Thinking about ecological sustainability

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THE concept of sustainability emerged in the mid-20th century as a fairly straightforward notion in the management of renewable natural resources such as forests and fisheries. In this narrower context, the term simply meant extracting from a resource stock at a rate below the stock's natural growth rate. In the 1980s, however, the term began to be used in broader context. A (re)defining moment came when the 1987 World Commission on Environment and Development (also known as the Brundtland Commission) popularised the term 'sustainable development', which it defined as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987). Today, the term has become ubiquitous. People are talking about sustainable health, livelihoods, communities, transport, cities and even defence!

While such indiscriminate usage undermines the power of the concept, there is no doubt that the idea of 'sustainability' has touched a chord somewhere. Indeed, it has almost replaced or become synonymous with 'environmental soundness' amongst activists, analysts and policy-makers alike. 'Sustainability science' is the new buzzword amongst environmental scientists abroad. But what does sustainability really mean? What are its nuances, underlying assumptions, strengths and limitations? This article is an attempt to explore these questions.

In common parlance, 'to sustain' is simply to maintain undiminished over time. In this elementary sense, it is not clear that sustainability is always a desirable goal or attribute – oppressive social structures such as casteism or dictatorships surely need not be sustained. Hence, when talking about sustainability, it is essential that one clarify what one is trying to sustain. Most usages of sustainability are in or have emerged from the environmental context, and therefore they refer (explicitly or implicitly) to 'maintaining undiminished the ecological basis of human well-being.' I refer to this as *ecological sustainability*. It is should be noted that sustainability is occasionally used with fundamentally social connotations, what one might call the 'maintaining the social basis of human well-being.'[1] While

important by itself, this concept of social sustainability is not taken up for discussion in this article, which focuses on ecological sustainability.

Why should one be concerned about sustaining the ecological basis of human well-being? On the face of it, the ethical basis for such concern is obvious. Human beings have always been naturally concerned about their own future and almost all human cultures often place a significant value on the well-being of future generations. But the recent attention to the concept is related to its empirical basis, viz., the mounting evidence that current human activities may irreversibly and unacceptably harm future humans. The loss of soil fertility, the depletion of groundwater resources, the pollution of rivers, the disappearance of biota and the increasing concentration of green-house gases in the atmosphere are all examples of the destruction or degradation of biophysical resources and disruption of ecosystem processes on which human well-being seems to critically depend.

If we know what sustainability is and why it should be achieved, then the answer to the 'how' question should also be straightforward. At the level of an individual renewable resource, which is where the idea of sustainability originated, the problem did seem straightforward earlier. But the problem is now complicated both at the individual resource as well as at the wider scale when one talks about moving towards a sustainable society. As always, the 'how' is intertwined with the 'what'.

Originally, in the context of forests or fisheries, the idea was that these renewable biological resources grow in a stock-dependent manner. Thus if one knows the natural growth rate for a particular stock size and harvests it at a rate less than or equal to this growth rate, then one will not deplete the stock as also ensure continued availability of the resource for harvest at the same rate in the future. This is at the heart of the notion of 'natural capital'. But decades of attempted practice of this principle has shown that there are difficulties on many dimensions.

First, ecosystems are internally complex and interconnected entities, not simple bank balances that grow at fixed interest rates. Within forests also exist pests; within fisheries also exist fish that are predators or prey of the harvested species of fish. Changes in one species set off ripples that can produce unexpected feedback, making mockery of 'sustained yield' prescriptions. Sustainable use requires 'adaptive management', something that local communities may have been practicing in the past (Berkes *et al.*, 1994) but scientists are rediscovering now (Ludwig *et al.*, 1993).

Second, external conditions can be quite variable. Therefore, the focus ought to be not just on sustaining a particular level of production, but also on ensuring low variation in that level from year to year. This has certainly been the learning from dryland agriculture.

Third, some have called into question the very notion of aiming for steady (or low-variability) production levels (even after trial and error), when external conditions fluctuate tremendously. For instance, the entire furore about overstocking of cattle in the rangelands of sub-Saharan Africa and resulting desertification was built on the notion that rangelands have a natural carrying capacity, which if exceeded leads to irreversible declines in their productivity. Recent research has shown that the productivity in these rangelands is controlled mainly by rainfall, which is extremely erratic (and not in the control of the graziers!), and there is limited empirical evidence for grazing-induced resource degradation once one factors in the effects of rainfall (see Turner in *Seminar* issue 486).

Some scientists argue that, under such conditions, the resource manager should focus on 'sustainability as resilience', i.e., the ability of the system to recover from devastating shocks or stress as in the case of a severe drought year. There is a raging debate as to whether reducing variability in the short-term may actually contradict efforts to increase resilience for the long-run (Ludwig *et al.*, 1996). Finally, there may be situations where external conditions shift systematically rather than just fluctuate – as possibly the greenhouse effect might to do to our climate. Under these conditions, what may be required to 'sustain' production systems is not just stability or resilience but adaptability.

This debate about which temporal attributes to focus on has enriched, as also complicated, the notion of sustainability. Few scientists have been able to translate these abstract notions of low variability, resilience or adaptability into concrete prescriptions for specific ecosystems. However, certain common threads seem to be emerging. If adaptive management is going to be necessary, then this trial-and-error should obviously happen at a scale and in a manner that resource managers can relate to as also not spill over into too many 'downstream' impacts. Clearly, users (such as tribal communities in central India) who are in daily contact with the ecosystem and have been so for several hundred years should have a major role in such adaptive management, and this should be done at micro-levels rather than going in for one-solution-fits-all approaches.

Furthermore, the response of modern reductionist science to high environmental variability and complexity has been to control and simplify – setting up monocultural pine stands, single-species aquaculture, or mono-specific cropping systems with irrigation and fertilization that overwhelms natural variability in rain or soils. But this approach is clearly reaching its limits, and creating rigidities that reduce resilience and adaptability, not the least because of the lost of biodiversity. Finally, this local-level simplification, while generating temporary efficiencies through specialization (whether of crop cultivars or of occupations) always comes at the cost of increased global linkages: many more inputs have to be imported and most of the production has to be exported to various markets.[2]

Without getting trapped in unrealistic notions of self-sufficient village republics, it is possible to point out that continuous increases in inter-connectedness at the global scale are not always desirable. Analysts of dynamic systems have shown that in highly interconnected systems, small structural perturbations may result in wild fluctuations (Siljak, 1978). Such behaviour has already been observed in large, interconnected power systems, leading to what is called 'cascading blackout'. Remarkably similar behaviour has been noticed in international stock markets and currency markets in recent times – crashes in one market triggering off fluctuations globally (for details, see Lélé, 1993).

Thus, it seems that sustainability considerations have some direct implications for trajectories of rural development and the question

of how trade-oriented agriculture should become. Building resilience into dryland agricultural systems against external fluctuations, whether major pest outbreaks or market crashes, might require them to be more internally diverse and complementary, and perhaps trading at multiple scales, not totally plugged into the global market.

The notion of sustainability becomes much more complicated when we transfer it to a higher level, be it livelihoods, economies or societies. If the discussion is about how to manage a particular patch of forest *as forest* or (better still) specifically as a source of timber, we can have a somewhat coherent discussion as to how it might be managed sustainably. But when the debate shifts to one of balancing across different uses of the forest or (worse) different uses of the land, some 'forest' and some 'non-forest', it becomes much more difficult (perhaps inappropriate) to talk about sustainability. Over the past several thousand years, humankind has steadily replaced forests with agriculture, which seems to have sustained quite well and support many more human beings at the same or even higher level of well-being. What combination of forest and non-forest is then *essential* to maintain human well-being undiminished? More recently, industrial processes have been providing substitutes for many forest products and even for some agricultural products. Is the conversion of agricultural land into industrial estates then necessarily a sign of 'unsustainability'?

Economists have been engaged in a bitter debate about the question of whether man-made capital such as industrial infrastructure can substitute for natural capital such as land. While Herman Daly's questioning of the notion of infinite substitutability between these forms of capital that is the bedrock of neoclassical economics seems intuitively compelling, I wonder whether the question is better resolved in specific contexts. For instance, if the replacement of agricultural products by synthetic ones generates much greater greenhouse gas emissions (due to say fossil fuel use) it might be called more unsustainable, otherwise not.

Lest this discussion seem esoteric, note that essentially the same issues crop up in a rural dryland context. We are perhaps able to talk individually about sustainable forestry or sustainable agriculture, but how does one apply a sustainability criterion to the

choice of landuse, to the question of forest encroachment for cultivation? In other words, when we shift our focus from sustaining *resources* as such to sustaining *livelihoods* or incomes, identifying sustainability criteria becomes much more nebulous or subjective. As long as pastoralists want to remain pastoralists, sustaining grassland productivity directly relates to sustaining their livelihoods. But what if they want to shift to non-pastoral and even non-land-based livelihoods?[3] What if, for instance, they wish to convert their traditional grazing lands into mines or quarries?

Mines, as producers of non-renewable materials, surely cannot be said to be promoting ecological sustainability? But does this then mean that all mining activity (or rather use of non-renewables from such mines) everywhere should stop? Surely even primitive societies used some amount of stone and metal? So what level or type of use of non-renewables should be considered unsustainable?

Again, the notion of sustainability offers only limited practical guidance. Indeed, some scholars have used the same argument even in the context of groundwater depletion. They argue that the mining of non-rechargeable aquifers – as is happening in many parts of India – may seem 'unsustainable' (and it is so almost by definition). But if this groundwater mining represents a temporary phase whereby farmers generate high levels of cash income, educate their children and diversify their livelihood portfolios by getting into non-agricultural activities, as has happened in parts of Gujarat, then this substitution of natural capital with human-made capital should be acceptable (see, e.g., Moench *et al.*, 2005).

That mining of non-renewable aquifers often leads to lowering of renewable aquifers makes this argument somewhat unconvincing, and when one considers the inequitable distribution of the gains from such mining one may choose to reject this approach altogether. Nevertheless, the argument serves to highlight the point that rigid notions of 'sustainable groundwater use' may be problematic when the entire world is engaged in the mining of all forms of non-renewables.

This brings us to the question of why, even in relatively simple situations, users continue to use resources unsustainably. The answers are diverse, if not divergent. At a superficial level, the debate is between those who point to the rapid and continuing increase in population levels and those who point towards

enormously high consumption levels in developed countries. At a deeper level are the various possible explanations for continued high consumption, poverty and population growth. I would focus on two forms of explanation that are dialectically interconnected.

On the one hand, political economic structures certainly militate against long-term thinking at micro and macro levels. At the micro-level, and in the context of India's drylands, the lack of clear, secure and adequate tenure over forest and water resources and even cultivated lands, whether the shifting cultivation lands in Orissa or the forest villages in Madhya Pradesh, is clearly a problem. At the macro-level, there is no doubt that the capitalist system of production strongly encourages, even fetishizes, material consumption and constantly resists state efforts at environmental regulation. On the other hand, value systems and perceptions about nature are changing in an interlocked manner: concern for the future may itself be diminishing as we become a more self-centred, consumerist society and the belief that modern technology can overcome all obstacles is supporting this shift.

The sustainability debate is thus part of a larger debate about the relationship between environment and development. For many, especially in the West, sustainability has for many become the new *avatar* of environmentalism. This trend has arguably increased support for environmental initiatives, but I am afraid it has also led to a narrowing or muddling of the environmental debate in certain ways. 'Sustainability-ism' has reinforced the notion of 'we are all in the same life-boat Earth, and this lifeboat is in danger of sinking unless we all act in a concerted manner'. But to believe that all environmental problems are the outcome of lack of (or inadequate expression of) concern for future generations would be highly inaccurate. Environmental problems in general involve different types of externalities – across time, across space and across sectors (for details, see Lélé, 1994; 1998). Ensuring sustainability only addresses the first, not the other two.

For instance, a factory dumping pollutants into a river affects *current* water users downstream immediately. Even if the factory managers are thinking long-term, they may not think about those affected downstream *unless* they are also concerned to some extent about equity or social justice. Similarly, water use in an upstream watershed could be 'sustainable' in the sense that villagers do not use more than the annual recharge, but may leave nothing for downstream users or in-stream organisms, unless the upstream

villagers are concerned about these other users or organisms as well.

In other words, ecological or environmental sustainability does not cover the environmental *justice* dimension of the environmental *problematique*. But focusing attention exclusively on intergenerational issues is convenient for those who wish to sidestep issues of intra-generation equity and justice in the access to and impacts of resource use. Focusing on the future of 'humankind' blurs the fact that human society is highly differentiated in the distribution of responsibility for and impacts of various environmental problems, or in terms of access to natural resources. It is no coincidence that what was originally called 'Sustainable and Equitable Development' in the World Conservation Strategy (Jacobs *et al.*, 1987) eventually became just Sustainable Development.

Similarly, talk of 'sustainable livelihoods' has the possibility of distracting us from questions of what allocation of property rights is one starting out with on which these livelihoods are to be built and sustained. Certainly none of the bilateral aid programmes that have adopted the concept of sustainable rural livelihoods seems to have focused on questions of reassigning property rights!

Finally, the concept of sustainability does not by itself tell us (nor, for that matter does the concept of environmental justice) as to what notion of human well-being one is trying to sustain (or provide equitable access to). This is a deeply subjective notion. While there is theoretical discussion of both material and non-materials needs of human beings, in practice much of the debate assumes that material needs are of primary concern.

At some point, however, one will have to confront the question of whether there is something called quality of life beyond the material, and perhaps acknowledge that, for instance, a biodiversity-rich or 'somewhat closer to nature' existence is a value in itself. Failing to be upfront about this question of quality of life or content of development can lead to a lot of muddled thinking or disingenuous argumentation.

For instance, many ecologists are bending over backwards to demonstrate how biodiversity conservation is *essential* for

ensuring the continued flow of material benefits from ecosystems.[4] Conversely, contesting currently prevalent notions of what constitutes the 'good life' may be as powerful a tool in the environmental battle as arguing that this notion of the good life is unsustainable. Of course, it may also mean that the fight for sustainability has to begin in closer at home, in changing urban lifestyles that are today dominating the dreams of rural communities.

Footnotes:

1. For instance, Barbier (1987) defines *social sustainability* as 'the ability to maintain desired social values, traditions, institutions, cultures, or other social characteristics.'

2. It is also creating very serious negative externalities in the form of fertilizer runoff or appropriation of someone else's water, an issue that I discuss below in the context of environmental justice.

3. The question of what if agriculturalists want to convert the pasture to cultivation is somewhat analogous but is more clearly in the realm of environmental justice rather than sustainability.

4. See Ghilarov (Ghilarov, 2000) for a critique of this trend.

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