Perspective

Defining sustainability: a conceptual orientation

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Abstract: Despite the ubiquity of the concept of sustainability, defining the term and construing meaning for different contexts is difficult. This paper presents several archetypes of sustainability that are useful for classifying and understanding existing definitions. Definitions that emphasize one part or another of the core concept of sustainability will be necessary at varying scales and in different contexts. This paper presents a conceptual guide that contrasts a dominant paradigm of economic growth and development with 'thick' and 'thin' versions of sustainability. Definitions of sustainability are explored in terms of their orientation to the ontology of nature, substitutability of resources, economic growth, population growth, role of technology, and social equity.

Keywords: sustainable development; theories of sustainability; limits to growth

INTRODUCTION

The *World Commission on the Environment and Development Report* of 1987 (the Brundtland Commission) introduced a new language of sustainable development.[1] Contemporary concepts of sustainability took shape during the 1990s; two decades later, the idea of sustainability permeates the discourse of environmentalism at nearly every scale, from technologies (e.g. buildings, chemicals, etc.) and organizations (e.g. corporations) to local and regional governments and in multilateral institutions.

Despite the ubiquity of the concept, there is little agreement about what constitutes sustainability. At the very least, the definition varies by scale and context of application; at the most, it varies by ideological constraints in its application, and can be seen as 'selling out to pragmatism'.[2] The fuzziness of the concept can be frustrating, especially for engineers accustomed to working with great precision. Still, this very quality is part of what makes sustainability so valuable, and has assured its ubiquity.

The objective here is to distill from definitions of sustainability, and its competing paradigms, archetypes to assist in understanding and defining the concept in practical ways. Definitions that emphasize one or another part of the core idea of sustainability will be necessary in different contexts, and as social and environmental conditions evolve.

WHY SUSTAINABILITY?

A number of important historical antecedents set the stage for the emergence of this concept. The World Conservation Strategy of 1980 proposed the concept of sustainable development.[3] The emergence in the 1980s and 1990s of environmental issues of global scope, such as ozone depletion and climate change, called attention to the marked increase in the rate and scale of changes to the environment wrought by the expanding global economy. Perhaps the most significant antecedent was the 1972 Club of Rome report, *Limits to Growth*.[4] The report used advances in dynamic computer modeling to demonstrate that the rate and scale of growth in resource use and pollution threatened to produce unanticipated consequences that would suddenly undermine growth in economic output.[5]

The radical conclusion of Meadow's and her colleagues[4] was that growth in economic output itself might not be able to continue indefinitely; the idea fundamentally challenged the basis of much of economics and concepts of political economy. If the pie could not expand indefinitely, to allow access to higher standards of living for the poor, how could the economic dominance of the developed world be justified? Further, population growth and economic expansion were typically viewed as inextricably linked, with one supporting the other. If economic output was truly limited, what were the policy implications

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for decelerating population growth to match the new realities?

Limits to Growth set the stage for sustainability by creating a need to answer such questions with a coherent set of policies that responded to the dominant models of growth. The choice is not between growth and non-growth, but between policies that create a soft-landing, through deceleration of growth, and a collapse of ill-defined proportions.

In one sense, the question is not so much what sustainability is, but rather what it means to be unsustainable. This issue is dealt with by Jared Diamond in *Collapse*[6], a powerful restatement, in anthropological terms, of the basic themes in *Limits To Growth*. For Diamond, the result of unsustainable use of nature (combined with other factors) is not a doomsday scenario, but rather future generations that have, 'significantly lower living standards', 'chronically higher risks', and are deprived of key values they currently hold. He echoes *Limits to Growth* in arguing that the most important capacity that the modern global economy has over earlier civilizations that have over-run their own resources is the ability to learn from the past, and use warning signs in the present to create policy shifts.

LEADING DEFINITIONS

Since the Brundtland Report was issued there have been many definitions of sustainability. Indicators, metrics and reports that rely, at least implicitly, upon definitions of sustainability have proliferated in the last decade and specific definitions must number in the hundreds. A comprehensive content analysis or catalogue of definitions of sustainability is beyond the scope of this article. Both Gladwin[2] and Hempel[7] provide tables with multiple definitions. Perhaps the most oft-cited definition of sustainability comes from the Brundtland report of 1987: the authors define sustainable development as, '... development that meets the needs of the present without comprising the ability of future generations to meet their own needs'.[1]

Subsequently 'sustainability' has found its way into many phrases across a variety of contexts. Well used phrases include: 'sustainable development', 'sustainable societies', 'sustainable communities', 'ecological sustainability', 'sustainable growth', and 'strategic sustainability'; each use has its own flavour, placing a slight emphasis on one or another aspect of the concept.

The concept of sustainability originated with biologists and ecologists who used it to describe the rates at which renewable resources could be extracted or damaged by pollution without threatening the underlying integrity of ecosystems.[8] It moved next into economics where the focus was on understanding the relationship between natural capital and economy, leading to the founding of 'ecological economics' a discipline committed to wider valuation of natural capital. The term has also been used by policy-makers, like the President's Council on Sustainable Development under the Clinton Administration and the US Environmental Protection Agency. More recently, the term has proliferated in the business and management literature[9] and the term is now used in engineering.[10]

Nearly all definitions of sustainability share core elements. The first is that they present a way of looking at environmental problems in relation to the economy and society. So neither social development nor economic growth is permitted to take ecological underpinnings for granted or, from another angle, ecological preservation schemes should not take economic outcomes or public support for granted.

The interconnections are usually described as a 'triangle', a 'three-legged stool', or overlapping circles in a Venn diagram, the three elements of which might be variously described as, 'economy, environment, and society' or 'equity, ecology, and economy'. Although specific elements, and their emphasis, may change, the thing that distinguishes sustainability is looking at systemic interconnections, and the idea that the elements should support, or reinforce one another in a reciprocal relationship.

Another core part of the concept of sustainability that distinguishes it from other ways of viewing the environment, economy or society is its focus on intergenerational equity; the Brundtland definition places emphasis on this aspect. The distinguishing trait here is that time scales, usually decades, are much larger than those considered in traditional business or even public planning cycles.

A final aspect shared by all definitions of sustainability, as opposed to traditional ways of looking at the environment, economy or society, is that they emphasize working beyond mere compliance with existing laws and regulations. This concept is captured for policymakers in terms of innovation that encourages performance beyond the minimum of the law. It is captured in definitions for businesses, where staying out front of regulations is seen as conferring competitive advantage.

Beyond these elements, there is less agreement as to what belongs in definitions of sustainability. Definitions may take one or another position along a range of dimensions, or may simply leave some dimensions out entirely. In Table 1 and the section below, this is explained in terms of 'thin' versions of sustainability that are in discussion most widely today, and 'thick' versions that would require deeper transformations from ideas dominant today.

The multiple definitions of sustainability are not necessarily a problem. Differing definitions of sustainability are useful because they allow for broader agreement and help to organize for social change when tough choices are being confronted.[3] Shifting definitions are also to be expected because the environment is a complex and dynamic system, with new problems emerging and understandings

Table 1. Archetypes of sustainability

	Dominant paradigm	Thin versions	Thick versions
Ontology of nature	Nature as raw materials for the human economy.	Some intrinsic values recognized in nature.	Many intrinsic values recognized in nature.
Substitution for natural capital	Infinite substitution.	Some natural capital cannot be substituted.	No declines in natural capital.
Economic growth	No limits.	Win–win relationship emphasized.	Must slow and reverse growth.
Population growth	No limits.	Population growth must be accompanied by per capita offsets.	Must slow growth and achieve declining populations.
Role of technology	Technological rationality.	Cautious skepticism.	Deep skepticism.
Social equity	Left to the market.	Takes connections into account.	Attention to redistribution.
Stakeholder participation	Decisions by experts.	Collaborative stakeholder processes.	Grassroots democracy.

of systems changing. As Braden Allenby writes, 'Sustainability is an emergent property of a complex system'.[11] In other words, sustainability must be viewed as a journey, not a fixed destination.[12]

COMPETING PARADIGMS

Of course, the dominant concepts of the environment, society and economy do not take even the core elements of sustainability into account. The notion that the physical environment imposes hard and fast limits to the scale of growth, or even softer limits to its rate, is not widely shared. While engineers and scientists understand the limits in a closed system imposed by the laws of thermodynamics, arguments abound as to whether those limits are being approached at all.

To better understand what is meant by sustainability, it is useful to contrast versions of the concept with the dominant paradigm that forms the set of assumptions in widest use today. To simplify existing definitions of sustainability, two versions are identified, a 'thin' version and 'thick' version, and they are contrasted to the dominant paradigm on several dimensions. The discussion draws extensively on Gladwin *et al*.[2], Vos[8] and Bryner.[3]

One key issue in defining a sustainable environment is the status or conceptualization of nature, and the proper moral relationship between humans and the natural world. Deep-ecologists, for example, view an improper ontology of nature as the major cause of a lack of sustainability.[8]

In the dominant paradigm, nature is seen as simply a resource of raw materials for the human economy. Humans are viewed as outside of nature, and dominating it. All of nature is available for human use, preferably as determined by market demands. In contrast, both thin and thick versions of sustainability now see nature and humans holistically. In other words, humans are fully integrated into the biosphere, but standing above it intellectually.[2]

In terms of the ontology of nature, the difference in thickness for definitions of sustainability is how much of nature is valued intrinsically (i.e. for its own sake). For a thin version of sustainability, some of nature is seen as intrinsically valuable, and therefore left outside the market. Thicker versions will take more of nature out of the market. The extreme end of this position is a deep ecological view where all of nature is seen as intrinsically valuable, and the human/nature relationship is changed from an 'I to it' relationship to an 'I to thou' relationship. Because of humanity's intellectual and technological development, and for a variety of other reasons, the deep-ecology position is no longer seen as tenable or useful in most definitions of sustainability. Still, many definitions of sustainability must grapple with what parts of nature are deserving of protection in their own right, and how these parts connect to the whole.

In the dominant paradigm, there is an assumption that economic accumulation in the present can compensate the future for any parts of nature that are destroyed in the process of economic growth. This is based upon the assumption that technology will allow infinite substitutes to be found for resources that are used up. It is precisely in the parts of nature mostly likely to be seen as intrinsically valuable where this assumption is found most tenuous. Once certain habitat types or species are gone, can they be re-created technologically, or will future generations have to accept environments without those possibilities?

The idea of 'natural capital' defines the value of nature in serving human needs. Nature provides services both as a 'source' for the raw materials in products or for recreational enjoyment and as a 'sink' that processes pollutants. For example, think of the immense economic value of the oceans as a food resource (source) and for absorbing carbon-dioxide pollution (sink).

Definitions of sustainability recognize the severity of the challenge for human ingenuity to find substitute new technologies for these services of nature. Many definitions of sustainability, following an ecological economics framework, insist on careful measurement and inventory of these values. Once values are obtained, then definitions of sustainability can compare natural capital with other forms of capital,

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like financial or human capital. Thin versions of sustainability seek to ensure that the overall value of natural and financial capital must be undiminished for future generations, even if the mix of the two is allowed to change. Thick versions of sustainability look for no overall diminution in the value of natural capital passed down to future generations.[3]

The dominant paradigm assumes that economic growth is highly desirable and has infinite potential; growth is assumed to occur due to the capacity of technology, through human ingenuity, to make more with less and, as analyzed above, to make substitutes for destroyed natural capital. As with increases in productivity, where economic output is increased with reductions of labor inputs per unit of production, so too economic output has been increased with declining resource inputs and pollution outputs, per unit of production.[13] In fact, so far, affluent countries cope more successfully with pollution than the developing world, by spending their way out of the problem, with new technologies.

However, new technologies to handle pollution in the developed world are powered by drawing on increasing amounts of global sources and sinks in the aggregate. Also, with the problem of global climate change, poor nations are particularly threatened due to their likely inability to spend their way out of environmental problems (e.g. sea rise, disease, or drought). The situation presents a profound moral problem for the developed world.[3]

Definitions of sustainability are less likely than the dominant paradigm to take for granted assumptions about the infinite potential, and ultimate benefits of economic growth. Thin versions of sustainability seek to reconcile economic growth with protecting the environment. They demand 'win–win' solutions that provide economic development paths that reduce pollution or resource use per unit of production. For example, President Clinton's Council on Sustainable Development defined sustainability, in part, as support for economic growth. Definitions in the sustainable communities literature call upon economic growth to solve both environmental problems and a range of local problems that people are typically concerned about; traffic, housing, open space, and crime.[7]

This 'win–win' aspect to sustainability is currently a popular concept in the business world. Here 'strategic sustainability' is a term used to capture the 'win-win' potentials of engaging with the ecological environment to grow the business, and gain competitive advantage.[9] Strategic sustainability means developing the capability of the firm to understand and react to changes in the natural environment.[14] The capability comes from investing in human capital and organizational design or strategic orientation. The business growth might come in a number of areas, like developing green products and services, increasing eco-efficiency in the supply chain, or developing new ways to relate to customers, like end of life, product take-back programs.

Thicker versions of sustainability go beyond per unit reductions in resource use and pollution, and instead look for reductions in aggregate. At their most extreme, these definitions of sustainability look to re-define how we measure economic growth; they may look to see reductions in growth rate or even reductions in the size of the economy.

To mitigate this definition, thicker versions of sustainability often differentiate between growth and development.[15] The focus here is on new ways of measuring the quality of life or of products, rather than as monetary values of economic output.[16] As Gladwin *et al*. write: 'Organizations in harmony with sustainability will increase the quality of life in equitable ways that maintain or reduce energy/matter throughput'.[2] The idea is to enlarge or improve the range of people's choices about how to live their lives, without increasing consumption.

Thick versions of sustainability will also often confront population issues head-on. By creating steep reductions in population over time, the growth of the economy could slow or even reverse without undermining per capita economic output. At the very least, thin versions of sustainability will demand that population increases be offset by *per capita* reductions in resource use and pollution generation. Like the other parameters in Table 1, definitions of sustainability question the dominant paradigm's assumption that population growth can go on without limits.

The role of technology in sustainability is another controversial element in definitions. The dominant paradigm tends to see technology as the ultimate solution to the sustainability problem. Indeed, Gladwin *et al*. refers to the dominance of a 'technocentric' paradigm.[2] The term 'technological rationality'[17] indicates that in the dominant paradigm technology comes to control development and the environment in a very narrow fashion. Technologies may be created and deployed by individual or corporate technologists with little societal evaluation of consequences. The creation of some technologies begets the need for others to counteract their effects. In total, the commitment to technological rationality detracts from other uses of human reason, like commitments to human will, value transformation or organization.

Certainly most definitions of sustainability also embrace technology. Indeed, architect William McDonough and chemist Michael Braungart,[18] leading sustainability proponents, see error in design as the primary, if not the only, cause of difficulty in achieving sustainable development. What sets both thin and thick definitions of sustainability apart from the dominant paradigm is that they treat technology with scepticism, and have a larger idea of what technology can mean. For example, McDonough and Braungart, while largely ignoring the roles of human will and organization in sustainability, re-envision and practice design so that technology harmonizes with the

natural world to preserve and enhance many functions of natural capital, or intrinsic values in nature.

The scepticism about technology in definitions of sustainability is often reflected in an embrace of the precautionary principle.[2] It is quite prominent, for example, in Agenda 21, a multilateral statement on sustainable development created at the Rio Conference on Environment and Development in 1992. The precautionary principle is itself open to a variety of interpretations and applications. It is subject to shadings as to the degree of risk it allows in launching new technologies. In general, thicker versions of sustainability rule out technologies with the risk of major, irreversible negative consequences; they also raise the burden of proof for safety, and shift it onto technology advocates.

One of the most important, but often overlooked, parameters in definitions of sustainability is equity. This was introduced into definitions of sustainability at the international scale in the context of 'sustainable development'. Early definitions of sustainability recognized challenges to achieving ecological protection in the context of severe inequalities in wealth between the developed and developing worlds. For example, if 'sustainable livelihoods' are undermined when people are displaced, land is destroyed or unemployment is widespread, then ecologies are in turn degraded through agricultural foraging or squatting in unsanitary urban conditions.[19] In the context of agreements to address global climate change, another example has been the insistence of the developing world that emissions reductions do not result in lost economic growth, or that they receive compensation in the form of technology transfers.

Social equity is also important at national and local levels. In the United States, the rise of the environmental justice movement coincided with the emergence of sustainability concepts. In this context, some definitions of sustainability recognize that if pollution is concentrated in the neighborhoods of poor or minority residents, it is harder to develop widespread support for pollution reductions. Efforts to preserve resources or reduce pollution can also bring changes in employment that hit the most vulnerable members of society the hardest (e.g. job losses in timber, mining or manufacturing industries). Definitions of sustainability therefore sometimes pay explicit attention to the distributions of the environmental benefits and burdens of economic growth and environmental protection.

In the dominant paradigm, the connections between social equity and the environment are ignored and left to the market to determine. In contrast, most definitions of sustainability seek to highlight the most important intersections where a lack of equity is interfering with ecological protection. Definitions may specifically address areas where these relationships need to be repaired, and strengthened so that society and the environment can be in support of one another.

Thicker versions of sustainability typically take on the equity issue as being important in its own right; here the emphasis is on broad redistribution of resources across society. The assumption is that redistribution itself will create support for other elements of sustainability; this view is prevalent in Agenda 21.

Many definitions of sustainability, however, give little consideration to broader redistribution of resources. For example, President Clinton's Council on Sustainable Development, perhaps for strategic political reasons, did not embrace wider equity issues in its definition. The redistribution issue plays on what are traditionally hotly contested ideological divisions. It leads sometimes to the charge that one or another version of sustainability is really a 'red' agenda in a 'green' costume.

It seems important that sustainability not be defined such that it is about everything that one advocate or another might desire. If it is to generate the sort of wide support that social change requires, it must be able to broker agreements across traditional ideological divides. In this regard, there is sometimes a useful 'strategic ambiguity' inherent in definitions of sustainability.[7] Some things must be left for political debate, outside the sustainability tent.

A final parameter that is important in definitions of sustainability comes under the heading 'stakeholder participation'. This is a key part of the definition for many organizations, which find that they need to have community involvement to ensure the success of long-range planning efforts or environmental programs. At a minimum, healthy stakeholder participation may help to head off or reduce litigation. At its best it may create support for difficult choices that must be taken to stay on a sustainable path.

Notwithstanding periodic elections, the dominant paradigm lets decisions about the long-term future of the environment at a number of scales rest with experts or economic elites. In the end, choices about the environment that affect future generations matter to all, everyone is a stakeholder of some sort. For thin versions of sustainability, stakeholder involvement is a collaborative process. Stakeholders both receive information, and give input that is weighed in taking decisions.

Thick definitions of sustainability have at times struggled with the balance between the need to protect nature and future generations and democratic practices.[20] The concern is that in democracies, present generations are likely to pursue their own interests at the expense of future generations. Lester Milbrath,[15] for example, calls for a guardianship concept. He proposes a council to protect the interests of future generations. Milbrath, like many advocates of guardianship, looks not to supplant democratic institutions, but rather to blend them with checks and balances for future generations. In the final analysis, it seems most likely that consent for the radical changes that thick definitions of sustainability make to the

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dominant paradigm will be most readily obtained by widening, rather than narrowing, participation in economic and environmental decision-making.

CHOOSING A DEFINITION: WHAT IS BEING SUSTAINED?

To deliberate over a definition of sustainability in a particular scale or context, it is important to consider the parameters discussed above in terms of 'what' is being sustained for future generations, especially in terms of the natural world. At the level of the organization what aspects of the mission need to be sustained for future generations? At the level of communities, what quality of life is to be sustained? At societal levels, what are the key values of the civilization and how does nature work to support them?

Powerful definitions of sustainability connect to abstract values that enjoy something close to social consensus. For example, values like freedom, equality or democracy may rely in part on the state of the natural world that is passed along to future generations.[21] Irreversible choices, like species extinction, deprive future generations of the freedom to relate to nature on their own terms. Extensive pollution, like global climate change, drives up costs and constrains the ability of democracies in future generations to shape their own fates.

Sustainability, in this sense, is a bit like security. It seeks to preserve a particular civilization, and offer a range of choices to future generations. It has long been recognized that security must be carefully constructed and balanced. A highly militarized state may be very secure, but the wrong kind of security can destroy the very values it is trying to preserve. So too, it is possible that the wrong definitions of sustainability can undermine the very values they are trying to sustain.

CONCLUSIONS

While definitions abound, the practice of sustainability today is still quite limited. Most practice is occurring at the community or local levels and within private firms, using some variation of the thin version. At the national level, President Clinton's Council on Sustainable Development is relegated to the dust-bin of history. Ironically, at the international level where the concept emerged, little action is being taken. Agenda 21, for example, has had little impact on a series of global trade agreements negotiated since. The failure to practice at the national and international levels is critical because policy changes there are deeply needed to support local and corporate efforts.

There is unlikely to ever be a single answer to the question, 'what is sustainability'. Instead, definitions should be crafted to serve well in different times and contexts. And, more importantly, the definitions should be practiced, by implementing metrics and indicators of progress along the road to sustainability. It is from practicing sustainability that definitions can best tested and refined.

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