8

The Benefits of Conservation

Extending Land Degradation Assessment into Conservation

The main practical and field-level purpose of land degradation assessment is to determine what measures of conservation are the most appropriate, and best meet the differing objectives of all parties affected by the degradation. Conservation is the next logical move from considering the consequences of land degradation for land users. Appreciating how all this information might be turned to productive benefit for the land user is an exciting challenge for the field assessor.

The identification and measurement of land degradation are essential steps in developing conservation strategies. While these measurements may provide useful information about environmental change, unless applied to reduce land degradation they serve little practical purpose. So, land degradation assessment should not be seen as an end in itself – it is a means to achieve a practical and useful outcome for a specified user of information. Users include planners, other professionals, development practitioners, field staff, farmers or the rural poor. Users may come from government agencies, international organizations, local and international non-governmental organizations, companies, research institutes and individuals. Their objectives and purposes for wanting land degradation information may be very different. Thus, it is vital that any programme of land degradation assessment has a clear idea of who the client is, what the client wants and how the information is to be used. In this handbook the particular emphasis is on farmers again, and how they may derive benefits from applying practices of land degradation control.

Meeting multiple objectives is a desirable aim. The classic *win–win* scenario is where the control of land degradation not only achieves a benefit to society, but also brings immediate support to the land user. One of the problems of conservation in the past is that these dual objectives of providing for both society and the individual land user were normally seen as incompatible. Typically, conservation was enforced on farmers, who then had to carry out additional and costly works to implement the recommended measures. So, conservation was always viewed as being a cost to the land user in extra labour, additional effort and more trouble. Farmers would justifiably say, 'Why should I live a poorer life, so that people downstream and in the towns can live a richer life?' It is not that land users are anti-social, but that in many cases their implementation of land degradation

control measures on behalf of society represents a major cost to them and their families. This cannot be a sustainable position – nobody works in order to become poorer. But if, instead, land degradation were reduced *and* the needs of the farmer were met, this would be a sustainable solution – sustainable biophysically and economically, because everyone benefits. This is neat in theory, but difficult to put into practice. Good field-level land degradation assessment is a necessary condition to identify such sustainable solutions. When combined with an assessment of the socio-economic conditions of the land user, the field assessor is in a position to evaluate different conservation strategies.

Potential users of the information from land degradation assessments, such as professionals and development practitioners, will want to know whether the land user addressing land degradation will actually gain a benefit. This is a crucial question that underwrites much of what we have reviewed in this handbook. Land degradation assessment, including knowledge of its impact on the land user, is the primary entry point to estimating the cost of land degradation. By preventing this land degradation through measures of conservation, a **benefit** is derived for the land user in terms of yields and easier farming practices. The benefit is, in effect, the amount 'saved' above a baseline of continuing degradation, the 'without conservation' line in Figure 8.1. So even if yields simply remain constant, there is a benefit as represented by the shaded part of Figure 8.1.

In simple terms, if the value of the 'saved' yield exceeds the costs of implementing the conservation, then land degradation control through these means is potentially worthwhile to the land user. The technologies have a good chance of adoption.

The key to making such predictions of likely acceptance of conservation is being able to value accurately from a **farmer-perspective** the following:

- Costs of the conservation measure: this must include not only direct costs, such as the materials for a technology, but also indirect costs such as the amount of land taken up by the measure and the activities which cannot now be undertaken because of the time it takes to do the conservation.

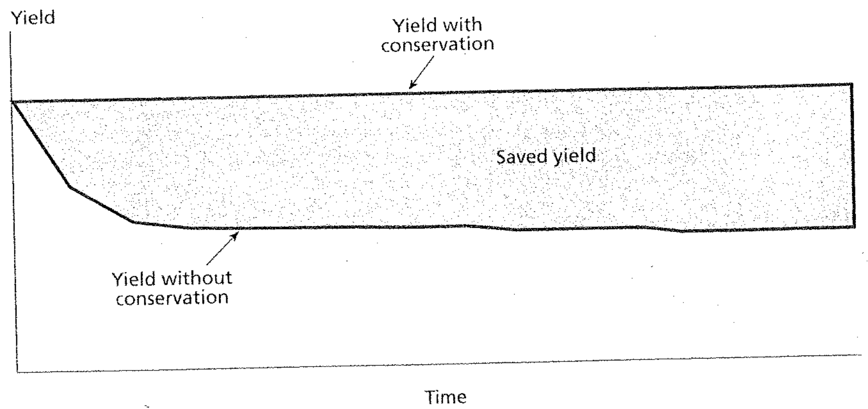


Figure 8.1 *The Benefit of Conservation*

- Benefits of the conservation measure: this must include both the direct benefits in getting increased crop yields (or maintaining existing yields, when otherwise they would have fallen without conservation), and the indirect benefits such as additional products, for example wooden poles from contour hedgerows.

The field assessor must try to assemble as much of this information as possible in order to move land degradation assessment on into a practical tool for determining what conservation measures are going to have a good chance of success. Success has to be judged not only biophysically in terms of amounts of 'saved' soil, but more importantly economically, in terms of the net benefit (or cost) to the land user.

Sensitivity and resilience are measures already introduced in Chapter 2. They are used to determine the vulnerability of a landscape to degradation. They can equally be used to assess the likely effectiveness of conservation strategies. In Chapter 7 the impact on yields of each cell in the sensitivity–resilience matrix was assessed. The likely approach to conservation by the land user in each situation is summarized in the matrix in Table 8.1.

Table 8.1 *How Sensitivity and Resilience Affect Conservation Decisions*

	High sensitivity	*Low sensitivity*
High resilience	**Much soil erosion; little effect on yields** Conservation would have very doubtful payback to the farmer. On-site impact is low, but off-site impact might be far greater. It could be a case where society may want to provide subsidies to the land user to protect the land	**Little soil erosion; little effect on yields** Simple, low cost conservation that relies on biological means might be worthwhile to utilize the properties of high resilience
Low resilience	**Much soil erosion; large effect on yields** Two outcomes may occur. First, although soil erosion is high, there might be little to be gained by the land user in addressing the problem, especially if the inherent soil fertility is poor. A typical strategy for a land user might be to use it quickly, then leave the land to fallow until, eventually, natural fertility is restored. This occurs under shifting cultivation in the humid tropics. Alternatively, if inherent soil fertility is good, it may be very worthwhile for the farmer to address erosion problems by investing in physical conservation works. Their payback in keeping the soil productive compared with a situation with no conservation could be extremely large	**Little soil erosion; large effect on yields** Since yields are difficult to restore, there is every reason for the little soil erosion that might occur to be controlled. Some combined physical and biological strategy, such as ridging and cover crops, could well be beneficial in keeping the soil in its productive state

Typical Benefits of Conservation

At the outset, it is important to have a grasp of all the benefits that conservation may bring to the land user. These range from the immediate and direct right through to the remote. It is also vital to appreciate that farmers do not often implement conservation all in one go (see Box 8.1). Any assessment should attempt to capture the full range of benefits and ways of implementing conservation, otherwise some items that have great significance for farmers may be missed. A simple typology and two examples of each type are shown in Table 8.2, which can be used to develop a checklist for the field assessor when discussing benefits with farmers and carrying out field observations.

Similar listings of costs should also be constructed. As seen in the example in Box 8.2, the costs incurred and the opportunities forgone by implementing a conservation measure may be offset by the benefits, both in number and in value. For example, *Gliricidia* hedges take up 9 per cent of the area of the field but they also provide extra income opportunities from the sale of poles and firewood. In such complex cases, an understanding of costs and benefits should immediately alert the assessor to potential problems (such as poor rates of adoption, failure to maintain conservation measure) or to potential advantages if this technology were to be promoted.

Many, if not all, of these benefits and costs can be valued in financial terms, thereby laying the groundwork for cost-benefit analysis. However, care must be taken to avoid any element of 'double-counting'. For example, it may be unjustifiable in economic analysis to accept both an increased value of land as a long-term benefit and increased future yields. The increase in the value of the land may incorporate the better yields. Thus, once listed, costs and benefits should be carefully examined, arranged and codified for particular analytical purposes.

Box 8.1 Incremental Conservation

Many conservation techniques can be implemented incrementally – that is, a little at a time. Land users will implement those elements of a conservation strategy that make the best use of the time, labour and money that they have available. For example, in one year a land user may construct just two barriers across a slope, separated by a greater than optimum distance. In the following year a third barrier may be constructed between the two existing barriers. Alternatively, a farmer may start implementing conservation practices by constructing trash-lines across the slope to help slow runoff and trap sediment. Over time the trashlines may be replaced with grass strips, which in turn may be replaced with some form of terrace.

Understanding such incremental responses to land degradation is essential. Field professionals may only see 'half-constructed' methods of soil conservation, and conclude that the farmer had lost interest. Instead, incremental conservation is usually a deliberate response to land degradation, enabling the farmer to utilize available resources in a systematic and efficient manner, while at the same time observing whether these methods do actually work.

Table 8.2 *A Typology and Examples of Benefits of Conservation to the Land User*

Type of Benefit	*Examples (two of each only)*
Immediate production	Increased yield through better water conservation Less need for fertilizer because of better soils
Future production	Less risk of crop failures because of better soil quality Diversifying into higher value crops now possible on better soils
Factors of production: land, labour, capital	Increased value of the land Reduced labour needed for weeding because of better plant cover
Farming practices	Easier access onto land along terraces Stonelines a useful place to put stones and to dry weeds for composting
By-products	Poles from conservation hedgerows sold for fuelwood Grass strip vegetation cut and carried for dairy cows
Farm household	Fuelwood available from farm means less time spent walking to forest for wood Better fed cows now give milk all year, and children are healthier
Indirect, including economic and aesthetic	Greater sales of farm produce enable investment in home industry to add value to produce (eg sweet making) More wildlife attracted to farm

Bringing Together the Needed Information

Assessing the viability, technical performance and implementation of conservation technologies is probably the major task for a field professional involved in soil and water conservation. There are many hundreds of possible technologies that have the potential to reduce rates of land degradation, not least among these being indigenous technologies developed in response to local conditions. The key question is which of these technologies has the greatest likelihood of working in the biophysical environment – soil, slope, rainfall – and in the socio-economic circumstances of the land user. The most appropriate technical solution is not always suitable for the socio-economic conditions. Hence, there is the continuing need to be assiduous in gaining a farmer-perspective.

Because the information comes from a wide variety of sources and techniques of field assessment, there is no simple quantitative way of putting it all together to obtain an overall view. Therefore, a consistent format is necessary, which highlights the important issues in summary form. Box 8.2 shows one example for *Gliricidia* contour hedgerows, which are widely employed by small farmers in South and Southeast Asia. This example describes their use in Sri Lanka. Most importantly it highlights the technology in its potential to fit the social and economic preferences of the land user.

Box 8.2 Conservation Technology Summary

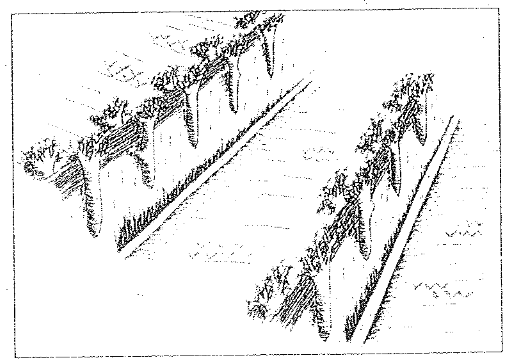
Conservation Technology: *Gliricidia* single row hedges for Sri Lankan Hill Country – also called SALT (Sloping Agricultural Land Technology) throughout Asia

Description:
A live fence, acting as a barrier to sediment movement down the slope, and retaining accumulations of soil. Lines of *Gliricidia* (*G. sepium*) sticks planted along the contour of the landslope – each stick is approximately 50cm long, and planted 15–40cm apart. Each hedge is about 4–12m apart – the steeper the slope, the closer are the hedges. Dead weeds and additional sticks are sometimes placed horizontally against the planted sticks to provide a better barrier to soil movement and to stabilize the hedge.

The sticks root quickly and within one year vigorous new growth is made. Maintenance consists of pruning new growth twice a year; placing leaves from prunings in the field to provide an organic mulch; and putting the more woody growth against the hedge to build the barrier further. Pruned sticks may also replace dead sticks. Over time, the hedges accumulate soil on the uphill side, forming bench terraces where crops are planted.

Variants/associations:
Usually drains are dug along the downhill side of the hedges. Drains may also be dug between the hedges on the terrace benches.

How does the technology work?
- A permeable barrier, trapping sediment but allowing water to pass through
- A vertical support against which up to 1.5m depth of soil accumulates
- Terraces (or less steep planting areas) form between hedges
- A source of organic mulching material from leaves which fall from prunings placed in the field
- Drains associated with hedges carry runoff



Reasons for construction and implementation:
- Conservation technology recommended for the Hill Country by local agencies and field staff
- A means of farming steep slopes with permanent barriers and fixed planting areas
- Maintenance of sufficient soil depth on slopes and long-term improvement in soil quality
- Assertion of permanent land use rights and possible means of attracting subsidies for crops
- A source of organic mulching material for fields and poles for bean supports and other uses

Other costs or opportunities forgone:
- Space taken up by hedges not available for planting
- Permanent hedges mean that most improved soil quality is close to hedges and most subject to plant competition for water and nutrients between *Gliricidia* and crops
- Upslope part of planting area may have thin soil because of downhill cultivation and digging out drainage line below hedge – hence poor crops on part of the field
- Some fertile soil buried against the hedge and is unusable by crop
- Cost of planting materials (rarely paid for, but needing labour to collect), and regular labour requirement for pruning

- Shading of crops by *Gliricidia* if not pruned regularly
- Susceptible to damage by cows.

Percentage of land taken up by technology:
Hedges only – 6 to 9 per cent; hedges plus drains – 16–25 per cent

Non-erosion benefits or opportunities gained:
- Cropping and land management: benefits gained in more accessible planting area with lower angle slope and deeper soil (on downhill part of terrace); some cultivation activities aligned along the contour parallel to hedges; soil quality improvement and greater depth enables more demanding crops; weeds can be disposed of easily by putting them in the hedges
- Economic opportunities: poles for sale or farm use; firewood for home use; subsidies available for planting and maintenance of hedges; fodder for livestock; land may be sold or leased at higher price
- Aesthetic and other benefits: hedges look impressive when intensively managed – farmer gains in reputation as a good manager

Other observations:
- Planting material usually from farm sources such as a woodlot or boundary plantings. Sticks are occasionally bought
- Labour for planting and maintenance (pruning and replacing dead sticks) is primarily a male occupation and done by the farmer
- Timely management of pruning is essential, otherwise the new growth of *Gliricidia* may easily overshadow the cropped area
- On well maintained hedges, pruned sticks are scattered in the field until the leaves drop off. The bare sticks are then woven between the living *Gliricidia* stems to form a reinforced barrier and effective sediment trap
- Hedges may offer part protection from bush pigs when combined with boundary fences

Constraints on adoption:
- The farmer does not have time to plant hedges – hedges are planted at the start of the growing season when it is raining. At this time the farmer has to work quickly to prepare the land and plant the crops. The farmer has time to plant later, but the climate is unsuitable for successful growth of the sticks
- The land is rented – where farmers rent land for only one year at a time, few will invest in planting hedges

Source: based on an unpublished paper by M Stocking and R Clarke (1997) *The Biophysical Assessment of Soil Conservation Technologies*, DFID Project R6525, Hillsides Workshop, Silsoe

Cost-benefit Analysis

Information such as appears in Box 8.2 is useful for making qualitative assessments of the possible benefits of a conservation technology to a land user, and hence its chance of acceptance. Subjective decisions on whether or not to adopt a conservation technology are likely to depend on the answer to the land user's question: 'How much money will I make (or lose) if I accept your recommendation to implement this conservation technology?' In order for the field assessor to simulate the decision-making process, monetary values must be attached to the streams of both costs and benefits and the timing at which they occur must be taken into account.

There are a number of ways of undertaking cost-benefit analysis, and a review

of these is beyond the scope of this handbook. Investment appraisal – that is, the assessment of economic viability of a technology as an investment in future profitability by the farmer – is a particularly useful technique because it is relatively simple and does not demand much data beyond the sort that can be gathered by following this handbook. The benefit of conservation is then seen as if it were like an entrepreneur deciding whether to buy a new piece of equipment or take on more labour. Will the additional cost (in this case of the conservation measure) be more than made up by the additional benefit over a number of years in the economic environment that pertains locally? Appendix VI describes the steps to be followed in carrying out an investment appraisal of a conservation technology, using examples drawn from the case in Box 8.2.

The conservation technology is appraised relative to the situation that would occur if the farmer did not adopt the technology. The baseline is usually, therefore, a 'do nothing' scenario, except that the soil is allowed to deteriorate. Before the appraisal, the field data have to be assembled in a form similar to that shown in Box 8.2. Then a systematic procedure of cost-benefit analysis, followed consistently but adopting a farmer-perspective (and hence a farmer-based valuation of costs and benefits), will give the assessor a much fuller picture of:

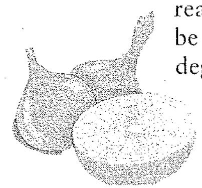
- the primary factors in determining the magnitude of the costs and benefits from the farmer-perspective (eg cost of labour);
- the technology that stands the best chance, economically and financially, of being adopted by land users;
- the mitigation measures that might be needed (eg subsidies) for technologies that are needed for downstream (off-site) protection, which are technically efficient but economically inappropriate for the land user who is expected to implement them.

Answers to these questions are vital in the planning of any campaign for soil conservation or land rehabilitation. Unless the assessor can capture the impact of additional work in the farming system to implement conservation, then past mistakes of forcing inappropriate technologies on resentful people will just continue.

Where Do We Go From Here?

This handbook has taken field assessment of land degradation well beyond its normal confines of dedicated experts examining land for signs of deterioration in its quality and then pronouncing on the cause – usually 'poor farming' or 'improper use of land'.

Finding the causes of land degradation has been described as being like dissecting an onion. You can peel off the skin, but underneath lie successive layers that each have to be removed until the core is reached. Each layer can be seen as a cause of degradation, but at a different place, in a different scale and from a different source. So, yes, 'poor farming' may cause land degradation. But



to stop at this layer implies a value-judgement on the part of the assessor that the farmer is to blame. Some farmers are simply bad farmers, but most are dedicated to their land and know well how to farm the land productively and conservatively. So the next layer addresses why, if the farmer is not intrinsically bad, the farming is poor. It may be that markets are insufficiently profitable to make it worthwhile farming well. Or farming is simply a spare time occupation, engaged in only when other jobs are scarce. Or there is no credit to buy seeds and fertilizers ... and so on. The next layer of our 'onion' should ask, 'Why is there no credit?' Eventually, the layers of the onion may reach right to causes of land degradation in the national and international economy, such as structural adjustment policies imposed by the international banks, or the burden of national debt and corrupt bureaucracies. It may seem strange to many that the field assessment of land degradation may end up asking questions of geo-politics. But the reasons why land degradation occurs are extraordinarily complicated and are largely outside the control of the farmer and the field professional.

This is not to say, however, that the farmer and field professional can do nothing. Throughout the developing world, more and more cases are being reported of farmers who have made a success of using their land wisely and productively, despite difficult economic, social and political circumstances. The book *Sustaining the Soil* (see Appendix IV) reports 27 case studies, where farmers have developed systems of land use that are win–win – a win for themselves in providing for secure livelihoods and a win for society in keeping productive assets of land for future generations. All are from Africa, a continent that is often seen as the most degraded and poverty ridden.

Such cases are still, sadly, not the rule. Land degradation is far too common. But the positive cases do point a way forward for more responsive, flexible and all-inclusive ways of dealing with land degradation, and of bringing the benefits of development to land users. If the field assessor keeps these ultimate goals clearly in mind, then he or she will be far wiser and more effective.

This handbook provides the tools for field assessors to identify the existence of, and assess the seriousness of, land degradation. But they go further to give guidance on how to identify the underlying causes of land degradation and to determine in what way the individual circumstances of the land user are affected by decisions regarding conservation and rehabilitation. Thus, the remedies suggested are more likely to reflect the perspective of, and be more acceptable to, the land user. If the perspective of land users is thus respected, then the field assessor will not only have tapped into the knowledge of land users about land degradation, but will also have promoted more effective soil conservation and land rehabilitation. With land users intimately involved, they will have greater ownership of the land degradation problem and the selected solution, thereby reinforcing the adoption of conservation. When field professionals work with land users, partnerships are created which should ultimately lead to more secure futures and sustainable livelihoods.

Appendix 1

Visual Indicators of Land Degradation

The following table summarizes the main visual indicators for the different types of land degradation. It must be remembered that these types of land degradation are interrelated. See Glossary (Appendix III) for explanations of terms.

Visual indicator	*Types of soil and land degradation*					
	Water erosion	*Wind erosion*	*Salinity or alkalinity*	*Chemical degradation*	*Physical degradation*	*Biological degradation*
Rills	✓	✗	✗	✗	✗	✗
Gullies	✓	✗	✗	✗	✗	✗
Pedestals	✓	✓	✗	✗	✗	✗
Armour layer	✓	✓	✗	✗	✗	✗
Accumulations of soil around clumps of vegetation or upslope of trees, fences or other barriers	✓	✓	✗	✗	✗	✗
Deposits of soil on gentle slopes	✓	✗	✗	✗	✗	✗
Exposed roots or parent material	✓	✓	✗	✗	✗	✗
Muddy water/mudflows during and shortly after storms	✓	✗	✗	✗	✗	✗
Sedimentation in streams and reservoirs	✓	✗	✗	✗	✗	✗
Dust storms/clouds	✗	✓	✗	✗	✗	✗
Sandy layer on soil surface	✗	✓	✗	✗	✗	✗
Parallel furrows in clay soil or ripples in sandy soil	✗	✓	✗	✗	✗	✗
Bare or barren spots	✓	✓	✓	✓	✗	✗
Efflorescence	✗	✗	✓	✗	✗	✗
Soil particles unstable in water	✗	✗	✓	✗	✗	✓
High pH	✗	✗	✓	✗	✗	✗
Low pH	✓	✗	✗	✓	✗	✓
Nutrient deficiency/ toxicity symptoms evident on plants	✓	✗	✗	✓	✗	✓
Increased incidence of plant disease/ morphological irregularities (eg stunting)	✗	✗	✓	✓	✓	✗
Decreasing yields	✓	✓	✓	✓	✓	✓

Visual indicator	Types of soil and land degradation					
	Water erosion	*Wind erosion*	*Salinity or alkalinity*	*Chemical degradation*	*Physical degradation*	*Biological degradation*
Changes in vegetation species	✓	✗	✓	✓	✗	✗
Plough pan	✗	✗	✗	✗	✓	✗
Restricted rooting depth	✓	✗	✗	✗	✓	✗
Structural degradation, including compaction	✗	✗	✓	✗	✓	✗
Poor response to fertilizers	✗	✗	✗	✓	✗	✓
Decrease in organic matter (lighter-coloured soils)	✓	✗	✓	✗	✗	✓
Increased sealing, crusting and runoff; reduced soil water	✓	✗	✓	✓	✓	✓
Decrease in number of earthworms/ants and similar	✗	✗	✗	✗	✗	✓

Appendix II

Forms for Field Measurement