural capital. This might involve the construction of monetary aggregates – more comprehensive measures of national income, saving and wealth – or physical accounts which are linked to the national accounts. Second, there are approaches that have sought to construct (sometimes highly aggregated but self-standing) sustainability indicators based on physical environmental metrics. Driving both approaches is a conviction that development prospects are unlikely to improve if policy-makers continue to rely on the same narrow set of economic indicators used to guide the short-term management of the macro-economy, most notably Gross Domestic Product (GDP).

Chapters 21 and 22 set out the substantial progress made in national accounting for natural capital (see also Chapter 2). First, Glenn-Marie Lange, in Chapter 21, appraises the efforts of a number of countries. This makes it clear that, while a large amount of work is being done, only a handful of countries have serious, active programmes. An exemplar here is the work of the Australian Bureau of Statistics. Across the world, most of this work is deliberately carried out in a way consistent with the United Nations System of Environmental and Economic Accounting (SEEA) (for example UN et al., 2012a). This is designed as an adjunct to – not a replacement for – the conventional System of National Accounts (SNA). Clearly, this falls short of an earlier, more radical entreaty, which can still be heard, to overhaul entirely the core national accounts. It takes the more conservative (but in all likelihood correct) view that satellite accounts best permit experimentation with relatively novel methods, without compromising uses associated with the conventional accounting framework.

This experimentation role is currently important, as Lange discusses, in getting to grips with challenging issues about ecosystem accounting (for example UN et al., 2012b). However, in what Lange rightly describes as a milestone, the publication in UN et al. (2012b) of the SEEA-CF, or central framework, represents the codifying of a number of crucial elements of environmental accounting in internationally agreed methodologies. As Lange notes, the challenge is far from over, not least in making progress on what does not currently command consensus in the statistical community and so did not appear in the SEEA-CF. Notably, this includes the valuation of natural capital beyond a narrow range of commercial resources.

By contrast, in Chapter 22, our second contribution on this theme, Kirk Hamilton and Esther Naikal describe the singular, but no less fruitful, approach taken by the World Bank. The deliberate focus of this work is on valuing changes in natural capital as a novel element of estimating a more comprehensive measure of saving (genuine saving or adjusted net saving) as the Bank's primary indicator of sustainability. The strengths of this indicator can be traced to both theory and practice. That is, as Hamilton and Naikal note, the proposition that interest should be in saving rates (net of changes in assets including natural capital) has survived rigorous scrutiny by economic growth theorists. Sustainability, in this theory, requires that countries avoid negative genuine saving rates at the very least. Scrutiny outside the economic domain has identified genuine saving's commitment to *weak* sustainability, which, in line with our previous discussion, may be insufficiently demanding where certain critical natural assets are concerned. Even if the analysis is confined to weak sustainability, empirical findings to date suggest many countries find it hard to achieve positive genuine saving. Moreover, Hamilton and Naikal note that the theory underpinning this indicator can itself be tested using available data. While measuring sustainability is likely to require a suite of indicators, the strengths of having at least one metric within this portfolio capable of being tested should not be underestimated.

Beyond the province of official (for example governmental) efforts to construct sustainability measures, a wide range of indicators has been proposed. In the remaining chapters of this section, we illustrate two of the more prominent and long-standing examples. In Chapter 23, Philip Lawn evaluates efforts to measure sustainable economic wellbeing (SEW), which can be broadly construed as a measure of consumption (typically the largest part of national income), adjusted and extended to flows of goods and services as well as changes in stocks (such as natural capital), which are not included in the calculation of conventional GDP. Clearly then there are parallels between this work and the two previously discussed chapters. Perhaps the key difference, however, is the breadth of ambition in terms of what is monetized in SEW studies. Lawn also notes that many SEW studies claim striking findings to the effect that the level of the SEW increases at first (from its level in the initial study year, typically 1950), before declining at some point (usually around the 1970s or 1980s), sometimes steeply. At face value, this indicates that, while wellbeing per capita initially rose, it has been declining for some time, in some cases precipitously.

Much of the reason for this decline it appears is natural capital loss. Thus SEW studies can be viewed as a bold attempt to construct national welfare accounts in a world where relevant shadow prices assume that environmental change is very costly indeed. SEW studies thus appear to reveal *dis*-saving on a massive and unsustainable scale as a consequence of over-consumption, which resonates strongly with the points made by Jackson in Chapter 18. While there are substantial suspicions, which Lawn tries to refute in his defence of SEW studies, that the findings of these studies are largely an artefact of the particular methods used by practitioners, it is interesting to note the burgeoning 'mainstream' respectability of the notion that people living in modern advanced economies are no more happy despite evidence of economic progress (especially in the literature on happiness and its determinants: see, for example, Graham, 2012).

Underlying much of the current interest in sustainable development is thus a growing sense that society (whether this be particular countries or the world as a whole) is 'living

beyond its means'. Indeed, to the extent that countries have negative genuine saving or decreasing measures of sustainable economic welfare, they can be said to be consuming too much (that is, not maintaining the assets upon which this consumption is based). Another powerful way of articulating this concern, however, is the analogy of an Ecological Footprint. This describes how human demand has exceeded biophysical limits, and how human demand and available biocapacity widely vary across the world.

In Chapter 24, Mathis Wackernagel, Gemma Cranston, Juan Carlos Morales and Alessandro Galli provide a detailed explication of the measurement and rationale of Ecological Footprints, their policy relevance and how they link to sustainable development. Like Lawn in his defence of SEW studies, they provide a detailed rebuttal to the many criticisms that – rightly or wrongly – have been raised against Ecological Footprints. However one stands on this issue and whether or not one agrees that decision-makers should base policy directly on this information, there is no doubting the success of Ecological Footprints as a rhetorical device and as an effective conveyancing tool of the message of over-consumption that appeals to policy-makers, the media and laypeople alike. But possibly even more significantly, sustainable development is about coming to terms with the planet's limited resource budget – whether it is through demand management, efficiency gains or boosting supply. Emphasizing this may be Ecological Footprint accounting's main contribution.

Numerous indicators purporting to measure sustainability now exist. This is in marked contrast to the early 1990s, when there was growing recognition of the need to monitor progress towards sustainability goals, but few practical indicators existed. Put this way, considerable progress has been made in constructing practical indicators over the past twenty years or so. The chapters in this section of our new volume, while not exhaustive – to cover all of these would command a volume in itself – provide a flavour both of this progress and the challenges that remain. What is also clear is that while the search for sustainability indicators has become something of a mini-industry, so too has criticism of these indicators.

How then might policy-makers make sense of the array of sustainability indicators now available? A reasonable expectation is that, over time, many of these indicators will wither on the vine. It is to be hoped that those that survive this process are the most useful, and proper scrutiny of indicators is one way in which this outcome can be achieved. Neither should the search for measures of sustainable development aim for one single indicator that can 'out-compete' all of the competition. In general, it is hard to envisage a single sustainability 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.

## THE INTERNATIONAL SETTING

Constructing extended national accounts or sustainability indicators typically reflects a motivation to find out more about the sustainability of a development path within a country. Of course, countries interact with one another in a globalized world and explicating the linkages between countries is surely also important.<sup>5</sup> Often, natural capital is not just shared across generations but also across national boundaries. The list is large

and includes ‘open access’ resources over which there is no ownership (for example the global atmosphere and the oceans), as well as those resources owned by a sovereign state that nevertheless provide ecological services across borders (for example forests and biological resources). Even where natural capital is found solely within a national boundary, the actions of other countries (such as in the case of transboundary pollution) can affect it. Furthermore, the increasing integration of the economies of different sovereign nations through trade and investment could have consequences for natural capital.

Given the undoubted and growing influence of international trade on the fortunes of the world economy and its constituent countries and regions, it was always likely that issues surrounding the impact of trade on the environment and sustainable development would loom large. Indeed, few issues have been so controversial, a point that is reflected in the range of extreme positions held. For some, trade and globalization are inherently unsustainable, arguably an unhelpful approach to what is essentially an empirical question. At the other extreme lie those who argue unfettered trade can serve many goals (economic, environmental and so on), thus being of universal benefit. In Chapter 25, Louis Dupuy and Matthew Agarwala provide an overview of some of these controversies and, in doing so, outline an array of candidate pathways whereby trade and sustainability might be linked.

The first is a matter of timing of resource extraction and trade liberalization. At what point should a country undertake trade liberalization in order to maximize its welfare gains, and how do changing terms of trade and long-run resource price trends affect the Hartwick rule? For some, increasing resource prices justify extra short-term consumption, allowing (resource exporting) countries to invest less than the Hartwick rule requires. For others, this is seen as fuelling the resource curse. Continuing in controversy, the chapter explores contributions from various perspectives – weak versus strong sustainability and production versus consumption-based accounting – and invites the reader to take a stance in these ongoing debates. Finally, Dupuy and Agarwala explore how trade policies, and in particular eco-tariffs, might impact the gains from trade. For best results, they argue, such policies should be agreed at the global level, perhaps at the World Trade Organization or a potential World Environmental Organization. Of course, the international politics of this are deeply complex and fiercely debated.

In Chapter 26, Carlo Carraro takes stock of what we know about the propensity of countries to cooperate in managing natural capital sustainably, based on insights from game theory. Game theory is an attractive (though of course not the only) way to analyse international environmental cooperation, where countries’ actions are interdependent. It is often the case that when a country acts to conserve a natural capital stock, it provides spillover benefits to other countries (for example in cutting greenhouse gas emissions or protecting biological diversity). This creates an incentive for countries to free-ride on each other’s efforts. At the same time, there is no supra-national institution with the authority and legitimacy to enforce resource management regimes on sovereign countries, so any agreements between countries are voluntary and, for them to be effective, they must be self-enforcing.

The most basic prognosis of the game-theory approach to environmental cooperation, the ‘tragedy of the commons’, is well known. But as Carraro explains, it is derived from a model that is too simple as a description of reality. Much effort in this field has been devoted to explaining why partial cooperation emerges in protecting the environment

across countries. Still the extent of cooperation is generally small, so the question naturally turns to how to encourage more. Numerous avenues have been pursued over the years. Carraro focuses on two of the most promising, transfer schemes between countries and making links between negotiations on environmental issues and on other issues such as trade liberalization and innovation. Nonetheless he concludes that '[d]omestic measures and/or policies implemented by small groups of countries are more likely to be adopted to protect the environment'.

In Chapter 27, John Vogler offers a complementary analysis of international environmental cooperation from the perspective of politics and institutions. He charts shifts in the political debate on sustainable development, from a primary emphasis on environmental issues at the 1972 Stockholm Conference, to a tripartite focus on environmental, social and economic development at the Rio de Janeiro Earth Summit in 1992, arguably a primary emphasis on poverty alleviation at the Johannesburg World Summit in 2002, and the emergence of the green growth agenda at the 'Rio+20' summit in 2012. Vogler draws the general conclusion that the principle of sustainable development has become firmly embedded in the international political system. He argues that this offers cause for both hope and despair. On the one hand, it is clear from any analysis that regional and national self-interest has played a major role in the international politics of sustainable development, often throwing up more obstacles than opportunities (as Carraro explained in Chapter 26). On the other hand, the 'institutionalization' of sustainable development – through which it has acquired a momentum all of its own – might help to shape and alter national perspectives of self-interest, thus facilitating deeper agreement and action than might otherwise have prevailed.

A major source of friction in international discussions on sustainable development is the question of whether the programme requires additional and substantial financing. Accepting this is the case, there is doubt over whether the necessary international transfer of funds will be forthcoming. In Chapter 28, Samuel Fankhauser, updating a chapter from our first volume written by the late David Pearce, argues that securing sustainable development requires those making a sacrifice to see it as being in their interest. The rationale for this is informed by eminently sensible economic arguments. One source of inspiration, for example, is the notion of a Coasian bargain (Coase, 1960), whereby a 'polluter' has a property right underpinning their current (unsustainable) behaviour – perhaps because a threatened biological resource is sovereign property – such that it is in the interests of the 'sufferer' (or beneficiary of conservation) to pay the polluter to change its behaviour. As the authors point out, overcoming well-known obstacles to these Coasian bargains remains a challenge, but if they can be navigated then it motivates possibly substantial financial flows linked to the protection of the environment.

Fankhauser and Pearce go on to review a range of financial mechanisms and flows. These include conventional, public sources such as Official Development Assistance and the UN's new Green Climate Fund, but increasingly they also include private finance through environmental offsets, carbon markets, payments for ecosystem services (PES) and an emerging green finance sector. These offer at least a cautious note of optimism to the effect that financial expertise can be harnessed to deliver sustainable development.

## DIMENSIONS OF SUSTAINABILITY

Such is the apparent appeal of sustainable development, the term ‘sustainable’ is now prefixed to numerous and disparate policy objectives. Within the academic literature, it has been variously asked how regions, local districts (for example cities), economic sectors and corporations can be ‘sustainable’. Much of this makes eminent sense even if sustainable development were solely a macro-goal, as there would be legitimate questions about how, for example, the households and corporations that comprise this society might contribute to the macro-objective. Yet, as the authors of a number of chapters in this volume demonstrate, adopting these more disaggregated approaches to understanding sustainable development also yields substantial and important additional insights.

In Chapter 29, Gary Yohe looks at sustainable development in the context of adapting to climate change. After being for many years – but for no good reason – the poor relation of mitigation (that is, abatement of greenhouse gas emissions) in climate change policy, the imperative to adapt is now widely accepted. Crucially, it is now firmly on the radar of policy-makers’ attention. The climate is changing, will continue to do so whatever happens, and efforts to mitigate at the global level are stalling. Adaptation and sustainable development often go hand-in-hand, particularly in developing parts of the world. The reason is that vulnerability to climate change depends not only on the climate itself, but also on socioeconomic factors that give rise to patterns of sensitivity and capacities to adapt (see also Chapter 13). Therefore, for many communities, to paraphrase a famous remark by Tom Schelling (1992, p. 6), ‘their best defense against climate change may well be their own continued development’. Given ongoing and pervasive uncertainties about the impacts of climate change, Yohe explains how the task of adapting is also being seen increasingly as one of risk management and of learning. He looks at the example of New York City following this approach, its challenges and opportunities, before considering whether it can be replicated in other contexts, especially developing countries.

Though adaptation to what is now unavoidable climate change is necessary for sustainability, it is insufficient in isolation and must work alongside mitigation efforts. If we hope not to exceed the 2°C limit on temperature rise (UNFCCC, 2010), then the binding constraint we face is not the scarcity of fossil fuels, but rather the planet’s capacity for assimilating carbon and regulating temperature. Starting from this point, Ottmar Edenhofer, Susanne Kadner, Christoph von Stechow, Gregor Schwerhoff and Gunnar Luderer show in Chapter 30 how research on climate change mitigation is linked to sustainable development by introducing a simple conceptual framework. Based on that, they present two categories of integrated assessment models (IAMs) as instrumental tools for applied sustainability research: those with a cost–benefit focus (CBA-IAMs), used for identifying the optimal amount of mitigation and associated with weak sustainability; and those with a cost-effectiveness focus (CEA-IAMs), used to identify the least-cost method of achieving any given mitigation target and associated with strong sustainability. The chapter describes the power of these models to optimize along multiple objectives, as well as crucial caveats, and reviews the state-of-the-science in real world applications. In particular, it explores the crucial technological, economic and institutional requirements of mitigation strategies consistent with a 2°C target, and shows that a delay of global cooperation and the limited availability of technologies can result in a substantial increase of mitigation costs. By embedding these insights into a multiple-objective framework, the

authors allow for a better understanding of mitigation pathways within a sustainable development context. To conclude, they propose an IAM research agenda encouraging modellers and researchers to improve the applicability of these models for the exploration of sustainable development pathways.

Despite mitigation and adaptation efforts, any residual climate change is likely to have a large number of impacts on people, economic sectors and natural capital. Some of these impacts will be novel although in some part amounting to an exacerbation of existing problems and risks. In Chapters 31 and 32, we explore the role that water resources play in sustaining development and the idea of sustainable agriculture. Thus, in Chapter 31, Matthew Agarwala and Tony Allan argue that water resources deserve special attention from those truly committed to sustainable development. Water's privileged position as a non-negotiable prerequisite for life and an integral component of all ecosystem services means that any future wellbeing hinges critically upon its availability and quality. Agarwala and Allan explore how water's many unique characteristics distinguish it from other resources, and how these affect the economic rules that could, and the political realities that do, determine its use and distribution. Unique among natural resources, a staggering 90 per cent of all the water required by mankind is used in a single sector, agriculture. Water is used to produce crops and livestock which enter a global food supply chain that is blind to the value of water. As such, the authors argue that it is the world's 1.5 billion farmers who ultimately manage this crucial resource, and that politics and economic incentives must align to ensure its sustainability.

Water availability and quality is clearly then a crucial element of agricultural sustainability. Clement Tisdell in Chapter 32 also makes it clear that the idea of sustainability in this sector has its roots in a wide range of policy concerns. Certain countries may well place a premium on food security and this might further motivate concerns about sustainable agriculture within nations. Enhancing and sustaining the livelihoods of rural people and rural communities might also be an important criterion. Sometimes the emphasis evolves with novel challenges, or contemporary villains, emerging. Recent examples include oil palm plantations and 'land-grabs' in different parts of the world.

One of the most prominent concerns remains a long-standing one: the ability of food production to keep pace with demand. Yet while this concern is hardly new, contemporary issues have added some novel twists to the story. Thus it may be that the resource base on which future agricultural productivity depends is being 'homogenized', with a reliance on evermore high-yielding but ultimately less resilient genetic materials (see also Chapter 5). While this drive towards uniformity in agricultural systems serves to increase food output, it might well come at the expense of sustainability. Some of the concern also stems from a worry that efforts to reduce the external impacts of agriculture through, for example, organic farming, may simply trade one form of degradation for another. For instance, to the extent that such practices protect wildlife, protect soil and generally lessen some environmental impacts there is also a suspicion that this might result in lower yields and so greater land conversion needs if organic farming practices are scaled up. Genetically modified organisms, or GMOs, by contrast might increase productivity and so lessen pressure on land use. However, negative side effects also exist here, notably possible reductions in resilience as well as further losses of variety and cross-fertilization with wild crop relatives. *Ex situ* conservation of these wild crop relatives might insure

against this. However, the possibility of *in situ* conservation objectives being compromised remains a concern for many.

Multiple perspectives on sustainability are just as relevant in the case of energy. In Chapter 33, Richard Green, Yacob Mulugetta and ZhongXiang Zhang explore this nexus of energy with development. While broadly the apparent importance of energy resources as (literally) the fuel for resource-based development seems not to be in dispute, these links – as well as the risks that these give rise to – are manifold. This includes economic and social vulnerability to volatile prices and particularly price spikes as well as physical interruptions to supply. For some, however, it is the absence of access to sources of modern energy that is the overriding problem. This is revealed in an inequality of energy use in terms of quantity consumed overall as well as per capita, and the way in which that energy is generated (such as reliance on traditional biomass in much of the developing world, particularly in sub-Saharan Africa).

Of course, from the perspective of sustainable development, energy is also both a good and a bad in the sense that the fuels we use to generate this good are increasingly recognized to cause substantial harm to natural capital. Green et al. suggest that China encapsulates a number of these facets in that, for example, the concern with fuelling rapid economic growth has been accompanied by growing recognition of the local and global environmental consequences of this energy throughput. In the OECD context, these environmental concerns jostle with anxieties about energy security. In some cases, this might motivate diversifying the energy mix through investment in renewable energy. In other cases, it might lead down a further path of carbon-dependence as in the case of shale gas resources, for example.

All of this suggests, as Green et al. make clear, that energy policy is characterized by hard choices and fraught by multiple dilemmas pulling politicians in different directions. Almost inevitably initiatives will come up short in satisfying all of these dimensions. For example, the recent focus on significant expansion of the renewable energy sector can increase security and reduce environmental impacts but might not reduce costs (and indeed may increase these substantially). Yet all too often it appears that politicians are enticed by charismatic energy projects and policies while ignoring whether their own country circumstances suggest these are appropriate or not. One risk here, identified by Green et al., is that feasible schemes such as energy efficiency which may satisfy competing dimensions lack the necessary charisma and so are downgraded in the energy policy mix.

Inevitably much of the emphasis in this volume is placed on the challenge of sustainable development for public policy. However, it is clear that this challenge is only part of the story. Individuals and communities of people might play their part too. This is important not least because it is this public which must accept the costs of behaving sustainably for the benefit of future generations. However, as Yvonne Rydin explains in Chapter 34, much of the impetus for current thinking about local sustainability was supplied some time ago by Agenda 21 in 1992. This local perspective has led to ambitious policy aims. For example, it has been argued that, as ‘global’ environmental problems have their roots in ultimately local behaviour, this places an onus on tackling such problems at local levels.

While this does not diminish the need for international cooperation to sustain meaningful outcomes on global problems such as climate change (where each locality’s contribution, in isolation, is negligible), an intriguing example, cited by Rydin, shows how

coordinated efforts across US cities have sought to bypass federal government reticence over climate change mitigation. One interpretation of this could be that policy-makers at local tiers of decision-making provide a better reflection of their citizens' preferences than at higher tiers, the latter perhaps being all too influenced by various interest groups and special pleading. In a related vein, a distinctive feature of the local sustainability agenda has been the identification of an enhanced role for meaningful public participation in (local) decision-making. Rydin thus makes a powerful case about the role local action plays in the quest for sustainable development, while being equally aware of the limits that local and urban sustainability faces.

Another crucial group of sustainability actors is the business or corporate sector. A great deal of debate has surrounded whether, and to what extent, businesses will respond to this agenda spontaneously or need to be coaxed (possibly reluctantly) by public policy or changing consumer demands. Andy Gouldson, Rory Sullivan and Stavros Afionis, in Chapter 35, give us a flavour of these debates about business governance and sustainability. Much of this, they note, has its roots in the notions of corporate social responsibility (CSR) and the expectation that those who own and control businesses should act morally (as well as within the law). Quite how responsibility for natural capital is an element of this obligation is an important question. However, as Gouldson et al. note, it is a question with no straightforward and singular answer. Indeed, more is known in practice about CSR examples and extent than why these actions might be carried out in theory by corporate entities.

That is, to the extent that these actions do not stem from clearly identifiable motives such as supply chains or compliance with regulation, 'reverse engineering' what happened in order to understand the reasons for the CSR that we observe is far from easy. This is especially so given that corporations are institutions made up of different interests rather than simply monoliths. A good example of this is recent corporate actions in relation to climate change, a question that Gouldson et al. focus upon in the context of the UK supermarket retail sector. Some of these actions appear to be path dependent. Companies with a CSR track record are more likely to take further initiatives. Moreover, these companies are often those relatively more concerned about both brand and reputation. None of this is divorced from government intervention to shift the business case for taking action. This can play a critical role in redefining how businesses perceive their interests although once in play this can create its own momentum. Supermarket policy on plastic bags in the UK is just one illustration. While initially government action was sluggish, a number of individual companies led the charge, introducing fees for plastic bags and, crucially, showing that customers broadly found this development to be acceptable. More recently, the UK government appears to be looking to codify (and extend) the resulting behavioural changes in the form of actual legislation. The inevitable question that Gouldson et al. pose is whether this business momentum can be harnessed to achieve the likely non-incremental changes needed for sustainable development.

## CONCLUDING REMARKS

This second edition of this volume comes after the twenty-fifth anniversary of the publication of the Brundtland Report (WCED, 1987). The debate on what is sustainable

development, how to measure progress towards it and how to put sustainable development into practice has come a remarkably long way. This volume has been an exercise in account-taking of what has been achieved and on which aspects consensus has emerged. Much more is known now than 25 years ago. Indeed, significant progress has been made since the publication of our first volume in 2007. For example, more is known about important components of natural capital such as ecosystems and how these relate to the fundamentals of sustainable development, as well as substantial progress made in constructing practical sustainable development metrics. That said, as this volume has illustrated, there are many complex and contested areas of continued disagreement. This suggests that there is much more to be learned and that the study of sustainable development will continue to be a thriving area of research. We believe that the contributors have covered a wide range of the most important topics in this ever-expanding field. Moreover, in the chapters that follow, the authors have provided an excellent discussion. Our hope is that readers will enjoy these contributions as much as we have in editing this new and revised volume.

## NOTES

1. While there is some debate about when exactly this terminology entered the literature, the main ideas can be found in Pearce et al. (1989), as well as Daly (1991).
2. The intellectual case for this position is set out in, for example, Solow (1992).
3. While at the margins so-called 'win-win' options may exist, the pervasiveness of these easy options can be seriously questioned.
4. For certain countries, it may be possible to adopt existing, more advanced and perhaps cleaner technologies from more technologically advanced countries (see, for a recent discussion, Perkins and Neumayer, 2005).
5. Indicators such as the Ecological Footprint (Chapter 24) have been designed to signal, from a particular perspective, the way in which countries consume resources extracted elsewhere.

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