Sustainability: A Fresh Look at the Literature

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Abstract

Sustainability as a broad goal for government policy toward society and the environment meets popular approval. However, more precise definition of the term is required before it is an operational policy goal, towards which progress can be measured.

In practice the term encompasses a number of distinct and sometimes conflicting goals. In this paper, goals and techniques for operationalising the concept of sustainability are reviewed, and applied in the context of New Zealand agriculture. In particular, soil erosion on hill country is evaluated, and the East Coast Forestry Project discussed.

Introduction

Much New Zealand agriculture is biophysically unsustainable, in the area of soil erosion alone, consider the following:

- in an average year New Zealand rivers carry 400 million tonnes of sediment from the land to the ocean. The Waiapu, which drains part of the East Cape, carries 35 million tonnes/year, which is equivalent to a 5 tonne truckload every 12 seconds (Hicks & Griffiths, 1992).
- sediment losses from schist catchments of Westland and mudstone catchments of East Cape are in the range of 10,000-30,000 tonnes/km^2/year, which rank amongst the highest in the world (Hicks & Griffiths, 1992).
- on steeper slopes in Taranaki, Wairarapa, Gisborne-East Coast and the South Island East Coast soil loss rates are higher than soil formation rates (Blaschke et al. 1992).
- pasture yields are reduced following mass erosion by about 20% in the long term in many North Island areas of New Zealand. This loss is irreversible because soil formed under grassland is never as productive as soil formed under native forest on the same site. In addition the soil eroded away contained a volcanic ash layer which improved nutrient cycling, whereas the newly formed soils do not (Lambert *et al.*, 1983; Trustrum

& Page, 1991; Gane *et al.*, 1991).

A litany of ills such as this, which does not even begin on problems such as weed ingress, rabbits, fertility decline, acidification and chemical contamination, suggests that New Zealand agriculture has a sustainability problem. This is in fact the case, if our definition of sustainability incorporates only the biophysical.

Defining Sustainability

How then do we define sustainability? The World Commission on Environment and Development, which was responsible for thrusting the concept into the public arena, defined sustainable development[1] as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987, p43). Subsequent to the World Commission's Report, a plethora of definitions of sustainability, sustainable development and sustainable management has been produced from a wide range of disciplines, and considerable debate has been stimulated. It has become apparent that whilst at a superficial level, the concept of sustainability is beguilingly simple, its meaning self evident, and its appeal universal; more precise definition, and subsequent application of the concept, is more controversial (O'Riordan, in Turner, 1990).

Some writers have considered that a definition is unnecessary, holding that agents will intuitively know when an activity or policy is sustainable (eg. Eller, d'Ayala & Hein, 1990; quoted in Jayasuriya, 1992). However, a definition brings precision to the policy process. Measurable evaluation criteria distilled from the definition provide a standard against which current activities and proposed changes can be objectively measured. In New Zealand, sustainable management is defined in statute, and is required of all those who have an effect on the natural (and in some cases, the built) environment. The Resource Management Act (1991) defines sustainable management as follows:

> "managing the use, development and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social,

[1] I have used the terms sustainability, sustainable development and sustainable management synonymously for the purposes of this paper.

economic, and cultural wellbeing and for their health and safety while:

a. sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

b. safeguarding the life supporting capacity of air, water, soil and ecosystems; and

c. avoiding, remedying or mitigating any adverse effects of activities on the environment. (Resource Management Act 1991, s.5)

Both the RMA and the World Commission are primarily concerned with equity rather than biophysics, with the RMA being somewhat less austere, allowing the current generation to provide for their "wellbeing", rather than the World Commission's "needs". The Act expands its definition in sections 6 & 7, requiring officials to recognise and provide for various conservation and cultural principles, and to have particular regard to other factors such as intrinsic and heritage values, and economic efficiency. The Act (in common with most working definitions of sustainability) presents officials with a collection of goals:

- equity goals: providing for the needs of future generations, and for equity in the current generation.
- economic goals: encouraging economic efficiency, and maintaining economic viability.
- ecological goals: maintaining the quality and quantity of natural resources.
- social and cultural goals: enabling communities to provide for their social and cultural wellbeing.

These goals will inevitably frequently conflict.

In terms of maintaining soil resources on agricultural land, the collection of goals implied by "sustainable management", also conflict. The existence of biophysical non-sustainability signals that ecological goals (the maintenance of the quality and quantity of soil) are not being achieved. However, non-achievement of ecological goals does not imply non-achievement of economic goals. McConnell's (1983) work indicated that in some circumstances allowing continuing soil erosion may well be economically efficient both for the individual farmer and for society. This view is echoed by Chisholm (1992), who, after noting the decline in world prices for agricultural output, writes (in an Australian context): "In these circumstances, in a world of perfect foresight, an optimal strategy would have been to exploit the land more intensively during the buoyant years of the 1950s, 60s and early 70s even, at the cost of greater land degradation..." p25. However, the economic viability of individual farms is unlikely to be served in the long term by soil erosion - Blaschke *et al.* (1992) considering that hill country farming could well become uneconomic in New Zealand in two to three generations at current rates of soil loss. This has flow-on effects on the social and cultural life of rural areas. The equity impacts of soil erosion are equally as ambiguous. The needs of future generations may best be met by careful stewardship of hill country soils, so that they continue to provide food, fibre and an agreeable landscape into the indefinite future. However it must be conceded that the most equitable use path could alternatively be to allow current rates of soil loss to continue unabated, accepting that much hill country may revert in the long term, and food and fibre production become concentrated on easier country.

To summarise then, the Act's definition, in common with most other working definitions of sustainability, incorporates an assortment of goals which frequently conflict. Some attempts have been made to operationalise the concept of sustainability by developing decision rules which make explicit tradeoffs between goals.

Operationalising Sustainability

Economic efficiency analysis using conventional Optimal Control Theory, or Benefit Cost Analysis is not able to accommodate the goal of intergenerational equity without modification, since its ethical basis is utilitarian - individuals maximise their own utility. While this may lead to provision for a generation or two ahead of the present, the needs of more distant generations are heavily discounted. By contrast, much of the work which attempts to incorporate an intergenerational equity goal into the analysis, draws on Rawls' contractarian approach (Rawls 1972). Solow (1974) and Hartwick (1977, 78) drew from Rawls' work the implication that consumption should be held constant over time at the maximum feasible constant level, and that this is equivalent to the maintenance of a constant asset base. Pearce *et al.*. (1991) extend this Solow-Hartwick constraint (no negative changes in the stock of capital), to a requirement that there be no negative changes in the stock of natural capital, since some natural capital cannot be substituted for with man-made capital. Benefit cost analysis is carried out subject to this constraint. In practice, this involves the expansion of portfolios of projects to include environment enhancing projects (perhaps tree planting), to offset the degrading ones (eg. erosive practices) adopted on efficiency grounds. The question arises as to what constant or improving levels of natural capital means with respect to soil resources. Does it mean constant or improving levels of soil depth, or of flows of goods and services from the soil, or of values of the flow of goods and services? The whole approach has been criticised (Dasgupta & Maler, 1990) for confusing the *determinants* of wellbeing (eg. the means of production), with the *constituents* of wellbeing (eg. health, welfare, freedoms) - a decline in the stock of environmental assets is, *on its own*, not a reason for concern. Dasgupta and Maler question which level of environmental stock is the appropriate one, Pearce *et al* having taken the view that the current level is the minimum acceptable. Sustainability is possible at many different levels of environmental capital stocks, and a rational decision must be made as to which level is appropriate. The RMA's intention appears to be that the current level is the minimum, and that environmental quality must be either maintained or improved.

An alternative approach, which recognises the difficulty of valuing environmental assets such as soil, is the Safe Minimum Standard (Ciriacy -Wantrup, 1968; Bishop, 1978). The Safe Minimum Standard (SMS) is operationalised by calculating a matrix of losses, using a game theoretic approach (Figure 1).

Figure 1: Safe Minimum Standard for Soil Loss: Payoff Matrix

	Sustainable Use of Land	Loss of Option of Sustainable Use
Adoption of SMS		
Allow Continuing Soil Loss		

Source: Dixon et al., 1989

The social costs of each situation are entered into the cells of the matrix. Bishop's (1978) rule is to adopt the SMS unless the social costs are unacceptably large. Young (1992) criticises the SMS approach as an incomplete decision criterion, and considers that it would have proscribed both the Industrial Revolution and modern agriculture.

Both the constant natural stock and SMS methods of operationalising sustainability are essentially efficiency rules, subject to an equity constraint.

There appears to be little agreement in the literature on appropriate techniques for operationalising the concept of sustainability. Many economists have abandoned the concept altogether - O'Riordan (1990) calling it "meaningless", and Jayasuriya (1992) terming it a "popular notion" that adds little to resource economics. However, simply because a subject is difficult to grapple with, or even define, does not make it worthless. Sustainability is worth aiming for, and working towards - as Longworth (1992) reminds us, it is like "Motherhood", no reasonable person is against the idea in principle. New Zealand society has embraced the concept of sustainability in the Resource Management Act (Meister 1991). In the absence of a clear decision rule to operationalise it, an incremental approach is probably the most appropriate - "[a]chieving sustainability is not moving toward a well defined goal, but is rather a process of defining paths which consist of incremental advances, mid course corrections, and constant feedback of measurements about the environment" (Carpenter, 1990, cited by Meister, 1991). An incremental approach is also a practical way of dealing with uncertainty about changes in technology, and changes in the preferences of future generations. Within this process, the resource economist takes his or her traditional role of clarifying the efficiency and equity implications of policies; of indicating the most cost-effective ways of achieving biophysical, social and cultural goals; and of evaluating policies ex-poste, to assess their successfulness (or otherwise) at achieving their stated goals. The economist can also provide insight into the appropriate level of environmental quality, and guidance as to which resources should be priorities for sustaining.

An incremental approach is applied to the East Coast Forestry Project in the next section.

The East Coast Forestry Project

The East Coast Forestry Project (ECFP) was announced in the 1992 Budget. The project aims to plant 7000 ha of production forest on specific types of eroded or erodible land in the East Cape area every year for 28 years, resulting in a total planted area of 200,000 ha. This amounts to nearly 40% of the farming land in the district. The scheme provides a subsidy for planting (35-70% of total costs), tending (0-50% of total costs) and final thinning (15-30% of total costs), the percentage of subsidy varying with the tending regime chosen (Ministry of Forestry, 1992).

It is instructive to compare the ECFP with an earlier afforestation scheme instituted for a five year term following Cyclone Bola *in* 1988. This scheme - the East Coast Project Conservation Forestry Scheme - aimed to afforest 15 ,000 ha of hill country with severe or potentially severe soil erosion problems upstream of the Poverty Bay and Tolaga Bay flats. The scheme provided farmers with a 95% subsidy on the cost of planting trees (Gisborne District Council, 1993).

In comparison with the earlier scheme, the ECFP in its first years of operation has been less tightly targeted for soil conservation:

- land other than that above highly productive flats has been approved for subsidy, yet the best justification in efficiency terms for government subsidy of afforestation is the reduction in the external effects on the Gisborne and Tolaga Bay flats.
- land clothed in closed canopy kanuka has been approved for subsidy, yet such scrub cover provides adequate soil conservation
- a higher percentage of less erosion susceptible categories of land has been included in the approved areas for subsidy.

This lack of close targeting arises from the multi goal nature of the project. Planting on non-target land has been justified on the grounds of the provision of employment and regional development. An alternative viewpoint is however, that the loss of employment in the agricultural and agricultural servicing sector, and the loss of elements of the agricultural infrastructure (including perhaps the local freezing works) may partly offset some of the gains to the region from the project.

It is apparent that the earlier scheme had some advantages over the ECFP - not only was it more tightly targeted for soil conservation purposes, it was administratively simpler, it incorporated a local funding component, and it was locally and cheaply managed.

Evaluation of the effects of the ECFP will need to be made over time. It may be that the

ECFP will prove to be an incremental move away from the sustainability path, rather than towards it.

Conclusions

The RMA provides decision makers with a definition of sustainability which contains a collection of goals. The implications of policies in terms of progress towards each of those goals need to be evaluated before they are instituted, and it is here that the resource economist has much to offer, along with input from other disciplines. The decision maker will inevitably make tradeoffs between the goals - accountability for the results of tradeoff decisions made can only be through the political process (Baine *et al.* 1988). The East Coast Forest Project provides an example where, if progress is to be made towards sustainability goals, careful evaluation is required, and changes made in the policy to refine it.

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