Planning Soil Conservation Projects Through Participation

A Guide (TDR Project R6570)

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Report OD 139
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HR Wallingford

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1 Introduction

1.1 Readership and scope of the guide

These Guidelines are intended for use by Government officials and others who are responsible for catchment management planning, and research and extension specialists, who wish to learn more of the methods and procedures involved in the planning of soil conservation projects following a "bottom-up", participatory approach. They describe the activities involved over the complete project cycle from problem identification to post project evaluation. However most emphasis is placed on the critical stages leading to project formulation.

1.2 Background

A recent study carried out by FAO has shown that poor project design has been the most significant factor leading to the failure of soil conservation projects. However, the lessons learnt from these failures have been instrumental in promoting a major change in thinking with regard to catchment management. There are two key elements underlying this new approach:

- People's participation
- Better land husbandry

The first element of the new approach – people's participation - derives from a realisation of the failings inherent in the "top-down", methods used to plan and implement soil conservation and agricultural production projects. Sustainable rural development requires a "bottom-up" approach, in which the project beneficiaries actively participate in the process, rather than being merely passive recipients of externally derived research and extension recommendations. The new approach aims to enhance rural people's inherent skills and capabilities to develop and disseminate their own technologies. With this approach the role of the technical specialist becomes that of a facilitator, someone who helps the local community to solve its own problems, and whose expertise is used in a consultancy capacity to complement the knowledge that already exists amongst the members of the community.

The second element in this change in thinking — better land husbandry — represents a shift in emphasis away from soil conservation *per se* to a more holistic approach. The concept of husbandry is widely understood when applied to crops and animals. As a concept signifying understanding, management and improvement, it is equally applicable to land. Thus, land husbandry is the care and management of the land for productive purposes. The concept derives from the belief that it is in the interests of those involved in crop, livestock or forestry activities to manage and improve (husband) their land resources, thereby enabling their use for productive purposes on a sustainable basis. Control of soil erosion then becomes a consequence of good land husbandry, a reversal of the previous belief that it is necessary to conserve the soil in order to get better crops.

1.3 How to use this guide

The Guidelines are divided into two main sections:

Section I: Approaches to catchment management. This section describes the mechanisms of catchment degradation, different approaches to catchment planning and the lessons learnt from the relatively poor record of success of soil conservation programmes in developing countries. It briefly reviews the potential costs and benefits associated with catchment management projects and concludes with a summary of the planning framework, which forms the second part of the Guidelines.

Section II: Framework for participatory planning. The stages of project planning, preparation, formulation and implementation are described in turn, placing the emphasis on the role and participation of the project stakeholders at each stage.

More detailed information on methods and procedures is provided in the appendices.

Section I: Approaches to Catchment Management

2 Catchment degradation

2.1 Components of land degradation

Land degradation is the reduction in the capacity of land to produce economic benefits for a given form of land management.

This definition embraces the bio-physical factors of land capability, and socio-economic considerations, such as the way the land is used and the products wanted from the land.

There are many, interrelated land degradation components, which may contribute to a decline in the productive capacity of an upland catchment. Broadly these are:

Soil degradation — a decline in the productive capacity of the soil as a result of changes in the water holding capacity, biological, chemical and physical properties of the soil.

Vegetation degradation — a decline in the quantity or quality of the natural biomass, decrease in the vegetative ground cover and lowered capacities for self-regeneration.

Water degradation — decline in the quantity or quality of both surface and ground water resources. Reduced infiltration of rain, and more surface runoff, resulting in an increase in downstream flooding, lower dry season stream flows, and a decrease in groundwater recharge.

Climate deterioration — changes in the micro and macro climatic conditions that increase the risk of crop failure.

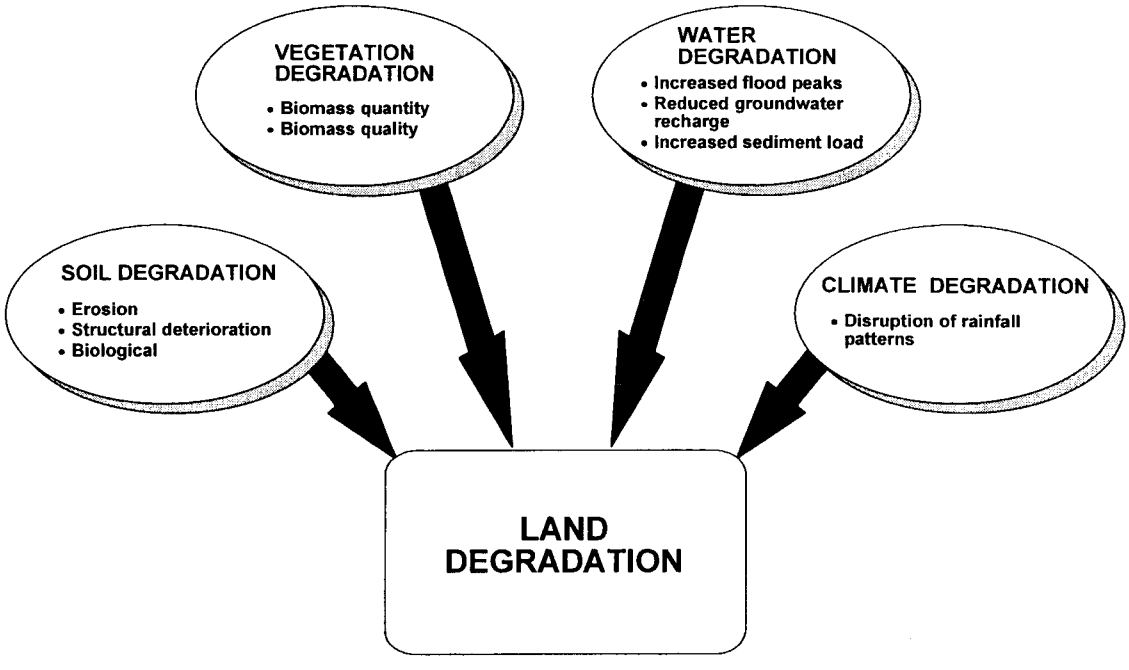


Figure 2.1 The components of land degradation

The degradation processes are described in detail in Appendix 1

2.2 Causes of catchment degradation

Catchment degradation results from land being used in a manner incompatible with its bio-physical capability.

Inappropriate land uses, and poor management, have often been claimed to be symptoms of the farmers' laziness and environmental ignorance. However, the root cause will usually be found within the economic, social and political pressures, outside farmers control, that force rural households to use the land in the way they do. Rural households rarely deliberately degrade the land resources on which their livelihoods and welfare depend.

Both the nature and extent of land degradation, and potential sustainable yields are ultimately determined by the bio-physical conditions that prevail within a catchment area. However, decisions as to what land holdings are used for, and the management practices followed, are influenced primarily by the socio-economic circumstances in which individual rural households operate. While current land use enterprises and management practices may accelerate land degradation, technical remedies can only succeed if they can function within these local socio-economic constraints.

Thus, problem diagnosis has to focus on **why** processes are occurring, rather than putting the emphasis on **what** is occurring. Priority in many conservation projects is given to tackling the visual symptoms of land degradation, eg. soil erosion control, whereas the first step should be to analyse why undesirable land uses and poor management practices are being followed. Successful catchment management requires that issues are looked at, not just from a bio-physical perspective, but also in terms of the economic, social and political environment of those directly affected.

2.2.1 Poverty

Poverty is the underlying cause of much of the land degradation within upland areas in developing countries. A lack of alternative income generating activities makes most rural households dependent on small-scale farming or forestry for their livelihood. The indigenous and migrant population of the highlands are generally poor, an d often have a struggle to meet their basic survival needs. Consequently, they cannot afford to forego short-term production (growing of annual food crops on steep slopes), for the sake of long term conservation benefits, even when this is clearly non-sustainable. Failures in government policy often exacerbate these problems. When sufficient political will exists, however, great advances can be made to overcome poverty and promote catchment protection.

Many of the conventional soil and water conservation technologies available for upland areas require substantial investments in labour, time, money and material resources — items that many households do not have. They also have high initial investment costs when compared to current land uses — costs that are beyond what most households can absorb. There is a lack of spare cash within the household economy, and access to low cost credit is generally very limited.

2.2.2 Land tenure

If a household does not own the land it farms, its members will be unwilling to incur short term costs for the sake of benefits that may not be realised until after the terminal date of a tenancy agreement. The same holds for households, whose legal claim to land is precarious, for example, squatters in state forests. The conventional wisdom is that poor use and management of communal resources leads inextricably to land degradation. Certainly in many areas, such resources are subject to unsustainable pressures, particularly overgrazing of communal pastures and excessive removal of timber, poles and fuelwood from communal forests and woodlands. The worst problems are associated with open access resources. An individual who considers practising conservation knows that any gains will be dissipated through increased exploitation by other resource users. Attempts to improve the resource are unlikely to succeed without altering its open access status.

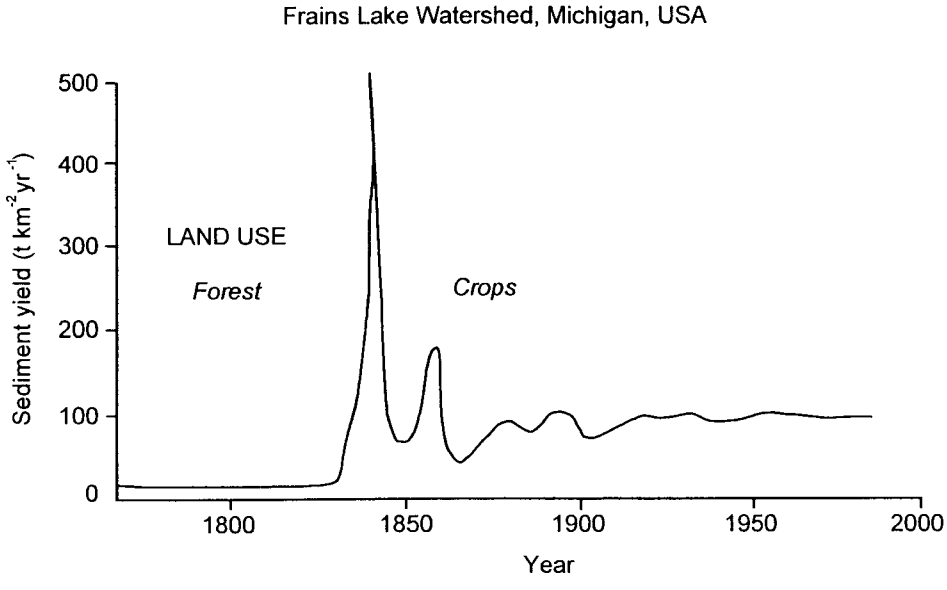
2.2.3 *Population growth and movement*

In many upland and highland areas there is a steadily expanding population, leading to increasing pressure on a finite, and often ecologically vulnerable, natural resource base. The problem is exacerbated where population growth is taking place at the same time as land degradation is already reducing fertility. Population pressure results in the conversion of forest and pasture land to crop land. Much of this new land is marginal for crop production because of steep slopes and shallow soils. Loss of the natural ground cover, the inability of stunted crops to provide adequate cover, and inappropriate tillage practices on steep slopes, all contribute to accelerated erosion. (See Box 1).

Box 1. The link between population growth and sediment yield

There is evidence, (Lawrence, 1995), that sediment yields in some developing countries are increasing with increasing population. Analysis of long term sediment yield data from agricultural catchments in fifteen developing countries showed sediment yields rising at between 1% and 8 % per annum, in countries with annual population growths of between 2% and 3%. However, data from six other similar catchments in countries with similar annual population increases indicated stable or declining sediment yields.

Data from developed countries indicates that conversion to agriculture in catchments with natural cover results in a large and rapid rise in sediment yields. This is followed by a decline to a stable, but enhanced sediment yield over the following decades as agricultural practices improve and soil conservation begins to have an impact.



Sediment yield variation following change from forest to agriculture

2.3 Natural erosion and sediment yields

The proportion of annual sediment loads derived from natural, rather than accelerated, erosion should be taken into account when a reduction of sediment loads supplied to rivers is the primary objective of a conservation project. Claims that soil conservation projects, particularly in large catchments, will result in significant and sustained reductions in the quantities of sediment delivered to rivers and water storage reservoirs have to be treated with some scepticism. A considerable proportion of the sediment entering main river systems is derived from natural processes such as mass wasting and the geomorphologic processes associated with the shaping of upland landscapes. Catchment management planners have to recognise that natural denudation and channel erosion processes can result in high sediment yields, even in areas where there has been no human disturbance.

In large catchments, there will be a time lag of decades or even centuries between the introduction of effective conservation and an observable reduction in sediment yield. The vast store of easily erodible sediments at the base of slopes, and in the rivers systems, continues to

contribute to sediment yields even where it is possible to reduce or eliminate erosion over most of a catchment area.

3 Approaches to planning catchment management

3.1 Objectives for soil and water conservation projects

Soil and water conservation activities are normally expected to contribute to one or both of the following objectives:

- Enabling natural resources to be used for productive purposes on a sustainable basis
- Protecting downstream regions from damage from excessive sedimentation and floods.

The objectives of a project must be clearly defined at the outset. It is particularly important to decide whether projects are intended to provide benefits primarily "on-site", for example, enabling farmers to sustain agricultural production; or "off-site", for example, to reduce sedimentation rates in downstream reservoirs.

3.2 Boundaries for catchment planning purposes

The area within a watershed — the catchment — is the obvious and appropriate boundary for technical planning. As a catchment is a clearly recognisable hydrological unit it is often assumed that it can serve as a socio-economic / socio-political unit for planning and implementing conservation projects. However, the cultural, administrative and political boundaries in which communities operate seldom coincide with catchment boundaries. It is common for farmers to cultivate more than one plot of land, and different plots can be located in different catchments. Where the primary beneficiaries of a catchment management programme are small-scale farmers, the boundaries of the planning area must correspond to the boundaries of the land area of the target communities. Thus, the outer limits of a planning area should be defined with respect to social and administrative boundaries.

Box 2. Catchment or Watershed

There are differences in the terminology used in technical literature to describe the area of land from which rainwater drains to a common outlet. British usage is **catchment** for the area that catches run-off, and **watershed** for the boundary of the catchment – the continuous crest line that marks the high ground dividing catchments. American usage is watershed instead of catchment and divide for the boundary between two watersheds. Within these guidelines, the terms catchment or drainage basin are used, in preference to watershed, for the area of land from which water drains to a stream or river system.

3.3 Development strategies

It is possible to categorise three distinct, but interrelated, strategies or thrusts that can be followed in catchment management planning, namely:

- Prevention Strategy
- Policy Strategy
- Corrective Strategy

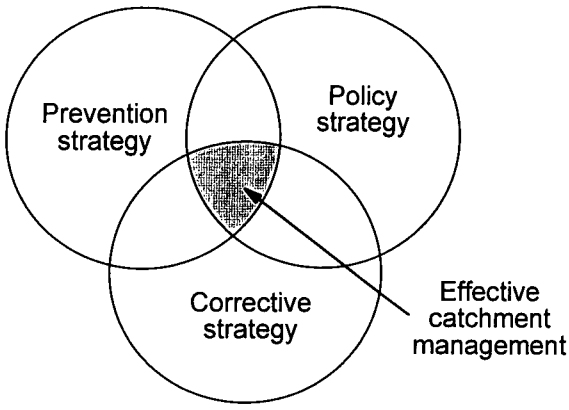


Figure 3.1 Strategies contributing to effective catchment management

In practice, a combination of the three strategies is likely to be required to maximise the effectiveness of an individual catchment management project. As each situation will be different, the key to success depends on recognising what the primary emphasis should be for a particular project, and in getting the correct balance between the different strategies.

3.3.1 Prevention strategy

The first priority for catchment planning must be to protect and sustain the productive capacity of land not yet degraded. This calls for a strategy that prevents land degradation from occurring. It is achieved by enabling land users to adopt practices that yield short-term production benefits (ie. are financially attractive) while being conservation effective (ie. maintain or enhance soil productivity).

3.3.2 Policy strategy

The underlying causes of land degradation are often due to a failure in government policy, or in the institutions set up to effect the policy. It is here, when sufficient political will exists, that the greatest advances can be made in promoting catchment protection. All that may be needed is a change in government policy over land tenure rights, crop pricing or marketing, or more effective implementation of existing policies, to create an enabling environment for the adoption of improved conservation practices.

Experience suggests that an approach including a policy strategy as a key element is required in most catchment management programmes. It will involve developing and implementing policies that:

- Eliminate conflicts between policies promoting short-run production and those encouraging long-run sustainability.
- Acknowledge, and to the extent possible accommodate, the diverse perspectives and development priorities of the different interest groups.
- Avoid inequitable development. Policies designed to promote catchment protection, for the primary benefit of those downstream, irrigators or hydro-electricity consumers etc. should not impose unacceptable social and economic costs on upstream farming communities.
- Enable individual farm households and rural communities to take responsibility for managing the natural resources at their disposal. This can be achieved through the passing of appropriate enabling rather than coercive legislation.

- Encourage the adoption of strategies that conserve the environment for use by future generations. Financial incentives such as cash payments, food for work, or free farm inputs have not proved particularly successful. When Governments cannot sustain these payments post-project then such incentives cannot be considered appropriate.

Those responsible for land use planning at the local level will not be able to change existing government policies nor introduce new ones. Planners thus have a responsibility to identify areas where there is a need for policy changes, and to advise on how existing policies could be modified, or formulate recommendations for new ones. Recommendations can then be forwarded to decision-makers for their consideration and action.

3.3.3 Corrective strategy

In many catchments the processes of degradation will already have had an adverse impact on soil productivity and sediment yields. It is then necessary to consider adopting a corrective strategy, where the primary emphasis is to correct an existing non-sustainable situation. This is achieved by removing the underlying causes, adopting improved practices to halt further degradation, and taking measures to restore the land to a productive condition.

A corrective strategy has parallels with the traditional physical planning in that it may involve:

The use of physical structures or vegetative techniques to control runoff and soil loss.

- The rehabilitation of severely degraded land by mechanical means (eg. filling in gullies, construction of check dams, ripping to break surface crusts and subsurface compacted horizons).

- The closing of severely degraded areas, relying on the self regenerating capacity of the soil over time to restore land to a condition where it could again be used for productive purposes.

Where it is cost effective, the corrective strategy could also involve:

- The planting of pasture leys, contour hedgerows of leguminous shrubs, and other forms of improved fallows to restore topsoil structure and raise soil organic matter levels.

- The application of soil ameliorants to correct chemical degradation.

- The use of engineering structures to reduce or control stream bank erosion and reduce the supply of sediment to downstream reservoirs or irrigation works, (sediment basins etc).

Following a participatory planning approach should ensure that where it is necessary to adopt corrective measures the decision to do so will have been taken by the community, and is not imposed by an external planning team. A participatory approach will also facilitate communal conservation activities requiring action at a wider level than individual farm holdings.

3.4 Institutional factors

Catchment management requires co-ordination of activities undertaken by different government agencies and a considerable degree of inter-departmental co-operation. This is difficult when government departments are compartmentalised and geared for top-down operations. Likewise, institutional structures at national and regional level often make it difficult to implement an approach based on collaboration between different disciplinary specialists. Recognition, at ministerial level, of the need for institutional changes allowing different departments and ministries to work together effectively, is often an essential prerequisite for successful catchment management.

At the community level, catchment management programmes usually call for co-operation between different social and ethnic groups. They may also have an impact on the activities of

other interest groups, such as logging companies, traders, fishermen, large-scale commercial estates and plantations. Success in resolving conflicts of interest within rural communities will depend largely on the existence, strength and organisational structure of local, people-based institutions. The development and support of such groups will often be the key component of a conservation project.

3.5 Traditional thinking and a new approach

To date, most catchment management projects have been planned and implemented using a top-down approach. Programmes and technologies have been conceived and developed centrally, and transferred to the field. Projects have been based on inflexible programmes, the "blue print approach", with a heavy emphasis on erosion control structures and reforestation. Participation, where it occurred, was often limited to the local community being asked to agree to plans prepared by professionals, before being expected to use their own resources to implement these plans. Land users had little or no opportunity to be actively involved in the development and decision-making processes of project design, and even less in policy formulation.

The problems targeted in "traditional" conservation projects – soil erosion, downstream sedimentation etc – are often not perceived as priorities by the land users. Results from conservation programmes have thus frequently been disappointing, with a lack of enthusiasm from the intended beneficiaries during implementation, followed by poor or non-existent maintenance of the conservation structures provided by the project. The lessons learnt from past failures (see Box 3) have been instrumental in promoting a new approach to the promotion of sustainable agricultural development.

Box 3. Reasons for success or failure of soil conservation projects

The FAO carried out a detailed study of the reasons for the success or failure of forty soil conservation projects covering a wide geographical spread, and executed by a range of different types of agency, (Hudson, 1991).

The study indicated that::

Poor project design, mostly due to incorrect assumptions, is the most significant factor leading to project failures. The main mistakes by project funders included:

- Over estimation of the effect and rate of adoption of new practices and technologies.
- A reluctance to make full use of low level institutions, (farmer associations, co-operatives, village councils, etc).
- Over-estimation of the ability of the host country to provide facilities and under-estimation of the time required to mobilise staff and materials.
- Unrealistic estimates of economic benefits.

Problems arising from the assumptions of the host governments included:

- Over-estimating their capacity to provide staff and local funds, and the capacity of the national research base to contribute solutions to the projects.
- Problems of co-ordination between different ministries and departments.

The FAO report also discusses failures in implementation, identifying the need for projects with long durations, and for improved post-project evaluation and feedback.

There are two key elements underlying the new approach:

People's participation

Better land husbandry

Both are directly relevant to the development of catchment management plans, particularly for areas that are already being used for agricultural and forestry purposes.

The need for people's participation derives from a realisation of the failings inherent in "top-down" methods used to plan and implement soil conservation projects. Sustainable rural development requires a "bottom-up" approach, in which the project beneficiaries actively participate in the process. With bottom-up development the role of the technical specialist changes to that of a facilitator, helping the farming community to solve its own problems using knowledge that already exists within the community. Except in countries with totalitarian political systems, where conservation practices with little perceived benefits to farmers can be imposed, a participatory approach will often be the only way that sustainable, conservation effective, land uses can be introduced.

The second element, better land husbandry, (see Box 4) represents a shift in emphasis away from soil conservation *per se* to a more holistic approach. The concept of husbandry is widely understood when applied to crops and animals. As a concept signifying understanding, management and improvement, it is equally applicable to land. With sound husbandry the land's productive potential can be sustained and enhanced. The concept derives from the belief that farmers can manage and improve their land resources, enabling their use for productive purposes on a sustainable basis. Control of soil erosion then becomes a consequence of good land husbandry, a reversal of the previous belief that it is necessary to conserve the soil in order to get better crops.

Box 4. Better land husbandry

The key concepts underlying better land husbandry are :

Loss of soil productivity is much more important than the loss of soil itself.

Land degradation should be prevented before it arises.

Erosion is a consequence of how the land is used, and is itself not the cause of soil degradation.

Plant yields are reduced more by a shortage or excess of soil moisture than by loss of soil, hence there should be more emphasis on water conservation and less on soil conservation *per se.*

Erosive run-off should be reduced before trying to control its overland flow, consequently, agronomic measures are potentially more significant than mechanical measures in preventing erosion and run-off.

Improved organic matter management is the key to maintaining soil productivity (ie. improved soil nutrient levels, soil moisture retention, soil structure and resistance to erosion).

Soil and water conservation should be promoted as an integral part of a productive farming system rather than as a separate land management exercise.

Indigenous land management practices and social organisations are the starting points for sustainable natural resource management programmes.

Conservation activities must be planned and implemented from the outset with the full knowledge, co-operation and involvement of the farmers and local communities.

To be attractive to farmers, proposed soil conservation activities must provide very large short-term benefits, without increased risk or forgone benefits such as loss of land.

Land husbandry requires a major change in the perceptions of those involved with the planning and implementation of projects. See Table 3.1.

Table 3.1 From erosion control to land husbandry – changes in approach and perceptions

FROM	TO
Looking at erosion in terms of **what** is happening.	Looking at erosion in terms of **why** it is happening.
Assessing land capability only according to the bio-physical properties of the land.	Understanding the socio-economic circumstances that control the way farmers use the land.
Ensuring catchment protection through increased regulation and restriction on land use activities.	Removing constraints to allow communities to manage their soil, water and vegetation in a productive and sustainable manner.
Conserving soil and water using physical structures.	Enhanced soil productivity through improved agronomic and silvi-cultural practices.
A single-sector approach (eg. forestry or agriculture)	A multi-sectoral and inter-disciplinary approach.
Top-down physical planning.	Bottom-up participatory planning.
Blanket recommendations centrally determined and disseminated.	Menu of demonstrated practices offered to farmers, for them to select the most appropriate.

4 Costs and benefits

The direct costs of undertaking a catchment management programme are readily identifiable and include staff salaries, consultants fees, buildings, equipment, vehicles, financial incentives etc. When quantifying the benefits arising from such a programme it is necessary to consider both the on-site and off-site economic consequences of allowing land degradation to continue and therefore the benefits of intervening. Potential on and off-site benefits are summarised in Tables 4.1.

4.1 On-site consequences

Failure to manage the catchment may result in reduced agricultural or forestry productivity, notably declining crop yields, reduced livestock carrying capacity, and a decreasing supply of forest products. In addition, there may be an increase in costs involved in sustaining existing production levels (additional fertiliser inputs, feed purchases etc). In some instances farmers have to change their cropping system in response to soil or water degradation by planting crops with less demanding nutrient and water requirements, which have a lower economic value.

The overall effect of soil erosion reduction and catchment management will be to benefit the environment. However with physical conservation there are financial and environmental costs associated with the construction and operation of catchment management structures. Land, soil and agricultural livelihoods can be disturbed during the construction process. Earth bunds, alteration of drainage ways and terracing can all increase soil loss for a short period until fully vegetated. Environmental improvement and protection should not be assumed to be automatic with soil conservation schemes. Such schemes are not without adverse environmental impacts especially when the commitment of primary stakeholders is not forthcoming.

4.2 Off-site consequences

These are related to the effects of floods or silt, and soil nutrients or agro-chemical products washed into surface water or leached into subterranean aquifers. The loss of storage capacity in reservoirs and the need for dredging in rivers are typical off-site costs. A reduction in off-site costs is often used as a justification for investing in catchment management programmes, particularly when the area to be treated is upstream of an irrigation or hydroelectric dam. However, a comparison of typical on and off-site consequences of land degradation indicates that the off-site costs resulting from siltation may be of a much lower order of value than the on-site costs related to productivity losses. Evidence for this comes from an analysis of soil erosion on Java Indonesia, (Doolette & Magrath, 1990). This estimated annual off-site costs are US$ 25.6 to 91.2 million, as compared to US$ 315 million for on-site costs from productivity losses.

Further, the available evidence suggests that there is no immediate linkage between catchment conservation and reduced river sediment loads for catchments larger than about 2000 km^2, (Doolette & Magrath, 1990). While it is often taken as axiomatic that soil conservation projects will reduce downstream sedimentation, reduced sediment yields may not be realised for decades or even centuries. See Lawrence, (1995), Mahmood, (1987) and Doolette & Magrath, (1990). Furthermore, reductions in sediment supply in the future have little or no impact in conventional economic assessments based on the discounting of future costs and benefits.

The linkage between soil conservation and reduced sediment loads becomes more significant as catchment scales reduce. At the micro catchment scale, very large reductions in sediment yields are observed following conservation, and these can justifiably be claimed as a benefit.

For flooding, the quantity and quality of historical data on land use changes and flood occurrence is generally so poor as to make a valid statistical analysis impossible. However, there is an emerging consensus that suggests that land use in upper catchments of large basins plays a relatively minor role in exacerbating catastrophic flood events. It seems likely that concern over flood damages is growing more in response to greater economic activity in flood prone areas than to the effects of land degradation. (Doolette & Magrath, 1990). As one recent UNESCO publication states, "It is often conveniently forgotten that floods are a natural hazard in areas with heavy rainfall", (Bruijnzeel and Critchley, 1994).

In practice, the economic justification for undertaking a catchment management programmes in all but small catchments should come from on-site benefits. Potential to reduce off-site costs should be seen as a bonus, ie. a secondary justification, which may perhaps decide the priority between two competing project areas.

Table 4.1 Benefits of improved catchment management

BENEFIT	ACTION	RESULT
On-site	Slow the decrease in soil productivity	Improved crop production
	Reduce gully erosion	Land going out of production
	Reduce loss of soil nutrients	Less costly fertiliser purchased
	Improve land husbandry	Crop yields increased and value of food and cash crop production enhanced
	Restore and improve pasture	Value of livestock products enhanced from better use of fodder and crop residues
	Increase tree planting and improve management of natural forests	Increased valve of wood and wood lot/forest products
Off-site	Reduce sedimentation in reservoirs and canals	**Irrigation** Value of crops preserved Reduced cost of maintenance
		Hydropower Life of scheme extended Dry-season power generation more reliable Costs of raising dam and building alternatives avoided/deferred Cost of maintenance and repairs to turbines and intakes reduced
		Flooding Flood damage avoided and preventative work reduced
		Fisheries Turbidity and flow regime improved Damage to coastal aquatic ecosystems avoided
	Reduce deterioration of water quality	**Domestic water supply** treatment costs reduced and costly alternative intakes avoided
	Improve river environment	**Tourism** Improved opportunities for recreation and tourism employment

5 A framework for participatory catchment management planning

5.1 Pre-requisites for successful catchment management

A checklist of the factors leading to the design of successful projects, developed by the FAO, is presented in Box 5.

5.1.1 Multi-dimensional

Successful catchment management requires recognition of the multi-dimensional nature of the task. In the past, the bio-physical dimension has received most attention, but this is only part of the story. There are social and cultural, and financial and economic dimensions, that have to be considered when degradation problems are addressed. Technical catchment management improvements must conform to the social and cultural norms of the communities involved if they are to be adopted and sustained. Improved management practices should be in line with the priority goals of the individual households and communities that are expected to adopt them, or will be affected by them.

5.1.2 Land Tenure

Land users require long term secure rights to use a particular piece of land and to harvest the produce from it. Hence regularising the land tenure status of the land users may have a high priority in projects where rural communities reside or cultivate in areas legally defined as Forest Land.

5.1.3 Equal Distribution of Benefits

Particular problems arise when a catchment management plan results in the costs being borne by communities in upper catchment areas, whereas the primary benefits (for example reduced sedimentation) accrue to communities in the lower areas. Such problems are further compounded when catchment boundaries cut across political, administrative, or even national boundaries. Solution of these problems requires special care to ensure that sufficient benefits accrue to those who are being asked to change their agricultural practices, so that they are willing change the way in which they use the land.

5.1.4 Institutional Co-operation

There are difficulties in implementing catchment management programmes that depend on inter-departmental, community and political co-operation. Planners need to be aware of such problems and must seek appropriate cultural, administrative, political and institutional solutions.

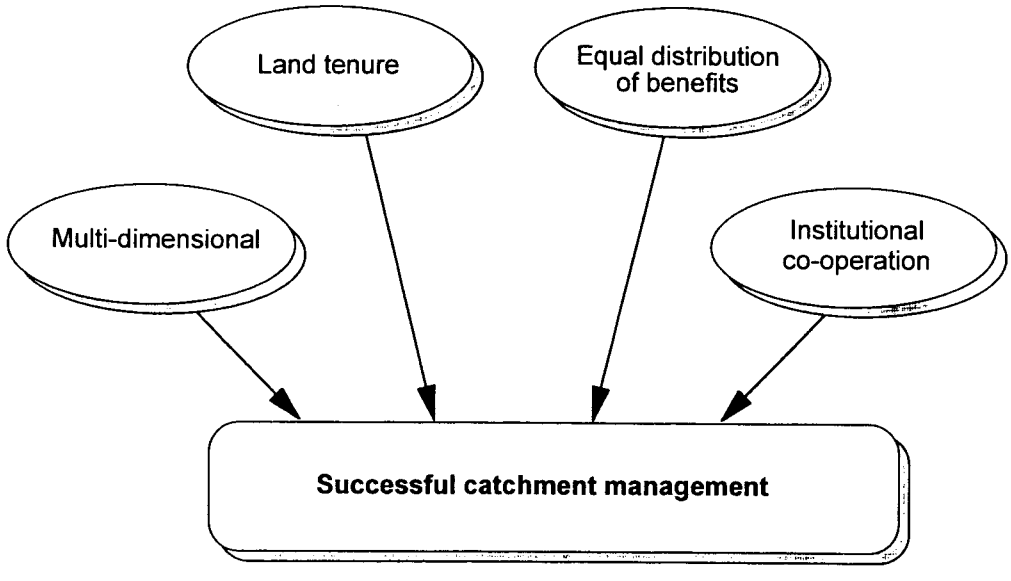


Figure 5.1 Pre-requisites for successful catchment management

5.2 The framework

The framework set out in Section II of these guidelines draws on the format established for Farming Systems Development (FSD), (Douglas, 1994). It consists of three stages:

- Project Identification
  - Planning and preliminary investigation
  - Characterising land resources and land users
- Project Preparation
  - Analysis and problem definition
  - Review of potential solutions
- Project Formulation and Implementation

When applying the framework it is important to recognise the following points:

- The activities should be carried out by a small, inter-disciplinary planning team.
- It is critically important that the farmers/rural communities living and operating within the planning area are involved at all stages from primary data collection to implementation.

It should be regarded as a flexible framework for action, rather than a rigid blueprint of compulsory activities. The time frame for completion of the various stages and steps will vary depending on the scale of the project and other factors.

5.3 Planning team and approach

Catchment management involves a wide range of development activities and requires an integrated and multi-sectoral approach involving a range of specialists from the natural and social sciences. Typically planning teams would include an economist, an agronomist, and a forester, supported by one or more specialists in livestock, irrigation, soil conservation, marketing etc. It is becoming more common to find that teams also include a sociologist and at least one woman, in recognition of the need to consult all the beneficiaries.

Conventionally planning teams follow a **multi-disciplinary** approach. While this involves the participation of different disciplinary specialists, each largely plans and executes a component of a catchment management programme separately. This guideline advocates an **inter-disciplinary** approach, where team members work together to plan, execute and evaluate a programme. The emphasis should be on promoting interdisciplinary interaction, with each member contributing to a common analysis from his/her own technical perspective. An inter-disciplinary approach helps ensure that recommendations are both technically valid, and socially and economically acceptable.

Box 5. Factors for design of successful projects (Hudson, 1991)

- A project must have clear objectives and definable, measurable targets which must be limited and obtainable. It must be clear whether the project is primarily directed at achieving national objectives or those of the individual farmer.

- Project design must be flexible so that the project can grow and change during the course of the project. The old style of detailed, blueprint type of plans is highly unsuitable for agricultural development.

- Project design must include details of implementation. The duties and responsibilities of the organisations and project staff and counterparts must be clearly defined, as must details of operating, down to who is responsible for paying for fuel for vehicles. An annual workplan is essential.

- Changes in agricultural systems take place slowly, and projects must be designed with a realistic duration. In a sample of soil conservation projects, of the successful projects, 75% had a duration of five years or more.
- Many projects have failed because of the technology.

  The technology should:

  - Be appropriate and tested locally.

  - Offer short term, on site benefits, and large increments (50-100%).

  - Not include forgone benefits, eg. giving up land, or increased risk.

  - Be in tune with existing social factors including the separate roles of men and women in agriculture.

- Where it is clear at the project design stage that there is a weakness in the capacity of local institutions there should be heavy emphasis on training.

Section II: Framework for participatory planning

6 Identification – planning and preliminary investigations

6.1 Preparatory planning

Preparatory planning is a critical first step; mistakes made at this stage may be costly, take time to rectify, and limit the effectiveness of later activities. However, this is also the hardest time at which to get things right, as it is necessary to anticipate the findings of the exercise. The key decisions that have to be made at this stage are:

- Determine the objectives
- Define the location and extent of the area to be improved
- Identify which institution(s) will undertake or collaborate in the work, or be interested in the results
- Select the individuals and disciplinary specialists to make up the planning team
- Prepare a work programme
- Arrange the logistics (finance, transport, office space, etc.) for the work
- Obtain clearance and local co-operation by briefing local officials and community leaders on the nature and purpose of the exercise

6.1.1 Development and project objectives

The development objective is the wider national sectoral or sub-sectoral level development goal, the achievement of which will be assisted by development of a catchment management plan within the project area. It must be established before the project objectives are finalised, to ensure that the project is in line with national and regional policy objectives.

Typical development objectives might include:

- Raising food crop production on a sustainable basis
- Improving the welfare and incomes of rural households
- Conserving and managing a region's natural resource base

A short, no more than one or two sentences, written statement of the development objective should be prepared at the start of the project.

The project objectives represent the specific purpose of the catchment management plan. At the start of the project they are likely to be defined in fairly general terms, such as "combating land degradation and rural poverty in village X, by developing locally appropriate productive and sustainable farming systems". As work progresses, and more information is gathered on the circumstances and problems, project objectives should be redrafted in more detail.

6.1.2 Defining the project boundaries

The geographic area covered by the catchment management plan will determine the farm households and other land users who are to be the beneficiaries of, or be affected by the project. In many cases, the project area will have been predetermined by the authorities commissioning the work. There are limitations to sticking rigidly to the hydrological boundary for planning purposes, and boundaries set prior to the project should be reviewed and revised as required in light of the comments in Section 2.2.

6.1.3 Institutional co-ordination

It is necessary to determine which institution(s) want the work done, who will do the work, and with whom. While the ultimate beneficiaries should be the rural households within the planning area, in most cases the project will be commissioned by a national or local government department. Irrespective of which agency takes primary responsibility for undertaking the work, there will be a need for co-ordination and collaboration between a wide range of different institutions. It is therefore important at the outset to identify all those that will be interested in the results, and whose co-operation will be needed to implement the study.

Initial contacts will have to be made with government departments, NGOs, local leaders, and prominent individuals and groups within the community covering civil, religious and political matters. The representatives of those working and living in the area should be briefed as to the purpose and nature of the project, and their permission and support for its implementation must be secured. Failure to contact the local community leaders and local representatives of the government departments, military, NGOs and political parties at an early stage may lead to suspicion and withdrawal of co-operation by the target farm households and land user interest groups.

Development and welfare agencies already working in an area may be able to provide secondary data, and their local staff should be consulted as key informants. A positive attitude towards people already working in the area is necessary in order to obtain their co-operation.

Inter-departmental discussions should also be held to determine communication and information channels, and develop appropriate national and regional level institutional linkages.

6.1.4 Forming an inter-disciplinary team

Catchment management planning requires a small team of subject matter specialists, assisted by others brought in to deal with specific problems, and supplement the core team's in-house expertise. The composition of the core team will vary with circumstances, but ideally, the skills and experience of the team members should embrace the following:

- Crop sciences, including horticulture
- Livestock sciences
- Silviculture/Forest Management, to include knowledge of indigenous and exotic timber, fuelwood, horticultural and multi-purpose trees
- Social sciences sociology/anthropology and economics
- Natural sciences - ecology, soil science, climatology and land evaluation

Within each of these broadly defined categories, generalists will normally be more useful as team members than individuals with narrow specialisation. The team leader should be strongly systems and inter-disciplinary minded and above all, a good communicator. A primary role of the team leader is to enhance the inter-disciplinary capabilities of the team by promoting the active involvement and effective interaction of the different disciplinary specialists.

6.1.5 Preparing a work plan

The provisional work plan should address the following questions:

- What has to be done, when and in what particular sequence?
- Which individuals or agencies will be involved in implementing each component step?

Table 6.1 A representative activity schedule for participatory catchment management planning

Stage	Step	Activity	Week 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A. Description/Diagnosis																						
	A1 Planning & Preliminary investigation																					
	A1.1	Preparatory planning																				
	A1.2	Collection & review of																				
	A1.3	Field reconnaissance																				
	A1.4	Preliminary characterisation of																				
	A2 Assessment of Catchment Circumstances & Problem Identification																					
	A2.1	Primary data collection																				
	A2.2	Analysis & description																				
	A2.3	Broad-scale development																				
B. Design																						
	B1 Development of Potential Solutions & Extension Recommendations																					
	B1.1	Review of options																				
	B1.2	Selection of potential options																				
	B1.3	Development of action																				
	B1.4	Ex ante appraisal & possible																				
C. Programme Formulation & Implementation																						
	C1. Project Identification																					
	C1.1	Determine need for project																				
	C1.2	Determine research needs																				
	C2. Project Formulation																					
	C2.1	Formulation of detailed project																				
	C3 Implementation																					
	C3.1	Preparation of work plans																After funding approval				
	C3.2	Implementation of activities																After release of funds				
D. Monitoring & Evaluation																						
	D1 Monitoring & Evaluation																					
	D1.1	Project activity monitoring &																on-going				
	D1.2	Impact monitoring & evaluation																on-going				
	D1.3	Participatory monitoring and																on-going				
	D2 Feedback & Revision																					
	D2.1	Revision of project field																as required				

When can each step be started and how long will it take?

- What information is required, can it be collected from secondary sources, if so where from, what primary data will have to be collected and how is this to be achieved?

- What are the financial and logistical requirements for implementing the various steps in the exercise?

While at this stage the work plan is provisional, it is important to ensure that it is prepared carefully, and that the financial and logistical requirements are in line with the anticipated level of funding. It is difficult to attract additional funding midway through a project to cover eventualities that were not foreseen at the preparatory stage.

Table 6.1 provides an illustrative schedule for completion of the various stages of catchment management planning project up to the implementation stage. Individual schedules will differ according to the circumstances in individual catchments.

Preparation of management plans will involve meeting with farmers, ideally at the time of year they face their major problems. Thus, part of the exercise should be conducted during the cropping season. From a conservation point of view, it is also useful to be able to observe the degree of protective groundcover at periods when rainfall intensities are expected to be at a maximum. The end of the dry season, when feeds are in short supply, may be the best time of year to observe livestock production problems and may also be an appropriate time to assess the catchment's water resources. It is often the only time of the year when it is physically possible to travel into remote upland areas.

Nevertheless it is important to schedule field activities for periods in the cropping calendar when farmers have time to participate in meetings. This means avoiding peak agricultural periods such as planting and harvesting. Likewise, avoid times set aside for the celebration of social and religious festivals.

6.1.6 Logistics

Staff. Arrangements for core and short-term specialist team inputs will need to be confirmed, and essential support staff such as secretaries, drivers, technicians and field staff identified and recruited.

Transport. Secure suitable vehicles, estimate the distances to be covered, and make arrangements for fuelling and vehicle maintenance.

Office facilities. A suitable office space will need to be arranged for the team to meet and work between field visits.

Equipment and supplies. This may include computers, mirror stereoscopes, soil augers, spades/hoes, Munsell soil colour charts, compasses, Abney levels/clinometers, surveyor's chains and tape measures. Essential supplies include time-series aerial photographs, and detailed topographic maps covering the area. If air photos and maps are classified documents they will need to be ordered well in advance, in order to obtain the necessary security clearance.

Finance. A budget will need to be prepared and approved detailing how much money is required for each activity.

6.2 Preliminary investigations

The objective of preliminary investigation is to quickly build up the knowledge base of the members of the planning team. An understanding of the bio-physical and socio-economic circumstances within the planning area should be developed, and gaps in the information identified. This is achieved through the following activities:

Table 6.2 Key informants and their likely knowledge base

Key informants	Knowledge base
Senior government officials (at the national, regional, & district level)	Development policies and strategies, macro-level constraints.
Department of Agriculture extension & development workers (regional, district and grassroots level).	General farming situation (crop and livestock statistics), agricultural development & extension support services, current extension recommendations, macro- & micro-level constraints, number of farm households, status of service co-operatives & other rural organisations.
Department of Agriculture veterinary workers (regional, district and grassroots level).	Nature and extent of animal health problems, livestock pest and disease control measures and availability of veterinary drugs.
Department of Forestry extension & development workers (regional, district and grassroots level).	Status of the local forest resources, recommended tree species and planting methods, location of nurseries.
Department of Land Development soil conservation workers (regional, district and grassroots level).	Nature and extent of soil erosion, recommended soil and water conservation measures, traditional soil and water conservation measures, location of past & on-going soil conservation/catchment management programmes.
Agricultural, forestry and soil conservation research workers	Potentials, opportunities, promising new crop, livestock and tree options, alternative land husbandry practices and soil and water conservation technologies.
Staff of the Regional Planning Office	Past, current and proposed development plans and programmes.
Staff of development projects & agencies	Local experience of particular development approaches and interventions.
NGO development workers	Local activities of individual NGO agencies, development problems targeted and approaches and interventions adopted.
District and Town Council officials and politicians	Administrative structure, political and development priorities and programmes at the district level.
Village leaders and councillors	Political and administrative structure of the village, including local institutions, and local level development problems and priorities.
Village elders	Historic events, experience of past projects and development programmes, traditions, social customs and cultural beliefs, consensus decision making, community structure and institutions.
Religious leaders - Priests, Monks, Imams	Beliefs, taboos, religious obligations & festivals.
Womens' group leaders, respected female elders	Gender issues, decision making, family member roles, domestic tasks, food and fuel preferences and needs, drinking water problems.
Women headed households	Socio, religious, cultural and economic constraints to women as farmers and producers.
Progressive farmers	Development opportunities, adoption of new technologies, prerequisites for adoption.
Local Commercial Bank Senior Staff	Local banking services, credit policies, credit disbursement & recovery record, loan conditions, local business opportunities.
Local businessmen	Marketing channels, local business organisations.
Traders, merchants	Products (including farm inputs) marketed locally, prices, trading regulations, transport, storage facilities.
Nutrition/health workers	Nutritional standards, calorie and protein availability, main human health problems, location & status of local health services.
Managers of local processing factories	Demand projections, pricing, quality issues, quota systems, delivery schedules.
University and College Academic Staff	Local knowledge of specific areas derived from academic bio-technical research and social-anthropological studies.

6.2.1 Collection and review of secondary data

The secondary data likely to be available and its interpretation are discussed in Appendix 2.

For most rural areas some, if not all, of the data types set out in Appendix 2 will be available. Secondary data can provide valuable information on the natural resource base, and rural household socio-economic circumstances. Duplication of work will be avoided if secondary information is collated and reviewed before fieldwork starts. In addition, establishing rapport with farmers and other land users is made easier if the planning team demonstrate that they have a basic prior knowledge of the local issues.

6.2.2 Preliminary reconnaissance

Short field visits should be made by all the team members to obtain an overview of the area's physical environment and land use patterns, and to be briefed by people with local knowledge. It may be necessary to undertake part of the tour on foot to see examples of the different farming systems and land use activities. The team should ensure that they see the more remote parts of the catchment, and the extent to which the remaining forest areas are being exploited.

It is advisable for the team members to be accompanied by local guides. These may be used as sources of information on the area, and can assist the team to obtain information directly from local farmers and other informants. Such consultations provide a timely opportunity for clarifying and supplementing information obtained from the review of secondary data. Potential key informants are listed in Table 6.2.

6.2.3 Preliminary bio-physical and socio-economic survey

The review of secondary data and reconnaissance visits should provide sufficient background information to enable the planning team to develop an initial appreciation of the catchment's characteristics, and the dominant production and sustainability problems of its land use enterprises. Although more detailed assessment will be undertaken in the next stage it is worthwhile for the team to use the knowledge gained to prepare a preliminary description of the bio-physical and socio-economic circumstances found in the planning area.

This step should not be overlooked, as a good preliminary assessment will save time later by focusing the team's attention on key characteristics of the area, and key problems requiring investigation. However, the team should be aware that it may be necessary to drastically revise initial interpretations when more detailed data becomes available. This step will also enable gaps in the information to be identified, helping the preparation of terms of reference for primary data collection activities.

Table 6.3 provides an outline guide for preliminary description of a project area.

Where sufficient climate and natural resources data exists it will be possible to identify the key bio-physical constraints and potentials that influence the choice of land use enterprises within the study area. It should also be feasible to differentiate the dominant land management units within the area, ie. those with sufficiently dissimilar ecological conditions to require separate consideration for planning purposes. Preliminary boundaries for these should be demarcated on a topographic base map and a brief description prepared of the environmental characteristics of each unit.

In most cases, the team will be able to identify dominant land use enterprises of the area, and the key socio-economic circumstances faced by rural households. With this information, the team can identify different farm household groups (recommendation domains) according to apparent similarities in their farming systems and circumstances. A brief description should be produced of each recommendation domain, detailing the household resources available, the land use enterprises pursued, and the constraints, problems and potentials of the farming systems.

The team should also identify and provisionally characterise other locally important land users (eg. large-scale commercial plantations, logging companies etc.)

Table 6.3 Outline for characterising catchments using secondary data

CHARACTERISTIC	DATA
History of catchment	▪ Settlement history ▪ Historically important events
Administrative location	▪ Region and district
Cultural characteristics of households	▪ Ethnic/tribal/religious affiliations ▪ Locally important customs traditions and religious festivals
Land tenure and user rights	▪ Legal land status (crop land, grazing land forest/timber land, protected areas) ▪ Security of user rights of individual land holdings ▪ Informal land leasing/sharing arrangements ▪ User rights of common property resources (grazing areas, woodlots, forest areas)
Basic statistics including trends	▪ Total area ▪ Population total, density and growth rates ▪ Different land user groups ▪ Number of rural households engaged in small-scale farm or forestry activities within the catchment ▪ Average household size and composition ▪ Typical farm size and range of sizes ▪ Area under crops and by crop ▪ Livestock numbers ▪ Key non-farm land use enterprises
Natural Resources	▪ Rainfall totals, distribution, reliability and intensity ▪ Seasonal maximum and minimum temperatures ▪ Risk of drought and other climatic hazards (eg. hail, strong winds) ▪ Length of cropping season ▪ Land management units ▪ Soil types, fertility levels ▪ Landforms and dominant slopes ▪ Land capability ▪ Status of natural woodland, forest and pasture areas (including ecosystems and biodiversity)
Hydrology	▪ Stream flows ▪ Peak floods ▪ Sediment yield ▪ Quantity and quality of water available for domestic, livestock and irrigation purposes (surface and ground water) ▪ Assessment of demand for water by different users, areas of acute shortage or excess
Crops (annuals and perennials)	▪ Major and minor crops grown ▪ Recommended crop husbandry practices ▪ Farmers crop husbandry practices ▪ Recommended inputs and actual use of inputs ▪ Average yields and range of yields ▪ Crop prices ▪ Crop production problems
Livestock	▪ Range of animals kept ▪ Percentage of households with livestock and average herd size ▪ Animal husbandry practices ▪ Type, source and seasonal availability of feeds ▪ Other inputs ▪ Livestock products and value. ▪ Livestock production problems
Food	▪ Household nutritional requirements ▪ Preferred foods ▪ Production strategies ▪ Degree of household self-sufficiency

Trees	▪ Sources of fuelwood and poles ▪ Existing trees planted or retained on farm holdings and products obtained from them ▪ Official tree planting programmes ▪ Recommended tree species and availability ▪ Exploitation/management of forest/ woodland resources ▪ Important minor forest products
Soil and water conservation	▪ Severity, extent and types of land degradation ▪ Causes ▪ Recommended conservation practices ▪ Levels of adoption and awareness ▪ Indigenous conservation/land husbandry practices
Support Services	▪ Government extension support services for crop and livestock production ▪ Government extension support services for agro-forestry and reforestation ▪ Government extension support services for soil and water conservation ▪ Extension support services provided by others including NGOs ▪ Credit facilities ▪ Marketing and input supply channels
Community Organisation and Structure	▪ Traditional authorities (Village chairman, town councillors, local politicians etc) and other community leaders (including village elders, priests, and monks) ▪ Community based organisations (NGOs and POs)
National, Regional and Local Policies	▪ Development thrusts ▪ Prices for inputs and marketed produce ▪ Credit ▪ Land rights ▪ Conservation/catchment protection ▪ Irrigation ▪ Upland agricultural development ▪ Afforestation

7 Identification – characterising the land resources and land users

7.1 Characterising land resources

It is important to identify and describe the prevailing biological and physical characteristics of the area, in particular identifying those factors with a direct influence on land use potential, and the risk of land degradation. The information forms the bio-physical base for all subsequent planning.

The natural environment can be described in terms of eight major bio-physical factors:

Landforms	Vegetation
Climate	Fauna
Hydrology	Disease
Soils	Geology

The interaction between these factors determines the set of natural circumstances facing an individual land user. Factors with the most direct influence on land use are climate, soils, landforms and hydrology. The data required to characterise these factors have to be relevant to the needs of the existing or potential land use enterprises, readily available, or easily recorded, measured, or estimated, during a rapid field survey.

A number of techniques exist to collect the information required. These range from formal natural resource surveys carried out by experts, to tapping indigenous knowledge through informal discussions with local land users. Table 7.1 provides a summary of these techniques[1].

Table 7.1 Bio-physical assessment techniques

TECHNIQUE	DESCRIPTION
Air photo interpretation	Allows rapid appraisal of land forms and land use over large and remote areas.
Map analysis	Use of topographic maps – where these are available – to define drainage lines, sub-catchments, administrative districts, land slope and altitude.
Soil sampling	Standard soil profile descriptions to determine soil depth, texture and fertility within different land units.
Rainfall analysis	Rainfall patterns are a major determinant of farmers' cropping decisions. Analyse daily data, where this is available, to determine rainfall probabilities for 5 or 10 day periods.
Direct observation	Verify and supplement information from other sources. Repeat observations should be made over as long a period as possible.
Tap Indigenous knowledge	Understand farmers' own criteria for classifying bio-physical factors affecting their farming systems. Use key informants, participatory transects and participatory mapping/modelling to tap local knowledge
Participatory Mapping and Modelling	Community members prepare and interpret a map or model of the bio-physical or socio-economic features of their village and surrounding area. (See 6.1.1).
Participatory transects	Team members walk a transect of the catchment with farmers, landowners and other key informants to observe and discuss land use and potential problems and solutions. Each transect should run through as many landform types as possible, guided by air photos or topographic maps.
Participatory seasonal profile	Community members prepare and interpret simple diagrams, normally histograms, on paper or on the ground, to illustrate monthly variations in factors such as labour inputs, rainfall, incidence of pests, etc.

[1] A set of worksheets, designed for documenting the baseline bio-physical characteristics of the catchment area, are presented in Douglas (1996,) and are available from HR Wallingford.

7.1.1 Participatory mapping and modelling

These techniques are being increasingly used in participatory rural appraisal exercises. They involve asking one or more representative groups of the local community to draw a map, or construct a model, of the main bio-physical and socio-economic features of their village and its surrounding area.

For community resource maps it is recommended that different interest groups be asked to prepare their own maps or models. This is because different groups often have different perceptions of their local environment, and attach different importance to specific resources. Men and women, old and young, landlords and tenants, land owning and landless households all have different interests, and these will be reflected in the prominence given to particular features. Comparison of maps and models will give an insight into the perceptions of the different interest groups.

Having asked the villagers to prepare a map or model of their village area they should be allowed to get on with it, with the minimum of interference and instruction from the external team. It may be appropriate to provide paper and pens, however, maps and models can be readily prepared on the ground using local materials. Farmers, even those who are illiterate, can be asked to prepare a simple sketch map of their fields, drawing with a stick in the dust on the ground.

A permanent record of the village map or model should be made by copying it onto paper or photographing it.

There are several types of maps and models, and many uses. For example:

- General village resource maps showing the location of farmers' fields, communal pastures and woodlands.

- Single topic maps such as a soils map (classified according to the locally recognised soil types); distribution of groundwater resources (perhaps based on the knowledge of a local water diviner or the seasonal location of shallow wells), or the location of irrigated land.

- Recording the severity and extent of problems such as pest incidence, soil quality and erosion rates.

- Combining a historical view with the present and likely future situations. For instance, one model may describe the situation 30 - 50 years ago, another the present situation, and a third how the local residents expect the area to look 20 years in the future. Time series maps and models can form the basis for lively and informative discussions between the map makers/modellers and the team members on the reasons for the past changes, and what can be done to prevent further adverse changes.

7.1.2 Land management units

Land management units (LMUs) are discrete geographic areas, in which the bio-physical conditions are sufficiently similar, so that for land use management purposes they can be treated as uniform. Within each unit, there may be a certain amount of variation in soil properties or slope etc, but these differences will be either minor, or restricted to small areas. Different land units would be recognised where the bio-physical properties are sufficiently different to affect the choice of, or management practices associated with, catchment management interventions.

Basic guidelines for defining land management units are:

- They should conform to the land users' traditional criteria for classifying differences in their local bio-physical environment. This requires participatory appraisal techniques to document farmers' own criteria for classifying differences in the bio-physical factors. As far as possible these should form the basis for recognising and defining different land management units.

- They should be as homogenous as possible, ie. variations in the bio-physical conditions within a unit should be within defined limits, and not require different land use management recommendations or land use enterprises.

- Differences between units should be based on features that grassroots extension workers could recognise in the field when advised what to look for, eg. differences in soil colour, texture, drainage, slope, vegetation, etc.

7.2 Characterising the land users

7.2.1 Defining broad land user groups

It is not practical to produce land use plans and land husbandry recommendations for individual land users, but recommendations can be developed for groups of land users, selected on the basis of similarities in bio-physical and socio-economic circumstances.

As a first step, it is possible to characterise land users according to which of the following broad categories they fall into:

- **Government** - some government departments/institutions engage in, or control, the use of land, eg. protection forest or timber plantations; national parks and game reserves; land used for Agriculture Research station field trials; land reserved for military training.

- **Private Sector Large Scale Commercial Operators** - includes private sector companies and individual entrepreneurs engaged in large scale commercial land use enterprises, eg. tea, sugar cane, coconut, pineapple and rubber plantations; fruit orchards; seed farms and tobacco estates; cattle ranches and dairy farms.

- **Small-scale Commercial and Subsistence Producers** - rural households using land for commercial or subsistence production on a small-scale basis, eg. engaged in dryland farming, wetland/irrigated crop production, small-scale tea/coffee gardens, fruit orchards, charcoal/fuelwood production, livestock production.

- **Communities and Community Level Organisations** - this category covers areas of land used and managed on communal basis, or by a community level organisation involving the members of a number of rural house- holds, eg. a village woodlot, community managed natural woodland area, or communal grazing area.

7.2.2 Grouping farm households into recommendation domains

Small-scale commercial or subsistence farmers will be the principle focus of most catchment management programmes. While there is considerable heterogeneity amongst small-scale farmers, farm households can be categorised into homogeneous groups or **recommendation domains**.

A **recommendation domain** is:

> **A broadly homogeneous group of farm households with similar bio-physical and socio-economic circumstances. An assessment of their circumstances will reveal common problems, constraints and development potentials, such an assessment being the basis for the development of recommendations suitable for adoption by all households within the group**.

Household socio-economic circumstances vary even when the bio-physical and external socio-economic circumstances do not. Thus, it is rarely possible to separate farm households into homogeneous groups occupying mutually exclusive geographic areas. It is common to find that neighbouring households within a village will pursue different land use enterprises, have markedly different socio-economic circumstances, and will be thus be classified in different recommendation domains.

The number of recommendation domains identified depends on the variation in the circumstances of all the households present. However, there is a limit to the number of groups that can be considered. In tackling the problems of small-scale farmers it is not necessary to seek precise recommendations, but general guidelines which individual households can adapt to their own circumstances. The decision on grouping households into recommendation domains is therefore a pragmatic one.

Improved practices will have to be disseminated to farm households through extension services, who cannot be expected to deliver recommendations to more than two or three different groups. The differences between recommendation domains should therefore be clear and obvious, so that extension agents can easily classify the households they work with.

7.2.3 Defining the characteristics of recommendation domains

A description of the characteristics of recommendation domains should be prepared under the headings shown in Table 7.2. Further, detailed guidance on this topic is given in Appendix 3.

Table 7.2 Headings for characterising rural household circumstances

Household enterprises	Cultivation practices
Household goals	Post harvest practices
Market orientation and strategies	Livestock characteristics
Food preferences, needs and production strategies	Animal husbandry practices
Household energy/fuel requirements and source	Utilisation of trees and forest products
Cash and capital resources	Silvi-cultural practices
Labour resources	Other land use enterprises and household income generating activities
Division of labour and decision making responsibilities within the household	Production inputs (material inputs and labour man days)
Land resources (availability and tenure/use rights)	Yields and production levels
External social and cultural influences	Household budget and income level
Membership of community level organisations and dependence on external infrastructure and support services	Production problems and constraints
Draft power and mechanisation	Land degradation problems
Cropping characteristics	Existing conservation/land husbandry practices

It is recommended that the planning team prepare a set of worksheets for organising and consolidating the data gained from a review of secondary data, and informal surveys.

Worksheets should not be used as a questionnaire during group or individual interviews. They are intended to be used by the survey team at the end of each day's field work as a means of consolidating the data in an organised fashion. Subsequently they provide the basis for compiling a report detailing the characteristics of the various farm households in the catchment area. A separate set of worksheets should be completed for each clearly identifiable group of households[2].

[2] Worksheets for characterising rural household circumstances have been presented by Douglas (1996), and are available from HR Wallingford.

7.2.4 Indirect land use interest groups

Other groups, although not directly involved, have an interest in how the land is used. Changes in land use may have a direct effect on the livelihoods of such groups, hence their interest in how the catchment is managed. For example, agricultural merchants and traders will be interested in the quantity and quality of any increase in farm production, as will carpenters requiring supplies of timber from forest areas, and brick makers and charcoal producers who would be adversely affected by a ban on the cutting of trees.

The impact of land use recommendations, particularly when these involve a major change in enterprise, needs to be appraised in terms of its acceptability to indirect interest groups.

7.2.5 Use of informal surveys for assessing farm household characteristics

Informal survey techniques, rapid rural appraisal and participatory rural appraisal (RRA and PRA) provide the best opportunities for interacting with farm household members to collect the knowledge they possess.

Particular advantages of the informal survey approach are:

- There is direct interaction with farmers and interviews are conducted by those responsible for analysing the information.
- Data collection is dynamic and iterative because the planners evaluate the data collected, and reformulate data needs, on a daily basis.
- Interviews are conducted by an inter-disciplinary team, with each discipline contributing collectively to the identification of problems and identifying and evaluating potential solutions.

A variety of informal survey and analysis techniques have been developed, some of the most useful are key informant interviews, various forms of group discussions and iterative discussions. A summary of the range of approaches that can be used is presented in Appendix 4.

8 Preparation – analysis and problem definition

The data describing the characteristics of the study area must be consolidated, and written up in the form of descriptions of land management units and recommendation domains before analysis can be started. Analysis then consists of an examination of constraints and problems at the recommendation domain and community levels. It should provide an understanding of the rationale that underlies the land users choices, regarding the enterprises and land use management practices they pursue, and the implications that this has for catchment management.

8.1 Determining the agronomic constraints

An analysis of the agronomic constraints is necessary to identify which crops could flourish in the project area, and those that will not. It is necessary to consider growth requirements, management requirements and the requirements for conservation. These should be determined for:

- Existing and potential annual and perennial crops
- Planted and natural pastures and fodders
- Livestock
- Trees for fuelwood and poles
- Multi-purpose trees

This review needs to be an inter-disciplinary team effort as it requires a wide range of specialist knowledge, which may need to be supplemented by information or inputs from other sources, (research stations, development projects, technical agencies, etc).

8.2 Determining the socio-economic constraints

These can be analysed in terms of internal and external constraints. Analysis can be guided by the factors listed in Tables 8.1, and 8.2, with others that may be locally important.

Table 8.1 Characterisation of households' internal socio-economic circumstances

The household goals	If existing farm management practices enable a household to meet its goals, why should it change them? Would the adoption of improved land husbandry practices enhance or detract from a household's ability to meet its priority goals?
The household resource base	Is the household's ability to sustain and increase farm production limited by its resource base – ie. how does its access to resources and the factors of production – land (holding size and user rights), labour, livestock, cash, capital and management skills – compare with what is required?
The household economy	To what extent is the household dependent on its on-farm activities to satisfy its livelihood needs? If net farm income is a small proportion of total household income, will this affect the willingness of a household to invest more labour and cash resources in improved farm management activities?
The household's short and long term welfare needs	Can the household satisfy its immediate welfare needs, particularly for food, fuel, and shelter without putting at risk its long term survival. For example, is the continued production of subsistence food crops, or the use of dung and crop residues for fuel at the expense of long term soil productivity?
The household structure	How does the social organisation of the household affect the availability of labour for its farming activities? Where there is significant division of labour and decision-making responsibility, by sex or age, what are the implications for the adoption of improved land husbandry practices?

Table 8.2 Characterisation of households' external socio-economic circumstances

Community level social organisation	Does the way in which the community is organised: • Foster or hinder co-operation between individuals and farm households? • Promote or inhibit innovation? • Facilitate or work against the exchange of information and services? • Encourage or discourage the formation of networks within and between communities?
Cultural values	To what extent do the cultural beliefs, norms and obligations of the community work for, or against, the equitable and sustainable use, of individuals' or groups' natural and financial resources?
Gender issues	Do the roles assigned to gender and age groups foster, or hinder, the dissemination of information on, and adoption of, improved land husbandry practices? To what extent does the community already recognise that gender and age roles are potential constraints to development?
Community leadership	Who are the real leaders, or people with influence in the community? Are these the community's traditional elders, or others, perhaps those who the government recognises as leaders due to the positions they hold? If different leaders have competing spheres of influence and conflicts of interest, how would these help or hinder community level catchment management activities? To what extent do the personal goals and development priorities of the leaders reflect those of all the households within the community? Notes: a) An agreement to a course of action by a particular community leader does not necessarily mean that the people will follow it. b) A course of action embarked upon against the final view of the traditional leader will probably collapse after a time because of his/her influence on consensual decision making. c) An agreement reached with the whole community does not necessarily infer a permanent agreement.
Community organisations	Are there community based, cultural or development organisations? To what extent are they representative in terms of ethnic composition, caste and socio-economic circumstances of all the households within the community? Are they male dominated, or do some provide a forum for dealing with the problems and opportunities of women? Do they have the potential for mobilising and organising land users in the participatory development of improved catchment management practices? Could they be used to enforce sanctions against those who do not respect locally established rules for communal property management? If such organisations do not exist, are there any constraints to their establishment?
Physical location and infrastructure	To what extent is the physical location of the community a factor in limiting its development or contributing to land degradation? Is the local physical infrastructure adequate to meet the input/output needs of the various farming enterprises?
Access to information	Do households have enough access, through formal or informal channels, to information on alternative crop, livestock and land husbandry practices?
Market opportunities	To what extent is there a market for crops in excess of what is required for household consumption? How does the value attached to the products of crop and livestock enterprises that are conservation effective, compare to those that are not compatible with good conservation?

8.3 Determining policy and institutional constraints

The adoption of improved catchment management practices may be constrained by the policy and institutional environment in which communities operate. To identify these constraints it will be necessary to consider development policies, legislation, land tenure and existing technical support services. As the impact of a policy may be quite different to the stated goals it is

necessary to distinguish between constraints that are a result of the goals of government policies, and those that relate to problems of implementation. Even where the right upland development policies exist, government departments often lack the manpower and financial resources to implement them.

The policy issues to be considered include:

Development policy – to what extent do development policy objectives run counter to long term natural resource management requirements?

Legislation – does existing conservation legislation enable communities to take direct responsibility for the preservation and management of their natural resources, or is it used to enforce restrictive land use rules and regulations formulated by outsiders?

Land tenure – to what extent do farm households feel that they have secure, and long term rights, to use a particular piece of land and to retain the produce from any agricultural or forestry activities undertaken on that land?

Technical support services – to what extent do the local government and NGO technical support agencies (extension, research, input suppliers etc) have the financial and skilled human resources to deliver the services required from them?

8.4 Assessment of production and sustainability constraints at the recommendation domain level

A list of the major problems experienced by land users in meeting their production objectives should be produced for each recommendation domain, indicating the nature and severity of each problem. Problems should then be ranked according to household members' perception of their severity.

The team should discuss the causes of the problems and the constraints to overcoming them, and develop lists of the causes and constraints contributing to each production problem. They should summarise knowledge of the way households cope with problems and constraints as this may throw additional light on the nature of the problems, as well as suggesting possible areas for intervention. Existing land use and farm management practices should be classified as conservation effective, conservation neutral, or conservation negative. This assessment should cover all the enterprises in the project area. The same procedures should be used to classify other features of farm holdings such as the location of footpaths, cattle trails etc.

Trends and problems will need to be predicted to determine whether the resources of land, water, labour, capital and management skills available are sufficient to maintain and increase production levels. If analysis shows that the rural households' current practices are sustainable for the foreseeable future, catchment management planning can concentrate on tackling short-term production problems. But if, as is more likely, current practices are contributing to the land degradation and putting future production at risk, it will be necessary to develop extension recommendations that target both production objectives, and conservation requirements.

8.5 Assessment of production and sustainability constraints at the community level

Often the problems faced by an individual rural household are not of its own making, and conservation and catchment protection may have to be tackled at a larger-than-farm scale. Examples include poor land use practices resulting in excessive runoff causing erosion on farm holdings located further down slope. Problems caused by use of community resources such a common forest or grazing land have also to be considered. It will be necessary to identify and list larger-than-farm scale problems, and to distinguish those problems occurring at the farm level where, despite the causes being at least partially attributable to on-farm land use practices, the solutions require a community level approach.

9 Preparation – developing potential solutions

After identifying problems, and determined that there is scope for intervention, it is important to review the range of policy, institutional, and technical issues that should be considered, before the developing detailed solutions. Given the commodity specific nature of many research and extension programmes a review of new technical options may have to be undertaken initially by looking separately at components of a catchment management programme (crop, livestock, tree production etc). However, the team should be aware that there are likely to be many inter-relationships between the different components, which may be usefully exploited. The review should therefore attempt to identify existing and potential inter-relationships between the various options.

In this chapter the issues requiring review are discussed briefly, before the methods used to develop and screen options for improvement are described.

9.1 Policy interventions

Land use practices of rural households are influenced by the policy environment in which they operate. It is therefore important to look first at potential options at the policy level. The elements of the existing policy environment, (prices, markets, subsidies, extension messages etc), that influence land use practices will have been identified earlier. Although the planning team will not be able to directly change existing Government policies, or introduce new ones, analysis may have identified present policies that are contributing to low productivity and land degradation in the study area. The project then has a responsibility to either advise on how existing policies could be modified, or to formulate recommendations for new ones. The fact that the planning team cannot change policies should not deter them from notifying those who can that there is a need to do so.

Table 9.1 provides a checklist to guide the review of policy issues and potential policy intervention.

9.2 Institutional considerations

Catchment management requires co-operation between different interest groups (farmers, foresters, ranchers, energy users, tourists etc) and technical specialists (natural resource scientists, social scientists, engineers etc). At the government level, success will depend on the favourable resolution of a range of institutional issues, including mechanisms for inter-departmental co-operation, and the co- ordination of activities undertaken by different government agencies. Success will also depend on the availability of the necessary manpower with the appropriate disciplinary skills, and effective extension research linkages in both the forestry and agricultural sectors.

At the community level, programmes to promote sustainable agriculture and forest management may call for co-operation between different social and ethnic groups within the same locality. They may also have a direct or indirect impact on the activities of other local interest groups such as logging companies, traders, and large-scale commercial plantations.

Success in resolving conflicts of interest within rural communities (eg. between groups of lowland and upland farm households) will depend largely on the existence, strength and organisational structure of local, people-based institutions. Where such institutions do not already exist, considerable time and effort may need to be included in the project design to establish the necessary peoples' organisations before participatory development can begin.

Table 9.1 Policy issues checklist

Issues likely for the formulation of macro-level policies:

- The relative returns to public sector investment in high potential areas, versus the requirements for poverty alleviation in marginal areas. The costs of development and service activities in upland areas, on a per unit area or per capita basis, will invariably be higher than in the lowlands.
- Extraction of upland resources (mining, logging etc) for short-term revenue maximisation, or long-term sustainable economic development.
- Competition between the forestry, agriculture, and energy sectors for land, manpower and investment finance.
- Local self-sufficiency and food security versus more emphasis on cash crop production.
- The effects of pricing policy on exploitation or management of forest resources, food or cash crop production, the use of water for irrigation or hydro-power generation etc.
- Maintaining a political balance between urban and rural areas, and between different ethnic groups and geographic regions.

Issues likely for the formulation of micro-level policies:

- Niche Exploitation: A diversified development strategy can profit from the many agro-ecological niche opportunities in upland environments.
- Equity: Development interventions should confront inequalities between different social and ethnic groups and gender issues to reduce the chance of inter-group conflict.
- Land tenure: Intervention involving the granting of individual stewardship certificates to migrants within forest lands or recognition of the ancestral rights of indigenous cultural communities may be necessary.
- Legislation: Legislation should be directed at enabling rural communities to take responsibility for the preservation and management of their natural resources, not at imposing restrictive land use regulations.
- Incentive payments: Experience has shown that using financial incentives or subsidies to promote reforestation and soil conservation is not a viable option unless they can be sustained from government revenue budget resources or locally managed revolving funds.
- Market development: There is often scope for policy interventions to improve market access, to find new markets for traditional highland products, and to introduce new products for which there is a demand.
- Pricing policy: Under-pricing of the natural resources of a catchment - forests, water, energy, minerals etc. - may lead to over-exploitation. Attaching a low value to forest products, and hence to forested land, will discourage reforestation and promote the conversion of forest to crops or pasture.

In reviewing policy interventions the following will need to be considered:

- What changes are required to the current policy environment at the local, regional or national level? Which specific policies need to be modified, or changed completely, and why?
- If policy recommendations are to be formulated, who (which department, institution or official) will be responsible for making the necessary changes and who will implement them?
- Will the policy recommendations require the drafting of enabling legislation, who will do this and how will the legislation pass into law?
- If conservation rules and regulations are required who will be responsible for their enforcement? Does this require national legislation or can local communities be assisted to formulate their own bylaws?
- What are the implications of the recommended policy changes for government/society in terms of advantages (ie. Benefits) and disadvantages (ie. costs)?
- What is the probability that politicians, senior officials etc can be influenced to change policies along the lines recommended?

The improvements in institutional arrangements that may need to be considered are:

- A framework that enables different development support agencies to collaborate and operate in an integrated manner.

- Government programmes that encourage the role of Non Governmental Organisations (NGOs), which often have comparative advantages when it comes to contact with natural resource users at the local level.

- External assistance to set-up and support community level organisations in the period before they become self-sustaining. These community organisations can provide a forum, in which local people's wishes can be articulated, problems analysed, plans formulated, and agreements reached on how interventions are to be implemented.

- Integrated land husbandry and conservation-with-production-benefits extension messages developed for use by generalist agricultural extension workers.

- Retraining at all levels to promote a participatory approach to catchment management by creating new attitudes, skills and awareness within professional people. Changing from a top-down to bottom-up approach.

9.3 Sectoral considerations

There is a wide range of sectoral considerations that will need to be taken into account when formulating catchment management proposals. The more important of these are discussed in this section.

9.3.1 Upland agriculture

Recommendations for improvements to upland agricultural practices are likely to be the most important component in the project recommendations. Some key questions that should shape the agricultural component of a catchment management plan are:

- Do appropriate technologies exist for improving crop and livestock production in upland and highland areas?

- Have the technologies been validated under conditions that correspond to the location specificity and diversity of upland agriculture?

- Can recommended agricultural practices meet the future demand for more food from an increasing population without causing non-sustainable exploitation of the natural resources?

- Can low external input farming systems meet the welfare needs of the upland farming communities, or does food security require greater use of purchased inputs (improved seed, fertiliser, pesticides, etc)?

- Do farmers have access to adequate amounts of organic matter (livestock manure, compost or green manures) to maintain their soils in a productive condition?

- Are the local infrastructure and support services adequate with regard to the marketing of surplus produce, provision of external farm inputs and dissemination of extension advice on improved hill farming practices?

- Is there a ready market, or can one be developed, for the conservation-effective crops (notably perennial tree crops) suited to the bio-physical conditions of the catchment?

Farmers rarely adopt complete technological packages, but prefer to select from an array of recommended technologies and practices, those perceived as most appropriate to the conditions in which they operate. Ideally these technologies should be:

Simple – be readily demonstrated to, understood and implemented by, farmers.

Low cost – be within the financial reach of farmers, require limited labour and require no foregone benefits (eg. land taken out of production).

Productive – lead to substantially increased benefits some 50-100% better than existing practices (ie. higher crop yields, increased fuelwood, guaranteed fodder supplies), preferably within the first year of adoption.

Maintainable – requiring annually limited effort or purchased inputs to maintain.

Low risk – non-susceptible to climatic variations (drought or waterlogging) or market fluctuations (supply exceeding demand).

Flexible – leave scope for future developments (a cereal variety can be changed after one season but a decision to plant a long lived perennial tree crop is not so easily reversed).

Conservation effective – contribute to the maintenance of soil productivity (eg. increase ground cover and soil organic matter levels, improve surface infiltration, reduce runoff, prevent surface movement).

In practice it will often be difficult or impossible to satisfy all these criteria with any one technology

9.3.2 Forestry

Agro-forestry

Agro-forestry is a collective name for land use systems where woody perennials (trees, shrubs, palms, bamboos etc) grow on the same land management unit with agricultural crops or animals. To qualify as agro-forestry, a land use system must permit significant economic and ecological interactions between the woody and non-woody components. In many upland development projects, the agro-forestry component turns out to be little more than orchard development or reforestation by rural households. The emphasis is almost exclusively on supporting the tree planting with little, if any, extension assistance provided for food crops that households may interplant with the trees.

The following issues need to be considered:

- The agro-forestry practices to adopt.
- Which tree species, crop varieties, or livestock types will make up the component parts.
- What are the input requirements eg. labour, fertiliser, seed, seedlings.
- What management practices need to be followed, eg. silvicultural, crop, animal and land husbandry practices, particularly if different to the way each component would be managed separately.
- What are the expected production levels eg. quantity of firewood, fodder, green manure, crop yields, livestock carrying capacity etc.
- What are the conservation benefits eg. runoff reduction, improved ground cover, raised soil organic matter levels.

- How does it fit within the local social and economic setting eg. do farm households have the resources of land, labour, capital and management skills required? Will it have a positive, or negative, impact on household income levels?

Social forestry

"Forestry for local community development", "community forestry" or "social forestry" are optional terms for programmes designed to assist rural communities and individuals to better meet their needs for tree products - fuel, timber, poles, food, fodder etc. Social forestry usually focuses on the planting and raising of trees and shrubs (afforestation) on a communal or individual basis. It may also involve managing and exploiting local natural woodland and forest areas. A basic feature of recent social forestry programmes is the active involvement and participation of the beneficiaries in the forest management process. **Participatory social forestry** calls for quite radical changes to conventional forestry practices. Particularly in terms of selecting what to grow, how to organise planting and management and what form government involvement and support should take in situations where foresters have a supportive rather than executive role.

The following issues will need to be considered when formulating social forestry proposals:

- Are the anticipated benefits to the participating communities and individuals consistent with their priorities and possibilities, and commensurate with any inputs (labour, land, cash etc) they would be expected to make?

- Can the costs and benefits associated with tree planting and harvesting be shared between, and within, rural households equitably?

- Are there socially and culturally acceptable mechanisms eg. traditional rules and regulations, within the community for controlling the use of communal forest resources, eg. cutting of trees, collection of minor forest products?

- Should tree planting be promoted as a community, eg. village woodlots, or an individual household activity? On-farm trees and communal forests, where they co-exist, are likely to provide different inputs into the local system and so form complementary components of an overall social forestry system.

- What role do trees currently, or potentially, play within the community or individual household livelihood system?

- Are individual tree species to be planted for a single purpose eg. to provide firewood or timber (as with conventional forestry species) or are they multi-purpose eg. firewood, poles, green manure and fodder (as with many agro-forestry species)?

Plantation forestry

Plantation forestry is the planting of one, or a limited range, of tree species on an extensive basis.

Reforestation in upland and highland areas frequently takes the form of plantation forestry. Key questions relating to the planning of plantation forestry are:

- Is the plantation to serve primarily a catchment protection or production role? If the latter, is this for timber, poles or fuelwood? Note the specific role will affect choice of species to plant and management practices to follow.

- Will there be any benefits foregone as a result of the plantation? Such as - loss of bio-diversity and minor forest products by replacing natural forest with uniform plantations; or loss of grazing by planting trees in grasslands.

- What rights of access will local communities retain, or be granted, to the plantation areas? Rights to gather fuel, fodder and livestock bedding materials from such areas may be important to the livelihoods of local people. However, over extraction of grasses, litter and tree prunings will reduce the conservation-effectiveness of the plantation as well as impoverish the soil nutrient status.

- Water erosion and sediment yield can be minimised in plantation areas by: maintaining undisturbed streamside buffer strips; maintaining continuous tree roots on landslip-prone sites; selective felling rather than wholesale clear felling; care in the location, design and maintenance of access and harvesting roads.

Maintenance of natural forests
Where there are patches of natural forest (virgin or secondary regrowth) within a catchment it is necessary to consider how best to maintain and enhance the resource. The following questions should be considered when formulating natural forest management or protection proposals:

- Are the remaining areas of natural woodlands, forests and bamboo thickets capable of being managed and used on an economic, sustained yield basis, for the production of timber, fuelwood and poles, ie. could the rate of exploitation of individual species balance the rate of regrowth?

- Do current management and utilisation practices result in any impairment of environmental benefits such as catchment protection, bio-diversity conservation, flood control etc?

- What social, cultural and economic impact would a policy of strict forest protection have on the rural communities living in or adjacent to a protected catchment?

- Is there the political will and resources to prevent illegal logging within areas designated for strict forest protection?

- Do the rural communities living in or adjacent to an area of natural forest have a direct interest in maintaining the natural forest eg. to protect the catchments of the streams that supply their communal irrigation systems?

- Are there valuable minor forest products - rattan, vines, honey, etc -that can be harvested on a sustainable basis? If so, are the rights to harvest them shared equitably amongst the local community?

- Is there an appropriate legal mechanism, eg. community forestry management agreement, certificate of community forest stewardship, for handing over long-term responsibility for the care and management of the natural forest resources to indigenous cultural communities or tenured migrant communities resident within Forest Lands?

- Is there scope to improve the natural forest through assisted natural regeneration?

- If restoration of the forest cover requires a major reforestation effort, is this something that rural communities would perceive as being in their own interest or would it only be of concern to society as a whole (ie. all costs would have to be met from government or donor sources)?

9.3.3 Water management

Changes in land use and the vegetative cover have an impact on the hydrological cycle within a catchment. Whether this is a negative or positive change will depend on the nature of the water management practices followed. The following are some of the key water management considerations that should be taken into account in catchment management planning:

- Is the objective to maximise the water yield from the catchment area, for the benefit of downstream users eg. to meet the needs of downstream irrigation schemes or hydro-electricity plants? Measures to restore a forest cover could reduce water yield as a significant proportion of the rainfall would be intercepted by the tree canopy and lost to the atmosphere through evapotranspiration.

- Is there scope for increased water usage within the catchment area through the development, or expansion, of irrigated crop production.

- What conflicts of interest over water use exist, or could occur, between upstream and downstream users? How can such conflicts be resolved in an equitable manner?

- Is there scope for improving water use efficiency through adoption of water conservation measures in the croplands, use of improved irrigation practices or reduction in water storage and distribution losses due to evaporation and seepage?

- What are the water requirements for environmental protection (wetlands, fisheries etc), amenity and cultural practices?

- At the field level, is the objective of water management to:

    - Maximise the effective rainfall for crop production by holding all the rainfall where it falls through improving infiltration and surface storage such as tied ridging, contour absorption ridges and level paddy terraces?

    - Increase the effective rainfall for crop production in semi-arid areas by transferring additional runoff onto arable land by water harvesting?

    - Retain as much rainfall as possible, but to cater for overflows during infrequent storm events by using contour permeable barriers hedgerows, grass strips, stone lines?

    - Manage unavoidable runoff and remove excess water in areas of high rainfall using graded diversion channels and protected waterways and drains?

9.3.4 Tourism development

Tourism is increasingly seen as having an important contribution to make to the economic development of highland areas, by generating additional revenue and providing a variety of employment opportunities. The spectacular and highly variable nature of highland landscapes are natural assets, which if exploited in the right way, can enhance the economy of these areas. Inappropriate tourism development however, may contribute to the degradation of the environment of the highlands.

While tourism may appear attractive, there are dangers. Upland areas have a low resilience to the impact of mass tourism and any environmental damage caused by over exploitation may be permanent, or take years to correct. Isolated communities in remote highland villages may have a low tolerance of alien cultures and values and when tourists outnumber local inhabitants at peak periods major social and cultural tensions will result.

Mass tourism needs to be supported by appropriate infrastructure development if it is not to over burden local roads, water supplies, rubbish and sewage disposal systems, and hotel and restaurant facilities. A major influx of tourists will significantly increase the demand for food and fuel. This may stimulate increased production of fruit, vegetables and other foodstuffs and encourage firewood plantations. However it may accelerate deforestation and expand cultivation onto marginal soils and slopes. Tourism related employment opportunities may be highly seasonal and may compete for scarce labour at critical times in the agricultural calendar, thereby affecting agricultural productivity.

Tourism development in the context of catchment management will thus usually be directed at promoting one of two types, namely:

- **Eco-tourism**: Tourism involving visits by small special interest groups to natural habitats. This may require the restriction of visitor numbers to minimise disturbance of the wildlife, and avoid damaging the landscape that the visitors have paid to come and see.

- **Recreational tourism**: Tourism that exploits the scenic and cultural aspects of specific areas, particularly in the highlands, for recreational purposes, such as sightseeing and trekking. This may involve small groups of visitors, but there are dangers when this type of tourism draws ever-increasing numbers of visitors.

9.4 Developing and screening options

The previous sections have described the review of policy, institutions, agriculture, forestry, water management and tourism. Based on this review the team should draw up a list of potential options, including alternatives.

Brainstorming can be used at this stage to tap the imagination and intuition of groups of people to supplement the list of ideas. Brainstorming should involve all the members of the planning team. It should also be possible to involve the local community in the process by organising brainstorming sessions during village level participatory workshops. These encourage villagers to come up with their own solutions to the problems rather than expecting someone else to solve them on their behalf.

Rural people are not used to being asked for their suggestions, and it may take time before they feel confident about expressing their own opinions. However, this is an important part of the participatory approach in terms of empowering villagers to identify ways of solving problems. This is not to say that the planning team cannot suggest ways of solving problems, but their suggestions should be made after the villagers have thought through possible solutions. It is important to avoid getting into a situation where, although the problems may have been identified in a participatory manner, the technical solutions are essentially designed and imposed by outside experts.

Box 6. Brainstorming

The process of brainstorming involves a small group of people, (preferably 5 – 6 but no more than 10) trying to think of solutions to a problem within a fixed time (no more than 15 – 20 minutes). Group members, call out their ideas in as few words as possible, with one member of the group recording each idea as it is put forward. The exercise is conducted at a fast tempo to stimulate the generation of ideas quickly and spontaneously. There should be no attempt to evaluate any of the ideas given during the session, and negative comments like "that will not work", or "that's a silly idea", are not allowed.

Once a list of ideas has been produced and grouped according to their function or the problem being tackled, they can be assessed to determine which appear to be worthy of further consideration. The initial appraisal should be a rapid, subjective process, using the experience and intuition of the group. Planning team members appraise each idea according to whether it is technically possible, feasible, financially desirable, and sustainable. Each team member will assign a subjective score from 0 – 3 for each of the above criteria, 0 = not technically possible, 3 = highly possible. Comparing the team's total scores for each of the ideas according to the different criteria will give a reasonable indication of those that might prove most promising.

9.4.1 Development of best options

Following the review of options and brainstorming the planning team will have a short list of "best bet" technical and policy options for promoting better land husbandry within the project area. The next task is to convert what are little more than sketchy ideas into detailed specifications. This involves specifying in detail the technical requirements for each field level intervention, and formulating the details of for each policy and institutional recommendation.

The planning team should seek to produce an integrated and flexible "model" for an improved farming/land use system for each recommendation domain within the catchment.

Technical specifications for improved catchment management practices should be produced in a form can be understood and agreed to, by all involved parties. Prior to the dissemination of

"model" farming systems, the team members should review the components to determine whether the improved enterprises, field level technologies and land management practices are sufficiently tried and tested to be directly disseminated to farmers.

9.4.2 Formulation of research components

Where there is a need for testing of technologies prior to dissemination, the team must determine the research requirements, and formulate proposals on how and where research is to be integrated into the project design. Technologies should be classified into the following categories:

- **Notional**: A notional technology is one that has had very little, if any, prior research or field experience. It is included because it is thought to have a high potential to improve the productivity and sustainability of the local farming system(s), while being financially beneficial and socially acceptable. However, the technical feasibility and financial benefits have still to be proven. Initially, development of notional technologies would need to be conducted at a research station as not enough is known about them to involve farmers in their testing.

- **Preliminary**: A preliminary technology is one that has received some previous research or is known to exist elsewhere in traditional farming systems which are comparable to recommendation domains in the catchment area. Experience suggests that it has potential to improve the productivity and sustainability of the local farming system(s), while being financially beneficial and socially acceptable. However, this needs to be verified before dissemination. Preliminary technologies are sufficiently developed to be included in on-farm trials with the aim of developing and improving them further as well as testing them under the bio-physical and socio-economic conditions typical of the intended users.

- **Validated**: A validated technology is one that has a well founded basis in past research or existing usage, under conditions very similar to the catchment area, and is considered suited to the bio-physical and socio-economic circumstances of recommendation domains within the catchment. It can therefore be recommended to the intended users with confidence without the need for further testing.

Ideally, all the options arrived at by this stage in the planning exercise would be validated ones. However, in practice many of the newer ideas on conservation, and particularly those that aim to tackle land degradation through the development of productive farming systems eg. agro-forestry, minimum tillage, intercropping, organic matter management etc. are based on practices which are likely to be notional or preliminary with regard to the circumstances facing small-scale farmers in the project area. Research will be necessary to develop and test these ideas prior to dissemination.

Two basic research activities are recognised;

- technology development
- adaptive research

Technology development is undertaken to convert notional or preliminary technologies into technically validated ones. It may take place on-station or on-farm.

Adaptive research involves households testing proposed improvements and comparing them with their normal practices. Of necessity, it has to take place on farm. Adaptive research provides a means of validating that improvements are both financially attractive, and socially and culturally acceptable

Ultimately all potential technologies should be subjected to farmer managed tests, preferably by using a participatory technology development (PTD) approach, (see Box 7).

On-station research is used when experiments have to be carried out carefully, under controlled conditions, using statistically valid methods - for example, when developing new crop varieties, or testing alternative conservation practices. Experimentation in farmers' fields overcomes the

difficulties encountered when experimental stations are not representative of the local farming conditions, for instance, because of high management levels or geographic location. It also promotes communication between farmers and researchers so that the researchers develop a greater awareness and understanding of the problems and constraints faced by farmers. A further advantage is that the experiments familiarise farmers with the technologies involved, and successful trials provide useful demonstrations of the results. If a significant proportion of the farming community has been involved there may be little need for a formal extension programme, as the benefits will have already been disseminated to others by word of mouth.

Farmer trials can be used to:

- Assess costs and benefits
- Analyse the risks associated with or without adopting the potential improvements
- Determine the likely effects on the farm-household food balance
- Assess the possible impact on labour requirements and division of responsibilities (family, male, female, hired, exchange)
- Ascertain the potential impact on the availability and requirements of fuelwood, fodder or manure.
- Predict the impact on soil fertility, soil erosion, weed growth, water supplies, woodlands, grazing areas etc.
- Consider the social and cultural impact, particularly changes in the status of individual farm households and the status of members within the household.

Box 7. Participatory technology development (PTD)

PTD is an important component of the participatory approach to catchment management. It is undertaken when the appraisal of the best bet options for tackling the production and sustainability problems reveals a need for potentially promising options to be locally validated prior to dissemination and widespread adoption. The aim is to strengthen local capacity to experiment and innovate. Farmers are encouraged to generate and evaluate indigenous technologies and to choose, test and adapt external technologies based on their own knowledge and value systems.

PTD is not a substitute for station-based research or researcher-managed on-farm trials. It is a complementary process that involves linking the power and capacities of agricultural science to the priorities and capacities of farming communities, to develop productive and sustainable farming systems. PTD is seen as a way of enabling farmers to further develop and validate potential options. PTD can encourage farmers to confirm for themselves, and perhaps modify, options that the planning team believes to be sufficiently validated for immediate adoption.

Farmers' experiments
There is an increasing body of evidence that farmers conduct their own experiments. Farmers experiments are generally one of three types:

- Curiosity experiments, ie. trying out a new idea purely out of curiosity, such as planting a few rows of a food crop variety acquired during a visit to another area to see how it performs and tastes.
- Problem solving experiments, ie. testing possible solutions to problems, such as tie-ridging a small part of the field as an experiment to conserve moisture and improve yields.
- Adaptation experiments, ie. testing a new technology or modifying an existing one to see if it works within the environment of their farm system. For example, trying out a new crop variety or farming practice promoted by the local extension service.

Strengths and weaknesses of farmers' experiments
The experimental methods used by farmers vary widely. As they are specific to the local communities and rooted in long history, their validity and limits will vary and may be difficult to assess. Some strengths of farmers' experiments are that:

- The focus for experimentation is on issues directly relevant to the farm household's needs and circumstances.
- They start with the knowledge of farm household members and their results expand and deepen this knowledge.
- They are usually directed to improving the use of locally available resources.
- They use evaluation criteria that are directly related to the values and objectives of the farm household, particularly regarding taste and utilisation. Observations are iterative and made from within the household, as they take place during routine farmwork, so evaluation is on-going and not only based on the end result, ie. farmers look at more than just the final yield.

However, farmers' experiments as an alternative to conventional research experiments also have their methodological limits:

- The search for improved technologies may be based on limited scientific understanding of the processes involved and technical knowledge of alternative options.
- Farmers may use a new technology over their whole field so that comparison can only be made with a crop of a previous year or in a neighbour's field.
- Errors in experimental design such as no replication of trials may lead to conclusions that are not statistically justified.
- Methods of measuring and weighing may not be scientifically accurate.
- Farmers limited theoretical understanding of biological or other processes, may attribute crop performance to one obvious factor, and not realise this is the result of several interrelated factors, or the result of the intervention of less observable factors.
- Communication of results may be limited to certain geographical areas, gender or socio-economic groups.

The PTD approach
PTD is a process of purposeful and creative interaction between local communities and outside facilitators which involves:

- Gaining a joint understanding of the main bio-physical properties and constraints of the different land management units used for agricultural and forestry purposes by a particular rural community.
- Gaining a joint understanding of the socio-economic circumstances of the different rural household groups within the community.
- Defining priority problems.
- Experimenting locally with a variety of options derived from both indigenous knowledge (ie. from local farmers and farmers elsewhere) and formal science.
- Enhancing farmers' experimental capacities and farmer-to-farmer communication. PTD not only seeks to generate technologies adapted to local environments, but also seeks to develop the local capacities, socio-cultural structures and organisational linkages necessary to sustain the process.

9.4.3 Desktop appraisal of best bet options

Having arrived at a series of technical and policy and research recommendations, the planning team should undertake a preliminary appraisal exercise. This is a theoretical exercise undertaken before recommendations are disseminated or tested in the field or passed on to senior decision-makers. As options have been reviewed and assessed as part of the development process this appraisal is carried out as a final check, allowing if necessary for the project to be reshaped before decisions that may be difficult to reverse later are made. It can be carried out with the aid of the appraisal checklist in Box 8.

Box 8. Checklist for appraisal of options

Appraisal of the field-level technical options

Technically possible? Given no socio-economic constraints to its adoption, can the recommendation be implemented on the ground and will it work? Is it suited to the environmental conditions of the area, will it performs its expected function(s) and has it been tried and tested under similar circumstances?

Practically feasible? Does the farm household/land user have the necessary resources of land, labour, capital, equipment, management skills etc required to implement it? If not, can these constraints be easily overcome?

Productive? Will it increase the productivity of the catchment/farming system in the short-term or in the long term? Will it enhance a household's ability to satisfy one or more of their priority goals? What are its direct productive benefits eg. increased crop yields, guaranteed fodder and fuelwood supplies? Are there indirect productive benefits eg. soil and water conservation, fertility maintenance and regeneration and micro-climate amelioration?

Financially desirable? Does it produce worthwhile returns to a household's factors of production, namely land, labour, capital and management skills? Are the financial returns increased significantly compared to previous practices, ie. over 50 - 100% and are these realisable within the first year of adoption? Are forgone benefits (eg. land taken out of production) more than compensated for elsewhere (eg. raised crop yields or other products)?

Stable? Is there an element of risk associated with the recommendation? Are the productive and financial benefits achievable each year or will the land user experience marked fluctuations in these due to factors outside his/her control, such as variations in the climatic conditions (drought risk) or economic conditions (risk of low prices should supply exceed demand)?

Sustainable? Can the short-term productive benefits be maintained without putting at risk the long-term productivity of the farming system? Will it have a beneficial, neutral or adverse environmental impact? Can the benefits be sustained without an annual need for a major input of labour from household members or cash outlay for the purchase of seeds, fertiliser, chemicals etc?

Universally applicable? Can it be implemented by all the rural households in the area irrespective of their circumstances or is it only suitable for adoption by those from a particular socio- economic/cultural group? Are the benefits achievable by all households and will some benefit more than others? Will some households be expected to put in proportionally more effort than at present, will they get proportionally more of the benefits in return?

Socially and economically acceptable? Does it conform to the social and cultural norms of the rural household and local community? Is it economically desirable for society as a whole? What are the direct costs and benefits to the wider society, who will be the beneficiaries and who will bear the costs? Are there potential secondary costs and benefits arising outside the area that need to be considered? Are there any intangible costs and benefits which are difficult to assign values to?

In the past, conservation recommendations have usually been judged according to the first and second of the above criteria, whilst recommendations for increasing agricultural productivity have rarely considered more than the first four of the above. It is important to consider all the eight criteria above to ensure that what is being proposed really does benefit those it's intended for.

Appraisal of policy interventions

Politically possible? Given the political realities within the community and country does the recommended policy run counter to the interests of those with political influence and economic power (eg. Landlords, business men, etc)?

Developmentally admissible? Is the recommended policy in line with existing national, sectoral and sub-sectoral development policies and priorities? Short-term national development objectives may conflict with recommendations for the long-term conservation of natural resources.

Socially acceptable? Does the recommended policy conform to the cultural and social norms of society? Policy recommendations derived from a purely technical perspective may be socially and culturally unacceptable.

Economically beneficial? Will the recommended policy produce tangible benefits to society at large? Some recommendations may result in some people gaining while others lose, from the perspective of the general society the need is for the losers to be greatly outweighed by the gainers.

Institutionally workable? Does the institutional capability exist, or can it easily be developed, to implement the recommended policy. Some policy recommendations may require a particular institutional structure or organisational arrangement before they can be put into practice.

10 Project formulation, appraisal, implementation, and evaluation

The emphasis of these guidelines is on project planning, however, in this chapter the application of the participatory approach to the later stages of conservation projects is briefly discussed. More detailed information is contained in Douglas, (1996).

10.1 Project formulation

Having identified what project interventions are required, the next step is to formulate the interventions that are to be included in a project package. The bulk of the data required for project formulation will have already been collected by this stage. However, it may be necessary to undertake additional fieldwork to establish the feasibility of certain development options. It will be important at this stage to confirm the capability of the various development agencies to participate in the execution of the project.

The planning team will need to define the project's overall scope and objectives, design individual project components, organisation structure and management arrangements, and determine project phasing and an activity schedule.

10.1.1 Project scope and objectives

A project should have clearly defined target groups as the focus of project effort. These will normally comprise each of the identified land user groups (recommendation domains) within the catchment area. There will be instances where interventions are not required for all of groups. For example, a better-off group of farm households may not require additional support services, merely a change in the existing extension message. Likewise, it may not be necessary to formulate a plan for the whole catchment when the objective is to alleviate a particular downstream problem, when project activities can be targeted just at problem areas.

Following the definition of the target groups and areas, the next task is to decide on the activities to be included and the time-frame for project execution. Groups of activities would normally be organised as separate project components.

10.1.2 Project components

If a participatory approach has been followed, the component activities will reflect the outcome of the various community level, problem identification and planning workshops. The planning team will need to consolidate a possibly large range of activities for implementation purposes. One option is to group these within an overall catchment management programme that forms the major component activity of the project but which allows for a series of sub-projects at the individual community level.

Project components generally fall into three main types: direct production, production support, or social support. The direct production of crops, livestock or trees as an end in itself, will not normally be the primary component of a catchment management project, although they may figure as part of the overall development programme for a given project area. The primary components will more usually be of a production support nature, with the emphasis on promoting production oriented practices which are conservation effective. Typical examples of the components of a catchment management project include:

- Agricultural/forestry/soil and water conservation extension (farmer training programmes, demonstration plots, preparation of extension aids eg. posters, leaflets, simple handbooks, audio-visual material, etc.).

- Installation of field level conservation measures (pegging of contour lines, planting of vegetative barriers, construction of bench terraces and other runoff control structures).

- Reforestation and forest management - farm forestry/agro-forestry, woodlots, plantations, enrichment planting and protection of natural forests; iv research and development (on-station experiments, on-farm trials, farming systems development).

- Human resource development (training of staff, local officials and community leaders);

- Public works and infrastructural development (construction and rehabilitation of irrigation schemes, installation of river training and stream bank protection works, improvement of village access roads, building of conservation structures on common property areas, protection/provision of drinking water supplies).

- Input delivery (fertiliser and pesticide supplies, provision of fruit tree and forestry species seedlings);

- Credit components (short and long term loans for farm/land use improvements).

In larger projects, planning support and management / administration services may be included as a separate component. External donor funded projects may also include a technical assistance component for a part of the project period. In very small projects, it may not be necessary to divide activities into separate components. For example, on-farm research and extension activities, together with support for a small community nursery could be grouped under a single production-support component.

Since resources are often a constraint, component design should always look towards cost-efficiency as a key criteria:

- Could similar results be achieved at a lower cost?

- Could existing facilities and manpower be better organised rather than merely increasing their quantities?

- Could local, low-cost options be used instead of higher cost external inputs and technologies?

10.1.3 Resource requirements & cost implications

For each project component, a clear statement should be made as to the main activities involved, the outputs to be achieved, and the inputs or resources required. For each activity, the financial, manpower and material resources required need to be carefully worked out and costed. Overall project costs can then be aggregated from the various component costs plus the common costs of project administration and management. Project costs need to be broken down according to capital and recurrent items for each year of the project life, and should include a contingency element to cater for physical variations and price inflation which may occur during the implementation phase. The local and foreign exchange elements should also be indicated, as government concern over the latter may not permit acceptance of projects with a high foreign exchange element. Along with the estimation of project costs, a preliminary project-financing plan will need to be proposed. This should indicate, for each major expenditure category, the respective amounts to be funded by the government implementing agencies, external donors, and by the communities/farmers affected. Again, an indication of the contribution of the different funding sources to the local and foreign exchange costs should be made.

10.1.4 Financial and economic analysis

The purpose of the analysis is to assess what the benefits of the project are from the national viewpoint through calculation of the net incremental value of production attributable to the project. This requires computing the benefits and costs for a “with” and “without project” situation, the difference giving net project benefits. Calculations may be made using actual market (financial) prices or economic (or shadow) prices, ie. financial and economic analyses

respectively. The latter reflects the viewpoint of the national economy as a whole, rather than that of an individual household's participating in the project.

Economic prices are net of all government subsidies, taxes or other forms of transfer payment. Market prices for traded goods are converted to their export or import parity value at the farm gate, using international prices rather than actual domestic prices. It should be remembered that project interventions often have benefits such as increased employment in rural areas, better nutrition of child household members, reduced income disparities between communities, and so on, which are difficult to quantify in an economic sense. Whether quantifiable or not, these should be clearly stated in the project document. (The same applies for dis-benefits).

10.1.5 Project organisation and management structure

An important issue to be considered is which agencies or departments should be responsible for project execution and operation, and the roles that are to be played. An organisational structure and administrative links have to be specified, with special attention given to how planning, control, co-ordination, and monitoring and evaluation functions are to be allocated. There must be commensurate executive powers and staff, equipment and finances to facilitate those given these responsibilities. Where deficiencies in existing management arrangements are indicated, clear details of the improvements required should be provided. The aim is to enable the project to secure the involvement of the appropriate technical and administrative staff from the relevant line agencies.

Whatever the organisational form selected, project implementation, including co-operation and co-ordination within and between agencies, is assisted by a set of operational guidelines and procedures which spell out precisely roles and responsibilities, financial authority, administrative lines of control, co-ordination arrangements (such as scheduled meetings and information exchange mechanisms), and monitoring and evaluation requirements. No project design would be complete unless these issues are properly clarified and included in sufficient detail in the project proposals.

Because of the importance of involving the project beneficiaries in project implementation (as well as other stages in the project cycle) it is also essential to examine whether existing bureaucratic procedures permit effective participation of the communities involved. In some instances, there will be a need to promote the formation or strengthening of local farmer and land use groups and to help improve their linkages with official implementing agencies. Voluntary and self-help community institutions often offer a better vehicle for genuine participation than co-operatives and associations specially set-up at the behest of official agencies.

10.1.6 Determining project phasing and activity schedules

The logical sequencing of project activities is an important design consideration. The planning team should make use of bar charts and simplified forms of task analysis, to define the main project phases and show the proposed schedule for implementing each component and activity.

Correct scheduling of different components can be critical. For example, staff may require training before they can advise on alternative land use practices, or other field extension activities can be implemented. Project planners need, in the first instance, to be clear in their own mind what work schedules are feasible, including an idea of their duration and relationship with one another.

10.1.7 Provisions for monitoring and evaluation

An important part of management's function is to see that implementation at various levels of the project hierarchy are proceeding according to plan. Adequate provision for feeding back critical information to management for monitoring purposes should be included in project formulation. This should specify the administrative steps and procedures at the different levels (eg. regional, district, village etc.) required to help improve activities (particularly those of an innovative nature) still in progress, and also assist in future planning and decision

making. There should also be provision for evaluation of activities both of an ongoing or ex-post nature.

10.1.8 Logical framework

As a project-planning tool, the logical framework is a useful technique for setting out, in a structured and coherent manner, the logic of the proposed project intervention. It is recommended that the planning team should use a logical framework at the initial strategies of the study as it will facilitate specification of:

- The project objectives, along with the criteria by which their achievement can be measured.
- The assumptions, upon which the causal linkages between the various levels of objectives are based.

In finalising the logical framework for the project, the entire hierarchy of means and ends (goals, purposes, outputs, activities and inputs) has to be specified, along with clear, time-bound targets, to facilitate effective project monitoring and evaluation. Guidelines on the preparation of a logical framework will be found in Solem (1986).

10.2 Project appraisal

Project appraisal is usually carried out by a government department or committee, in association with a donor or financing agency. The appraisers' role is to review the project proposals critically and satisfy themselves that various criteria are met before recommending acceptance. In particular, proposals must be realistic and consistent with the country's sector and macro level development goals and objectives. The data used and analyses carried out must be shown to be of an acceptable quality. It is essential that the planning team is aware of appraisal requirements. A project prepared with the key appraisal criteria in mind at the outset should minimise the need for revision or reformulation later on.

The following check-list of appraisal criteria headings could be used.

- Technical & practical feasibility
- Socio-economic compatibility
- Financial & economic viability (plus sensitivity analysis)
- Organisational & administrative workability
- Post-project budgetary/funding availability
- Post-project field level sustainability
- In-country replicability
- Development context and overall equity

10.3 Implementation

It is desirable that those involved in project investigation and planning should continue to be involved in the implementation phase. This will enable them to re-appraise the original findings, and revise recommendations in line with experience and changing socio-economic and political circumstances.

10.3.1 Organisational issues

Organisational issues that need to be addressed when implementing a catchment management plan include:

- Preparation of realistic annual work plans, ie. ones that are achievable rather than merely aspirations.

- Timely release of funds in line with realistic annual budgets ie. funds should be available when required and in line with the absorptive capacity of the spending institutions.

- Ensuring that the technical and support staff needed are in post and have the necessary skills and expertise to perform their required duties. Staff should be recruited and trained in line with the schedule of activities proposed.

- Ensuring that all the equipment and materials needed to undertake activities are available as required, ie. vehicles, machinery, fuel and spare parts, office and field equipment, building materials, farm and forest inputs etc. are purchased in time or readily available from local sources as and when required.

- Creating an appropriate framework for inter-agency collaboration, ie. ensuring that the different agencies that are required to work together do so, in a timely and co-ordinated manner.

- Allowing for flexibility in implementation to be able to learn from experience and take account of changing circumstances, ie. implementation should not mean adhering rigidly to the original work plan as set out in the project document, and those responsible for its implementation should have the authority to make changes as suggested by on-going monitoring and evaluation.

10.3.2 Implementation of on-farm research and development

Having brought together a group of interested farmers the role of the researcher is to discuss the purpose of the trials and advise on how they could be conducted, and then to leave the households to implement them. Further involvement of the researchers should be restricted to that of advisers and facilitators. Observations of the way rural households alter the tests together with their reasons are important test results. Such information can be fed back as the basis for modifying the technologies and identifying opportunities for further research.

Such tests show how households are likely to react to new technologies should they be introduced on a broad scale. They also show how adaptable and stable the technologies will be under the specific local circumstances. Because farmer managed tests essentially belong to the rural households, the researchers should not suggest enterprises or management practices unless they believe they will perform at least as well as the household's normal practices. Farmer managed trials are not for the early stages of development where the details have not been fully worked out and the outcomes are uncertain.

As a rule, incentives should not be given to rural households to get them to participate in farmer managed trials. These trials are intended to test how household members react to improved technologies when applied within their own household systems and Incentives may distort both the test and household response. However, reimbursement should be made for any produce destroyed or removed from the fields as part of the trials. Also, losses due to an unforeseen design error on the part of the researcher should be compensated. Should the trials involve new materials such as seed and chemicals that are not yet available in the area these could be supplied by the researchers on credit with the households paying for these inputs at harvest time.

10.3.3 Dissemination and extension

When the various components in improved systems have been sufficiently tested, they need to be disseminated. Providing implementation of recommended production or conservation systems does not require the injection of resources not currently available locally, it should be possible to develop a flexible extension package that can be incorporated into existing extension programmes.

One option is to start dissemination by establishing demonstration plots showing the recommended practices and alternatives. Initially, demonstration plots may have to be on land belonging to the extension services and managed by them. However, whenever possible efforts should be made to persuade the more innovative households to adopt one or more component technologies so that their farms, or forest plots, can be used for demonstrations. Some may even be interested in developing with the team members a full land use plan. This would enable most, if not all, of the recommended components to be included at the outset. It should be remembered that where perennial crops and agro-forestry interventions are a part of the package, it may take several years before all the benefits are realised.

Where the technologies have been successfully used elsewhere, household members can be taken on excursions to see how others have applied them. Such farmer-to-farmer extension is often far more effective at convincing rural land users than an expert telling them of the benefits. A participatory training approach known as the Farmer Field School Approach has been used with success in Asia. A brief description of informal and formal methods that have been used to enable farmers, rather than extension workers, to take the lead in disseminating information and directly training other farmers is presented in Appendix 5.

10.4 Monitoring and evaluation

Monitoring and evaluation are an essential part of catchment management as they enable an assessment to be made as to whether a project has achieved its objectives. If it has not, then monitoring and evaluation should help identify why.

Monitoring involves the systematic collection of data in an organised manner to provide information on the **implementation** of the research and extension inputs, on the timing of activities, and on the generation of outputs. Monitoring is also the basis for ongoing and ex-post evaluation (**impact** monitoring), which is directed to effects, positive or negative, on the participating households and their objectives, and in detecting and assessing change within the catchment. **Evaluation** uses the data from the implementation and impact monitoring and compares this to the development objectives of the catchment management plan, to see if targets and objectives are being achieved.

Targets against which actual achievements can be measured will have to specified. Typical examples include the estimated labour requirement of a particular land use management practice, predicted yield levels, anticipated adoption rates, expected income levels and soil erosion rates.

10.4.1 Data requirements

To avoid the tendency to gather too much data it is necessary to decide the purpose for which data is needed, how detailed it must be, and at what frequency is it needed. Established methods of data collection should be used as much as possible. Possible sources of data include:

- The direct observations of those undertaking the M&E activities.
- Status reports by the extension services and marketing agencies.
- Field measurements eg. crop cutting experiments to measure yield, instrumentation to measure runoff and soil loss, collection and analysis of soil samples to measure soil degradation, sediment sampling of streams and rivers.
- In-depth investigation of small samples of households or individuals using informal survey techniques.

- Sample surveys of a medium-to-large number of households or individuals, normally using a set questionnaire with closed, alternative choice questions.

- Interviewing key respondents amongst the government services, parastatal organisations and the local community.

- Seasonal yield and production data for crops, livestock, trees etc. available through the relevant government departments or the national statistical office. When such data are not routinely collected, alternative arrangements will need to be made to obtain it.

10.4.2 Implementation monitoring

A primary role of project management is to ensure that the project resources (inputs) used, lead to achievement of physical outputs within the time-frame and expenditure set out in the project work plans, budget and logical framework. Physical and financial monitoring facilitates this through collation and scrutiny of information available from routine administrative records and reports. This is supplemented as necessary with field checks on both quantity and quality aspects.

Information required concerning *project inputs* includes such items as:

- Manpower deployment (key posts filled/vacant).

- Plant, vehicles and supplies, (physical availability on project and serviceability).

- Budgetary allocations and their actual utilisation.

Information on *project outputs* includes:

- Number of seedlings produced/distributed.

- Number of extension workers trained.

- Area of farm land conforming to the requirements for better land husbandry (ie. following productive and conservation effective farming practices).

- Number of small water impounding dams constructed.

- Length of stream bank protected.

- Amount of pastureland brought under rotational grazing, etc.

The frequency of such reports could be monthly, quarterly or annually depending on the size and complexity of the project.

10.4.3 Impact monitoring

Indicators provide a standard against which to measure, assess, or show the achievements in improved household livelihood and other project objectives. In selecting appropriate indicators, use should be made of local knowledge gained from the early planning activities, and monitoring and evaluation specialists within the appropriate government departments should be consulted to see what standard indicators are already being used. However, monitoring some project impacts, for example environmental impacts, may require the use of additional indicators to those conventionally used in agricultural and forestry development projects.

Indicators should be:

- Valid – actually measure what they are supposed to measure.

- Reliable – ie. verifiable and objective. Conclusions based on them should be the same if measured by different people at different times and under different circumstances.

- Relevant – relevant to the design objectives.

- Sensitive – sensitive to changes in the situation being observed.

- Specific – based on available data.

- Cost effective – the results worth the time and money involved.

- Timely – possible to collect the data reasonably quickly.

In practice, few indicators can fulfil all these criteria. However, indicators can usually be identified which indicate trends and the general magnitude of changes. Small-scale farming and forestry are not precise, scientific activities, and detailed quantitative indicators may not be necessary for monitoring and evaluating the impact of an innovation at this level.

There will be a need for what is termed “beneficiary contact monitoring”. This will make it possible to gauge whether the extension recommendations are relevant at the household level and are being followed as intended. Beneficiary contact monitoring includes items relating to issues such as awareness of the recommendations by different rural household groups (recommendation domains), actual adoption of technical recommendations, reasons for non-adoption, degree of adopter satisfaction, and so on.

For most projects, the check-list of indicators given in the Table 9.1 may be used as a guide in determining the scope and frequency of beneficiary level information to be collected.

The main purpose of collecting the information is to provide warnings of potential problems from the beneficiaries' perspective, so that corrective action may be instituted. As a fairly large margin of error can often be tolerated, short-cut methods, and the use of rapid rural appraisal techniques will often be appropriate.

The above discussion has focused largely on the conventional approach to monitoring and evaluation in which the effect of a project on the beneficiaries is monitored and evaluated by outsiders. However, whenever possible the beneficiaries should be directly involved in this work. This requires the adoption of a participatory monitoring and evaluation approach so that beneficiaries become active rather than passive participants with a real interest in the outcome. This point is discussed further in Douglas (1996).

10.4.4 Feedback and revision

Feedback from M&E during implementation may show that certain topics are in need of further attention. M&E may also show the project implementers that there are gaps in their knowledge and that this may have prevented the planners from making an accurate analysis of constraints and opportunities within the catchment area. In the event of M&E showing that there is a need for further investigation, this would require a review of the catchment management plan. It is essential that project programmes are designed with enough flexibility to allow revisions to be made following M&E.

*Table 10.1 Beneficiary contact monitoring: list of some possible objective indicators and their suggested recording frequencies**

TYPE OF INDICATOR	EXAMPLES	SUGGESTED FREQUENCY
1. Adoption of conservation effective farming practices	a. Land clearing practices b. Tillage methods & practices c. Planting & Weeding practices d. Crop rotation practices	Yearly
2. Changes in land use, cropping patterns and enterprise production levels	a. Crop areas cultivated per farm b. Cropping intensity per farm c. Crop type & sequence d. Crop yields and marketed production e. Livestock nos. per unit area f. Livestock outputs and sales	Repeated seasonally or yearly
3. Changes in sources of timber/phalloid	a. Collection /harvesting /purchase from farmers own holdings or community woodlots b. Collection from traditional sources (areas at risk)	After a period of 3 years and then yearly
4. Adoption of on-farm tree planting and agroforestry soil stabilising techniques	a. Forestry seedlings obtained & planted b. Silvi-pastoral species obtained and planted c. Extent of planting in contour hedgerows, on bunds and terrace risers d. Survival rates of plantings and replacement of failures	Yearly
5. Changes in sources of animal fodder	a. Establishment of cut and carry plots b. Utilisation of fodder from surrounding areas	Every 1-2 years
6. Changes in patterns of transhumance	a. Location of wet & dry season pastures b. Herd sizes and movement (in relation to areas at risk)	Every 1-2 years wet and dry season
7. Maintenance of physical structures	a. Status and condition of bunds/ terraces /storm drains /waterways b. Incidence & frequency of repair operations c. Method used for repairs & maintenance	From around the second year after construction then every other year
8. Use of inputs and support services	a. Purchase of improved seed for crops b. Hiring of tractor /oxen services c. Sought advice from extension service)	Seasonally or yearly
9. Participation in community activities	a. Voluntary community level construction, & maintenance of conservation works, revegetation & bush clearing of grazing areas b. Voluntary restraint on livestock numbers & movement	Periodically as required
10. Changes in Family Welfare	a. Household food self sufficiency b. Health status c. Income levels d. Standard of housing	Every 1-2 years

* All information to be obtained at the beneficiary (rural household) level.

11 Acknowledgements

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Appendices

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Appendix 1. Components of land degradation

Appendix 1 Components of land degradation

A1.1 Soil productivity

There has been a tendency in the past to place too much emphasis on assessing soil degradation on the basis of the weight of soil lost, expressed in tonnes of soil lost per hectare per year. The real issue is not the amount of soil lost, or the area of land degraded, but the effect of this loss on the productivity of the land. Innumerable experiments have sought to quantify erosion rates, only a handful have measured the loss of plant nutrients, and even fewer have attempted to correlate the nutrient loss with productivity.

Research is still largely focused on the causes and description of erosion, with less attention given to the consequences. Despite this there is an emerging consensus that erosion rate is a poor indicator of impact as measured by crop yield. This is because erosion can have a large impact on yield, even when rates of erosion are low (applies particularly in the tropics).

Soil productivity is the productive potential of the soil system that allows accumulation of energy in the form of vegetation. It is a function of many factors including soil parameters, climate, vegetation, slope and management. It is a central element to any discussion on catchment management, because productivity determines the potential agricultural and forestry production. Soil productivity, like soil fertility, is a real property of the soil, but is not amenable to direct physical measurement. Crop yield is therefore commonly taken as a useful proxy indicator because of its measurability, its relevance to farmers and planners, and the ability to quantify it in monetary terms. However, there is no single parameter that will consistently explain the loss of yield potential following soil degradation.

The most important factors appear to be adverse changes in the chemical and biological status of the soil, eg. depletion of nutrients, loss of organic matter, and a reduction in the water available to plants. This is caused by a reduced soil depth, as erosion brings limiting horizons (those that provide a lower limit to rooting depth) progressively nearer to the surface, and reduced water capacity of the remaining soil, as the coarser particles that remain following selective removal by erosion, of the organic matter and fines, have a lower ability to retain water. In addition, the decline in structural stability and increase in bulk density will influence seedling emergence and root development.

Assessments of soil erosion need to be quantified to generate data which can allow an economic value to be calculated. It is clear from the work undertaken so far that there is no simple equation that can be used to calculate that a soil loss of x mm will result in y kg/ha reduction in crop yield.

There is a link between soil erosion and yield decline, but there is more to the maintenance of soil productivity than simply the installation of runoff control measures. In the past, it was thought that soil conservation must be done before yields can rise, and that soil conservation raises yields. These concepts were used to justify the installation of conservation structures in farmers fields. We now know that catchment management programmes that merely promote the use of runoff control barriers as a means of sustaining soil productivity, are deceiving farmers. Even where land is protected by terraces, hedgerows and rock walls, mismanagement of the interbank areas, resulting in adverse changes in the chemical, biological and physical properties of the soil (eg. nutrient loss, decline in organic matter, crusting, compaction etc), will result in productivity continuing to decline.

A1.2 Soil degradation – water erosion

The dominant soil degradation process of concern is the physical loss of soil due to water erosion. However, erosion is not the only soil degradation problem that may need to be considered. Depending on the catchment, chemical, biological and physical soil degradation problems may also be found. Problems of waterlogging and salinity may occur at low-lying sites.

Leaching can result in soluble nutrients being removed from the plant root zone, while acidification may result in insoluble nutrients becoming fixed and unavailable to plants. Leaching and acidification can be serious problems in tropical soils in high rainfall areas. When soils are used for agriculture and forestry, nutrients are removed in the harvested

products. If these are not replaced by chemical fertilisers, organic manures, nitrogen fixation from the air or by weathering of rock minerals, then there will be a net decline in soil nutrient levels. Plant growth may be adversely affected by the build-up of particular metals or salts to toxic levels within the soil. Aluminium toxicity can be a problem in strongly acid soils.

Splash erosion is the process that commonly initiates water erosion. It occurs when raindrops fall onto the bare soil. Raindrop impact can break up the surface soil aggregates and splash particles into the air. On sloping land, relatively more of these will fall down-slope, resulting in a net downhill movement of soil. Some of the soil particles may fall into the voids between the surface aggregates thereby reducing the amount of rainwater than can infiltrate into the soil, thus increasing runoff.

As water runs over the soil surface, it picks up some of the particles loosened by splash erosion, and detaches other particles from the soil surface. This may result in **sheet erosion**, where soil particles are removed from the whole soil surface on a fairly uniform basis. Where runoff becomes concentrated into channels, **rill and gully erosion** may result. Rills are small rivulets of such a size that they can be worked over with farm machinery. Gullies are much deeper (often several metres deep and wide) and form a physical impediment to the movement of farm machinery.

On sloping land, when soil is saturated, the weight of the soil may be sufficient to exceed the forces holding it in place. Mass movement in the form of landslides or mudflows may then occur. On steep slopes, this mass movement may be very rapid, involving the movement of large volumes of soil, in an isolated and localised event. In geologically recent and unstable mountain areas, landslides may be natural phenomena. However, their frequency and severity can increase following destruction of the natural vegetative cover by logging or clearing for cultivation.

The capacity of water to scour soil, and transport it, is determined by its flow velocity and degree of turbulence. Where the necessary conditions are met within individual rivers, streams and creeks, undercutting of the banks may occur with **stream bank erosion** contributing directly to the sediment load of the river system, particularly during flood events.

A1.3 Soil degradation – structural deterioration

Crop and livestock production, and many logging practices, can lead to deterioration in the physical condition of the soil. This can take many forms, and has a variety of consequences. Structural deterioration is of concern because of its effects on soil-water relationships, aeration, crusting, infiltration, permeability, runoff, interflow, root penetration, leaching losses of plant nutrients, and ultimately the productive potential of a soil. Topsoil degradation may occur when an open structure of soil aggregates is broken down by excessive tillage. In addition, the impact of raindrops or livestock hooves may produce a continuous compacted layer at the surface. Reduction in topsoil porosity, and particularly surface crusting, will result in decreased water infiltration, increased runoff, poorer seedling emergence and often increased erosion.

Physical degradation of the subsoil may be in the form of a distinct pan, or a more general compaction ie. loss of the original subsoil structure and increasing bulk density, with reduction in size and quantity of pore spaces. Subsoil compaction may be associated with logging trails and skid lines, where heavy machinery is used to assist with the felling and extraction of timber from forestlands. The physical effects may be decreased water storage capacity, loss of aeration and reduced soil permeability. Waterlogging may occur in the soil above the compacted horizon and the absorptive capacity of the subsoil will be reduced thereby increasing the proportion of rainfall going as surface runoff. Plant root development will be hindered in the subsoil because compacted horizons are physically difficult to penetrate. Plant growth will be restricted because of the lower availability of air and water, and therefore nutrients, in the root zone.

Whereas conservation measures can be adopted to control soil erosion, and chemical fertilisers can be used to replace soil nutrients, structural degradation, particularly in the subsoil, is less easily overcome. The only realistic option for improving topsoil structure is through the raising of organic matter levels. This may be achieved in the short term, either by

digging in organic manure or by growing a grass or herbaceous legume cover crop. In the long term, forest cover should be re-established. This may also reduce the risk of sealing and crusting.

It is better to prevent compaction from occurring in the first place, for instance in forest areas by using alternative timber extraction methods (eg. buffalo logging) or in upland pastures by controlling livestock movements and regulating grazing. Corrective measures (eg. deep ripping by tractor) are costly and technically difficult.

A1.4 Biological degradation

Soils that have been used for agriculture can be deficient in the biological processes which both maintain their physical structure, and their ability to supply essential chemical elements to plants. Of particular concern is the decline in organic matter content of the soil following cultivation. Large amounts of bio-mass are harvested and removed from the site, but in addition, humus mineralisation rates may increase, due to soil temperature changes following the removal of a protective vegetative cover.

The agricultural significance of organic matter in tropical soils is greater than that of any other property with the exception of soil moisture. Its functions are to improve soil structure, and thereby root penetration and erosion resistance; to augment cation exchange capacity; and to act as a store of nutrients, which are slowly converted to forms available to plants.

It is possible to obtain an overall balance of soil organic matter with shifting cultivation under conditions of low population density. However, shortage of suitable land, due to population pressure, means that shifting cultivation is not a sustainable option for many upland areas. Under permanent agricultural systems, decline in organic matter can be severe and rapid. Typical values of the organic matter status of tropical soils that have been under cultivation for two or more years are 30-60% of the corresponding values under natural vegetation. Values below 50% are considered to represent an undesirable situation calling for remedial measures.

A1.5 Vegetation degradation

Vegetation degradation is a reduction in the available biomass, and decline in the vegetative ground cover, as a result of deforestation and local overgrazing of grassland areas. Such degradation is likely to be a major contributory factor to soil degradation, particularly with regard to soil erosion and loss of soil organic matter. The term also applies where there may be no actual reduction in the overall quantity of biomass but a reduction in the quality. For instance, the loss of palatable pasture grasses within natural grasslands and their replacement with non-palatable species. The value of the land will decline from an agricultural point of view with a decline in its livestock carrying capacity. However, the degraded vegetation may still be making a positive contribution to the soil in terms of ground cover and organic matter.

Soil degradation usually accompanies vegetative degradation, but it may not be such a clear cut relationship as that associated with deforestation. Well managed secondary forests may not have the same species composition as the original primary forest, but can still provide good ground cover and a similar degree of catchment protection.

A1.6 Water degradation

Land degradation, and particularly soil and vegetation degradation, results in a deterioration in the quantity and quality of surface and ground water resources. With less vegetative cover to protect against the impact of raindrops the end result is less rain infiltrating the soil. Runoff increases, stream flows fluctuate more than before (in particular, storm hydrographs are likely to have sharper and greater peaks) and flooding becomes more frequent and extensive. Groundwater recharge decreases, streams and springs may cease and the water table is likely to drop so that wells and boreholes may dry up.

Increased runoff encourages upland erosion, while an increase in severity of flash flooding encourages stream bank erosion. As a result, sediment loads in rivers supplied from degrading catchments increase. The storage capacity of dams and weirs is reduced by siltation, lowland irrigation schemes are affected by silted up canals, hydro-electric schemes

are damaged, navigable waterways are blocked and water quality deteriorates. High silt loads reduce the fish catch not only in inland waters but also where silt laden rivers discharge into coastal waters.

The implications of water degradation for sustainable agriculture are serious. With less water entering the soil and being stored for use during dry periods, crop yields fall. In dryer regions, this may mean the difference between success or failure in producing a worthwhile crop. With less water available for irrigation less land can be irrigated, crop yields and total production decline. The result is further degradation of the upper catchment areas converted to food production and a spiral of decline in the quantity and quality of the water resource.

A1.7 Climate deterioration

Loss of vegetative cover, and soil degradation, may disrupt long-term rainfall patterns and increase the likelihood of drought. With natural fluctuations in climate, this is often difficult to prove from meteorological records. However, mathematical simulation models suggest there are three ways in which deforestation and soil degradation reduce rainfall:

- Over-cultivation, overgrazing and deforestation all strip soil of vegetation. Bare soil and rock reflect more solar radiation into the atmosphere than do grass, shrubs and trees. Increased reflectivity (albedo) keeps the atmosphere warmer, disperses cloud and reduces rain.

- A general lowering of soil moisture can itself suppress rainfall. Much of the rain in tropical moist forests comes from water evaporated off the vegetation, and not from outside. Wholesale clearing of rain forest breaks this cycle and may produce a drier local climate.

- Deforestation and loss of topsoil structure allows the wind to throw more dust into the air. Dust reduces the amount of sunshine reaching the earth's surface, which would have the same rain-reducing effect as increased reflectivity.

It is therefore at least theoretically possible that catchment management programmes, which tackle the problems of deforestation and soil degradation, could also have a positive impact on the local climate. Improved land management practices may help to ameliorate micro climatic conditions thus improving soil conditions for the benefit of crop production. For instance, the windbreak and shading effect of trees, and mulching with crop residues and leaves can help to reduce soil surface temperatures and conserve moisture.

Appendix 2. Sources and analysis of secondary data

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Much secondary data can be extracted from maps, aerial photographs (especially where time series sets are available) and satellite imagery, with regard to an areas ecology, land use, settlement patterns, means of communication and the existence of remote and isolated communities. Government reports, technical surveys, consultants reports and government statistics can provide much useful data. Academic papers and books, research theses and case studies, and survey reports may also contain invaluable information. Time spent searching for such information can be highly productive in terms of information gained. Hence, an initial task should be to contact the relevant national, regional, and local level authorities and institutions to ascertain what data they may have, and its likely relevance to the project.

The following notes detail the type of secondary information that is expected to be available, and which should be collected and reviewed at the start of a catchment management planning exercise.

A2.1 Agro-climatic information

Climate

An initial overview of climatic conditions to be obtained by identifying which of a standard set of the agro-climatic types prevails. Source: Meteorological Department

Rainfall

An attempt should be made to identify the location and obtain the daily records for all rain gauges in, or close to the project area. If available, data should be collected on rainfall intensity. Source: Meteorological Department.

Other

An attempt should be made to obtain meteorological station data on temperature, wind speed and direction, sunshine hours, relative humidity, rate of evaporation and the risk of such climatic hazards as hail and frost. Source: Meteorological Department.

It is unlikely that a full meteorological station will be located within the project catchment. However, it should still be possible to extrapolate from the nearest stations whose records are thought representative of local conditions. Agro-climatic data should be analyzed to obtain information needed for catchment management such as reliability and length of growing season, drought risk, occurrence of hazards such as flooding or strong winds and rainfall runoff and erosivity.

Because of the time scale of development projects identifying the local agro-climatic constraints and potentials will rely very heavily on existing data, backed up by a qualitative confirmation derived from discussion with key informants, and local farmers.

A2.2 Topographic & other printed maps

Contour maps at scale of 1:50,000 can be interpreted to provide information on the land characteristics of an area such as average slope, altitude, relative relief, drainage patterns, sub-catchment boundaries, and land form variations.

Source: Department of Survey

It may be possible to locate other maps, eg. administrative and road maps as well as special bio-physical and socio-economic thematic maps.

Source: Government administrative and technical development agencies.

From a thorough review of the available maps, it should be possible to obtain information on the topography and soils of planning area and its socio-economic environment. The appropriate maps can be used to obtain information on the boundaries of administrative units, about settlement distribution (eg. urban areas, villages and homesteads). Maps can also supply information on communications infrastructure such as the location of airstrips, railway connections, roads, tracks, petrol stations, and post offices. They can also reveal the

occurrence of local community service facilities, such as schools, health centres, markets, and temples.

A2.3 Aerial photographs

Aerial photographs have been used for many years by natural resource scientists as a basic tool for rapidly assessing rural areas for land use planning purposes. They are considered, along with good topographic maps, as key aids for catchment management planning as they can serve the following functions:

Location: Photographs can be a more reliable and up to date means than maps of finding routes and identifying locations in the field. They can reveal the location of remote and isolated communities whose presence may not be recorded on maps or detected from road based surveys.

Interpretation: A rapid stereoscopic examination of air photographs is the best means of pre-field familiarisation with an area particularly with respect to gaining a broad overview of landforms, vegetation, land use, land degradation, crop zones and irrigation channels. Later they can be used for more thorough interpretation of land management units, land use/cropping patterns, plot size, forest cover, population (from house counts), and the nature, extent and type of land degradation.

Changes Over Time: Where time series photographs exist it is possible to compare photos of the same area flown in different years, which will provide information on changes in land use, settlement, forest cover, river courses, gullying, sediment deposition etc. It is also possible to compare the latest photos with the direct observation during the course of the field survey work to determine what changes have occurred since the photos were taken.

Visual Aids: A large blow up of a standard 23 x 23 cm air photograph can be a useful visual aid in discussions with farmers and community leaders. Rural dwellers may have difficulty in reading a map but can usually relate quickly to an enlarged black and white photograph that clearly depicts their houses and field boundaries.

Existing air photographic coverage of the area may be patchy and of poor quality. However, every effort should be made to find out what is available, and if possible to obtain copies. For interpretation purposes high quality photos, less than 5 years old, at 1:25,000 to 1:20,000 scale are the most desirable. However, it may be necessary to work with older photos, smaller scales and poorer quality depending on what is actually available.

A2.4 Satellite imagery

Satellite imagery is becoming increasingly available particularly from the US LANDSAT and French SPOT satellites. A satellite image or scene provides a rapid overview of an area enabling broad regional differences to be seen at a glance. Each scene covers an area that would be difficult or prohibitively expensive and time-consuming to cover entirely by air or ground survey. Satellites cover the same area at regular intervals and can therefore be used to identify seasonal changes, providing arrangements have been made in advance for data to be routinely collected (ie. to ensure the sensing equipment is switched on as the satellite passes over the area of interest). Satellite imagery cannot normally be used for stereoscopic interpretation, nor, because of the very small scale, can it provide information that requires a fine resolution such as hut counts, plotting field boundaries and locating wells or boreholes. Whilst considerably less useful for planning work than air-photographs, satellite images are often easier to obtain and can provide information for years when no air photographs were taken.

A2.5 Land use, soils and other natural resource maps and reports

It is likely that some natural resources data relevant to the bio-physical conditions within the catchment will already exist. This may be in the form of thematic maps and reports, providing secondary information on such topics as land use, soils, vegetation and other natural resources. Such information may only be available at a reconnaissance or exploratory survey level. Detailed information may exist for small areas within individual catchments eg. a soil survey of the land of an Agricultural Research Station, or land use plans for commercial large-scale

farms/estates. Where they exist, good land use and natural resource surveys can provide information on the nature and extent of environmental constraints, potential crop/land use suitability and existing land use problems.

Source: Soil Survey and Land Use Planning Sections of the Departments of Agriculture, technical annexes of agricultural, forestry and integrated area development project proposals.

A2.6 Hydrological data

Hydrological data includes records of stream flow and sediment loads, which can be used to estimate sediment yields. Records of annual and monthly average stream flows can be useful for assessing the total water yield and the magnitude and frequency of low flows and floods. If such data does not exist for the project area it may still be possible to derive estimates using data from other catchments with similar climatic, soil /hydrogeology, vegetation and land use conditions.

It may be possible to obtain qualitative background information on the seasonal availability of water from different sources (springs, wells, boreholes, streams, rivers, dams etc) within the catchment, through informal interviews with local key informants during the reconnaissance field visit.

Source: Irrigation Department, Department of Public Works, Hydrometeorology Division of the Meteorological Department

A2.7 Census reports and statistical year books

Census reports and statistical yearbooks provide data on population numbers, distribution, density, growth rates and a range of other demographic characteristics. Such documents may also contain statistical data related to the social and economic situation within the catchment, eg. ethnic composition, average income levels, sources of livelihood, social services, infrastructure etc. They may even contain information of an agricultural nature eg. livestock numbers, crop production statistics. In most cases, data will have been compiled for local administrative regions which will probably not coincide with the project area based on a hydrological catchment.

Source: The National Statistical Office

A2.8 Production data

Data related to crop, livestock and tree production can be obtained from diverse sources within the national, and regional, offices of the Departments of Agriculture, Lands and Forestry. It may be contained in agricultural statistical yearbooks, extension reports, monitoring and evaluation surveys, past farming systems research surveys and social forestry studies. From such data, it should be possible to determine the main crop, livestock and tree enterprises pursued within a catchment.

Production data may also exist on the planted area for different crops, cost of production, yields and figures for total production. Particularly from extension sources, it should be possible to obtain information on average holding size, numbers of livestock per household and the percentage of households pursuing particular production enterprises.

A2.9 Price and market data

Representative information on quantities marketed and prices paid for the products of the various land use enterprises (crops, livestock, trees etc), on the costs and distribution networks for inputs and sources of credit can be obtained from government and private agencies operating within or in the vicinity of the catchment, such as the extension services, marketing boards, finance corporations, fertiliser companies, private traders etc.

A2.10 Forest resource management data

Information on the exploitation and management of any state forest resources within, or adjacent to, a catchment should be available from the national and regional offices of the Department of Forestry. As should information on re-afforestation programmes, commercial tree plantations, integrated social forestry schemes, and state run tree nurseries.

A2.11 Livestock management data

Information on livestock types, numbers, animal diseases, fodder/grazing land availability and animal husbandry practices should be available from the extension, animal husbandry and veterinary divisions of the Department of Agriculture.

A2.12 Experimental results

Reports of previous agricultural and forestry research conducted in or near to the catchment could be particularly useful since they will contain detailed, area specific data. Such past research experience could be relevant to the design of future project components. Past and on going research will be a source of information on suitable crop, pasture and tree varieties and alternative land use/farm management practices (cultivation techniques, conservation technologies, pest control, post harvest etc), for specific conditions. Information will be found in the reports and technical publications of International (eg. FAO, IBSRAM), Government and University Institutions involved in crop, livestock, forestry and soil and water conservation research.

A2.13 Extension recommendations

Information on existing extension recommendations for crop, livestock and tree production as well as recommended soil and water conservation measures can be obtained from the reports and extension materials produced by the relevant extension sections within the Departments of Agriculture, Forestry and Lands. In addition to obtaining information on the current recommendations, it is essential to obtain information on how they are disseminated ie. how the respective extension services operate within the area. This is because it is essential to review existing recommendations, with regard to their compatibility to local rural household circumstances, as well as the effectiveness of the present dissemination process.

A2.14 Health and nutrition

Information on health problems, incidence of particular diseases and malnutrition can be obtained from the Department of Health and local health clinics. Information on nutritional requirements (ie. how much and what types of food are required for a healthy diet), food balance sheets and related health problems may be available from the reports of government and NGO relief agencies, as well as in the technical publications of a Nutrition Institute. Local health clinic staff and community development workers can provide information on local food preferences, production strategies and problem areas

A2.15 Anthropological and social information

Academic papers, theses and case studies prepared by staff and postgraduate students within universities, colleges and research institutes may provide valuable information on local traditions, customs, attitudes, social structure, community organisation, role patterns in society etc. All of which will influence rural household behaviour and the household members perceptions of particular land use recommendations.

A2.16 Macro-economic and policy environment

Information on the national and regional macro-economic and policy environment can be obtained from reports, national development plans and policy documents produced by the Office of the Prime Minister, the Ministry of Finance and their counterpart institutions at the regional level. Information on sectoral macro-economic and policy issues will be found in similar documents produced by the planning sections of the concerned departments and regional offices. From these it should be possible to obtain information on national, regional and sectoral development goals and objectives, conservation and development planning policies, planning rules and procedures, foreign exchange regulations, internal and external trade regulations, marketing and pricing policies and macro-economic data related to domestic demand, quotas, taxes, levies, exports, imports etc.

A2.17 Secondary data compilation and review

It is unlikely to be possible to collect all the information mentioned above. The need will be to determine what information is really needed, and whether a particular issue has relevance to developing an understanding of the bio-physical and socio-economic circumstances within the planning area.

Having identified what data can be collected, and where from, a schedule should be prepared for its collection and review by the different team members. As the information is collected it should be studied and properly filed for easy retrieval. Important issues should be summarised and should be passed on to other team members. The review will also need to consider how recently the data was collected. Demographic data that is more than 10 years old, and socio-economic data that is more than 5 years old, is likely to need updating. However, data on the natural environment (with the exception of factors subject to change such as land use, forest cover and land degradation) is less likely to be outdated.

The team members will also need to be aware that some of the secondary data may be incorrect, the method by which it was collected could be suspect, or the conclusions drawn by those originally collecting the data might be based on false assumptions. At some point in the preliminary investigation secondary data should be validated, and where necessary corrected, through direct observation and discussion with key informants and others within the catchment area.

Appendix 3. Characterising recommendation domains

Appendix 3 Characterising recommendation domains

The following notes detail the type of information used in characterising a recommendation domain made up of rural households involved in commercial or subsistence agriculture and forestry on a small-scale basis. However, many of the sections will also apply to the characterisation of domains comprising the private sector large-scale commercial operators and indirect land user interest groups.

Where there are marked differences between the characteristics of different recommendation domains then separate descriptions should to be prepared for each. However, if they only differ in a few key specific areas (eg. land holding size, ownership of livestock), then it may be possible to produce one characterisation which points out the differences related to a particular component of the overall description.

A 3.1 Household enterprises

This should provide an introductory statement of the enterprises engaged in by the rural households in the recommendation domain being described. It includes enterprises common to all households and those that are engaged in by a significant number of the households. The primary interest is in enterprises that use the land directly for production oriented purposes. However, the description should also cover non-farm and off-farm income generating activities undertaken. This will indicate how dependent the household is on farm enterprises for meeting its welfare needs. Note, for instance, if farming is making only a secondary contribution to the households welfare, compared to the non-farm activities such as fishing, working as a labourer in a logging concession, children's' remittances. This may influence the household's willingness to adopt improved land use practices that call for more of it's resources (particularly cash and labour) to be devoted to farming activities than at present.

The aim is to provide a summary description of the various enterprises that make up the household production system; detailed descriptions of individual components will be covered in later sections. Household enterprises should be described in broad terms eg. hunter gathering, hill farming, irrigated rice production, logging, cottage industries, labouring, waged employment etc.

For on-farm enterprises give brief details of major and minor crops, livestock types, tree species grown or managed within the land used by the individual household and the reasons for pursuing these enterprises (eg. products obtained). Give brief details of the products (timber, fuelwood, rattan, bamboos, honey, nuts, medicines) obtained from nearby woodland, forest and grassland areas, if they are significant as a component of the household's productive activities. Recent changes, eg. new crops adopted or old crops decreasing in importance or disappearing completely, should be described.

A 3.2 Household goals

This section describes the goals which the typical rural household is seeking to meet through the enterprises described above eg. food security, risk avoidance, cash maximization, educating children, meeting extended family/community obligations. Any land use or farm management recommendation that runs counter to the household goals is likely to be rejected. For example, the goal of short term food security may make households unwilling to grow perennial cash crops instead of annual food crops. Again, the long-term goal of educating the children may mean the household is unable to increase crop production by investing scarce cash in buying fertiliser, when any spare cash is needed for paying school fees.

A 3.3 Market orientation and strategies

This section defines the degree to which the rural household's enterprises are directed towards subsistence or commercial production. Households may be considered as subsistence farmers even though they sell limited quantities of their total production (less than 20%), and those engaged in commercial farming may consume limited amounts of their own produce (up to 20%). Market orientation may also be expressed in relation to the particular crops grown. A household may be engaged in commercial production of tobacco, for example, with subsistence production of upland rice, taro, sweet potatoes, mung beans, groundnuts, and vegetables.

If subsistence needs are met by current farm management practices, and the food crops grown have a low market value, a household will have little incentive to increase production by adopting improved crop husbandry and soil conservation practices. However, there may be interest in improved practices that would enable the household to obtain the same production levels with fewer inputs (eg. less land, labour or purchased fertilisers). Households already engaged in commercial land use enterprises are likely to be responsive to recommendations promoting environmentally sustainable alternatives providing the new enterprises, or management practices, offer significantly improved returns to the factors of production (land, labour, capital, skills etc). Any recommendation that is financially less attractive, or requires increased effort eg. more labour, is unlikely to be accepted.

The section should also describe the marketing strategies followed to dispose of any production not consumed by the household. This may involve formal or informal market channels or exchange of produce between different households and communities. Households require a market for any production surplus to their consumption requirements, if adequate marketing channels already exist then increasing production presents few problems. However, many past recommendations for a change of land use have failed because inadequate attention was given to whether a market existed for the new produce.

A 3.4 Food preferences, needs and production strategies

It is common for small-scale farming households to produce a significant part of the food they eat. Consequently they devote much of their attention and resources to the production of the preferred foods and are particularly responsive to recommendations that target the production problems of these food crops. This desire to produce for themselves the preferred foods is the reason why households with no alternative land, will cultivate annual crops in upland areas that, from a land capability perspective, would be considered too steep. The legitimate response of the hill farmer to the recommendation, “don't grow crops, grow trees”, is to say, "my family cannot eat trees". Rural households have valid socio-economic reasons for wishing to grow annual food crops on sloping land.

This section should identify the preferred staple foods, the household’s food requirements and the means pursued to meet their needs, eg. grow it themselves, purchase, exchange or barter, or collection from the bush. Where there are shortfalls in food production, the regularity (eg. every year?), time of year, amount, and reason for the shortfall, should be noted. This information may be obtained by means of a seasonal profile (See Table 6.1 and Appendix 4.5).

Some foods may have cultural significance, being associated with traditional ceremonies or feast days. This, plus the issue of taste preference, may explain why certain low yielding traditional varieties continue to be grown despite the availability of improved higher yielding cultivars. If such points are applicable they should be described. There may also be recent changes in the type of food being consumed by the household. New foods, grown on the farm or purchased, may be becoming popular and replacing traditional ones. This may be a change in dietary preference, a reflection of growing affluence or a deliberate choice by the wife to use, except on special occasions, an alternative staple food because it requires less processing and cooking time than the traditional one eg. substituting purchased rice for home grown yams and sweet potatoes.

A 3.5 Household energy/fuel requirements and source

Rural households are usually dependent on local materials for their domestic fuel needs for cooking and heating water, as well as a range of income generating activities such as curing tobacco, beer brewing and brick making. Should firewood or charcoal not be readily available, then inferior fuels such as crop residues and dung may be used. Where these resources are used for fuel they are not available for use as livestock feeds, mulch or organic fertilisers.

This section should therefore define the household's annual fuelwood requirements, describe the preferred fuels and those actually used, and indicate the source of the fuel ie. from the households’ own land, purchased from others, collected legally or illegally from forest land. The amount of time, and distance travelled, to collect fuelwood should be noted as this will indicate how scarce a resource it is.

Given the costs of bottled gas and paraffin (kerosene), only the better off households are likely to use such fuels on a regular basis for cooking. Evidence of its use is therefore an indicator of the household's income level. As a result of rural electrification programmes more and more rural households have access to this as a source of energy particularly for lighting. In these areas, households without electricity may prove to be the poorest in the community.

A 3.6 Cash and capital resources

For most rural households the scarcity of productive capital and cash, and limited means to obtain them are severe constraints to the adoption of many improved land use practices. The scarcity of cash and its dual purpose in both consumption and production tends to make rural households invest cash conservatively because they cannot afford a major loss. This section should therefore attempt to estimate and describe in general terms the capital resources available, and required, for investment in the different land use enterprises. Household cash constraints can be described in terms of their cash flow situation, with seasonal inflows due to farm sales and other sources of cash income (eg. non-farm and off-farm employment) and seasonal outflows such as input purchases and other necessary expenditures (eg. food purchases, school fees etc.). Credit might be used by households to overcome cash constraints particularly for the purchase of inputs but the availability of credit, households' means of access to it, numbers using it, amounts borrowed and ability to repay should be noted.

A 3.7 Labour resources

Family labour is generally the rural household's primary productive input but reliance solely on family labour can create seasonal bottlenecks. Labour constraints are particularly severe for households with young families where there are many small children to feed and only one or two adults to undertake the work. This section should therefore note the typical family size and age structure in order to determine the availability of family labour. Some of those regarded as members of the household may be working off the farm, or engaged in non-farm activities, on a full or part time basis. Such members of the household will not be in a position to contribute their labour on a full time basis to the household's land use enterprises, although they make a significant contribution to the overall household economy.

The labour available should be compared to both the annual total and seasonal labour requirements for all the land use enterprises undertaken to determine whether and when any critical labour shortfall occurs (see also Section 21). If there is a shortfall of labour, the household's strategies to overcome this should be noted (eg. hiring of labour, modifying particular farming practices). Many conventional soil conservation practices are labour intensive (eg. construction and maintenance of terraces) and a shortage of household labour (or the greater opportunity cost of using limited labour resources elsewhere) are reasons why many technically correct conservation practices are not adopted.

A 3.8 Division of labour and decision making responsibilities

Within rural households there may be a division of labour and decision making responsibilities between the sexes with regard to the different land use and household activities. Hence, it is important to determine the tasks carried out by each family member. Is it the man or woman who decides which crops to grow, what livestock to keep and when to sell, when to let land revert to fallow and which areas to open up for cultivation? Who controls the household funds? This section should seek to provide answers to these questions. If the division of labour and decision making responsibilities within the household are not understood, extension advice on changes to particular land use enterprises may be directed at the wrong person. Note that where households are farming on a share cropping basis the landlord may be the primary decision maker with regard to which crops to grow and what purchased inputs to use.

A 3.9 Land resources

The land resources available to a rural household will directly influence the enterprises undertaken, management practices followed, and the level of production obtained. This section should describe the size, shape and fragmentation of typical land holdings and the different land management units used for crop, livestock and tree production by a household. Any trends such as decreasing holding size or increasing fragmentation should be noted, as should changes in land use caused by increasing land scarcity. In the case of shifting cultivation points to note are the amount of land cropped in any one year and the total land area in which the household/ community has the right to practice shifting cultivation.

It is important to note that a household may have several plots of land, including some in adjacent catchments that fall within the traditional boundaries of the community to which it belongs. If this is the case then the project proposal will need to extend beyond the original catchment to ensure that the project's recommendations, technical advice and inputs are available to all of the fields cultivated by a farm household. Project enforcement of land use recommendations, such as no annual crops to be grown in hillside plots in one catchment area, may lead to excess pressure on a neighbouring catchment where the household has alternative plots. The problem is merely transferred, not solved, as the household will expand the area of hillside cultivation in an area outside the projects control, to compensate for the loss of food production from their field(s) within the project area. Likewise, banning logging in the project catchment may lead to increased exploitation of the forest resources located in neighbouring catchments.

It is important to describe the manner in which ownership or rights to the use of land are held (land tenure arrangements and the legal status of the farmers with regard to the land being used) as well as the household's rights of access to forest resources and other common property resources. The following terms may be used to describe the tenure status of the land used by individual households in a situation where private ownership is the norm:

Owner - operator: the household's ownership of the land is based on a legal certificate.

Permanent user: the household occupies and uses the land without a legal certificate, but claims ownership through payment of tax, right of inheritance or ancestry.

Share tenant: the household operates a "holding of a farm by another" in return for a share of the harvest (the percentage, or the agreed amount, of the harvest shared between the household and the owner should be recorded as this may vary from area to area).

Lessee: the household leases an area of land from the landowner (including the government) in return for an annual cash payment (eg. rent) or for an agreed share of the harvest.

Stewardship agreement: the household enters into a formal agreement with the government for use of a specified area of land within what is legally public forest land. This is usually for a specified period eg. 25 years renewable for a further 25 years. In return for the right to use the land, and to pass those rights onto their children, the agreement may stipulate certain land use requirements eg. tree planting and soil conservation practices to be part of any hill farming enterprises.

Squatters: the household occupies and uses the land without having legal possession or land use rights, ie. their occupation and use of the land is not covered by lease, title or tenantship.

Different tenure arrangements may apply to different plots of land used by a household. In the case of share tenants and lessees the owner of the land (absentee landlord) may not have given the farm household full rights to decide how the land is to be used. In many cases the decision on which crops to grow will be taken by the absentee landlord who will also supply the material inputs, with the household providing the labour in return for a share of the crop.

In some traditional societies, there is no individual ownership of land. Instead, land is communally owned by all those belonging to the village or community, based on a historical claim to have settled in and used the area. Individual farm households will be granted rights, by the community, to use a particular piece of land on a customary land tenure basis. The authority to grant land is usually vested in the village headman or traditional authority who has a moral responsibility to allocate land to individual households in conformity with their needs. Under such a system once land has been allocated, and providing the household is using it for crops, livestock etc, it cannot be taken away from them without their agreement and they have full rights to the products of the allocated land holding.

A 3.10 Social and cultural influences

The level of education and technical knowledge within a rural household will have a marked influence on the existing land use management practices and their willingness to adopt new recommendations. This section should describe the general education level of the household members, how many years formal schooling, and the level of literacy. The level of technical knowledge household members have and their receptiveness to innovation and change with regard to their farming and forestry activities should be described, noting if this is based on traditional knowledge or derived from contacts with the agricultural and forestry extension services. A qualitative description such as the following examples may be sufficient:

- Household members are mainly without formal education, follow traditional methods and have had little contact with extension services;
- Most productive members of the household have at least primary schooling, have frequent contacts with the extension services and have shown a willingness to adopt improved methods where short-term benefits can be clearly demonstrated.

This section should also describe any aspects of the local culture and traditional beliefs which influence the land use/farming practices of the household. Likewise, the peace and order situation in which the household operates eg. presence of armed dissident groups or risk of theft, may affect decisions with regard to the land use activities followed.

A 3.11 Community organisations, local infrastructure and support services

Members of a rural household may belong to, or make use of, organisations and institutions operating at the community level. Some of these such as farmers clubs, irrigators associations, credit groups, or marketing co-operatives may directly relate to the farm enterprises pursued. Others such as women & development groups, and the local church or mosque may be less directly related but may be channels through which problems can be identified and extension messages disseminated. It is therefore useful to identify and describe those which the household has links with.

This section should also describe the features of the external economic environment on which land use enterprises depend by providing answers to such questions as:

- Is the area accessible by all weather roads or is it geographically isolated?
- Is there an agricultural or forestry extension service operating in the area?
- What veterinary support services are locally available?
- Do households have access to produce markets and input supplies (provided by the government or the private sector)?
- Do households have local access to schools and health services?

Notes on these should be included since they can play an important part in determining the production orientated components of a household's land use enterprises.

A 3.12 Draft power and mechanisation

A shortage of draft power is a common constraint limiting the agricultural production of many farm households. Households with their own draft power and farm equipment are at an advantage compared to those without when it comes to the intensity and timing of farm operations such as cultivation, planting and weeding. This section should therefore note the means by which land preparation and other farm operations are carried out (eg. human labour, animal power or tractors) and the different types of equipment used (owned, hired or borrowed) for the different operations.

A 3.13 Cropping characteristics

For most rural households the major land use enterprise will be crop production. This section should therefore describe the following:

- The different types of crops and the particular varieties/cultivars grown.
- The type of cropping system eg. pure stand, mixed cropping, sequential cropping
- Intensity of cropping - years cultivated versus years fallow
- Crop combinations and any rotations followed.
- The type of fallow (bush fallow, grass fallow, planted tree fallow etc) and the length
- Use of short fallows of less than 12 months (applies to parts of the humid tropics with effectively a year round cropping season).

The section should include a seasonal calendar to show which crops are grown at different times of the year. An 18 rather than 12 month calendar may provide a clearer description of the cropping sequence, which should be related to seasonal variations in the climatic growing conditions.

A 3.14 Cultivation practices

The most versatile means of providing protective ground cover is to rely on the canopy provided by the leaves of well-grown crops. Improvements in crop husbandry practices (eg. early planting, optimum density, use of improved seed and fertiliser, intercropping and leaving more of the crop residues on the surface than formerly) can significantly reduce splash erosion and improve water infiltration. It is therefore important to describe existing crop cultivation practices, as by improving these it may be possible, not only to raise yields, but also to reduce erosion through improved ground cover. The following should be described for each of the main crops grown, with regard to the operations performed and timing within the production cycle:

- land preparation, including clearance
- tillage practices/cultivation operations (methods and number of times ploughed, harrowed etc.)
- planting practices, including nurseries, transplanting, timing of planting
- fertiliser application: timing and methods of application
- weeding: frequency, timing, methods
- crop protection practices, eg. spraying, timing and frequency
- harvesting (for perennials, including frequency and timing)

A 3.15 Post harvest practices

This section should describe how the households store their produce and any particular practices used to prevent losses. The section can also be used to record any post harvest processing undertaken by the household prior to consumption, storage or sale.

A 3.16 Livestock characteristics

Livestock are an important part of the total production system of many rural households, being kept as a major or subsidiary productive enterprise, for prestige purposes or for draft power. This section should describe the types, numbers of livestock kept, their products (milk, meat, eggs, etc.) and why they are kept (function within the household economy).

A 3.17 Animal husbandry practices

It is important to describe existing animal husbandry practices as by improving these it may be possible not only to increase livestock production, but to raise soil organic matter levels and justify the use of contour vegetative strips for soil conservation purposes. Details should be given of the husbandry practices followed in raising and managing the different types of livestock, eg. grazing on communal areas, on planted pastures or stall feeding. Information should be given on the types of livestock feeds used, their source (eg. produced on-farm,

gathered from local sources or purchased) and adequacy. Depending on the importance of livestock production, it may be appropriate to prepare a profile of the livestock production cycle (mating, births etc) and compare this with the seasonal availability of particular feeds.

A 3.18 Utilisation of trees and forest products

Trees feature as an important component of many small-scale commercial and subsistence farming systems. Many small-scale farming systems are based on perennial tree crops such as coconuts, coffee, oil palm, rubber or fruit trees (mango, durian, rambutan, citrus etc). It is also not uncommon to find a home garden, immediately surrounding the house, comprising a mixture of trees, shrubs, and other plants for food, fuel, cash sales and medicinal purposes. Indigenous trees may also be selectively left when a forest area is cleared for cultivation. Hence this section should give details of the species and numbers of trees, their spatial arrangement within the holding(s) and their products (fuel, timber, fruit, shade, fodder etc.). Where households are deliberately practising a form of agro-forestry details should be given of the tree/crop/livestock components and interactions.

Many rural households depend for some of their needs on exploiting the local forest resources. If this is the case then this section should describe the type of products obtained from the forest (timber, poles, fuelwood, rattan, wild fruits and nuts, fibres, medicines, game, edible fungi, medicines etc) and whether these are for sale or household consumption. Rural households who value the produce they obtain from a nearby forest will have a vested interest in its protection and sustainable management providing they can continue to obtain the benefits.

A 3.19 Silvicultural practices

The growing of perennial tree crops is commonly recommended as an alternative form of land use to the cultivation of annual crops on hillside plots. It is therefore useful to know what skills households already have with regard to the establishment and management of trees. This section should provide details of the ways in which household members are currently raising or managing the various trees found within their land holdings. If households have not planted any trees, and show little interest in doing so, this may indicate that they do not own the land they cultivate and therefore have no certainty that if they planted a tree they would be the ones to harvest the produce.

A 3.20 Other land use enterprises and income generating activities

This section should describe other typical land use enterprises and income generating activities that might be undertaken by the members of individual households within the recommendation domain to raise additional cash resources. This could include on-farm activities such as bee keeping and fish farming, or off-farm and non-farm activities such as cottage industries, in shore fishing, working as a hired labourer etc.

A 3.21 Production inputs

This section describes the material inputs used by the household for its crop, livestock and tree production and how they obtain them eg. from within the farm, cash purchases, on credit, supplied by the landlord, from government nurseries etc. The following should be specified whenever possible:

- For each crop variety or specific cultivar, quantity of seed or planting material required and source (eg. whether purchased or retained from previous crop)
- Fertilisers: type and amount (times and methods of application are given under cultural practices)
- Organic manures and composts: type and application rate
- Crop protection inputs: type and amounts used of sprays, pesticides, etc.
- The age, numbers and source of livestock purchased for rearing (eg. day old chicks, piglets, steers etc)
- The numbers and source of tree seedlings, grafted fruit tree cultivars etc.

Note whether households are using the recommended inputs, in both type and quantity. If not then an explanation should be given as to why. The answer might well be due to high cost; availability; or that the household is not convinced (often justifiably) that the recommendation is correct.

The labour of household members is an important input. The quantity of the available labour is described under Section 7. This section should therefore focus on the number of man-days required for each production enterprise and include seasonal labour profiles. If labour is required for conservation oriented activities such as terrace construction or tree planting these will have to be timed for periods of the year when household labour is not fully engaged in production oriented tasks. Comparing the available labour with the seasonal demand profile should reveal whether there are periods of the year when there is spare labour capacity or whether the need is to introduce new land use practices that are less labour demanding.

A 3.22 Yields and production levels

This section should provide an estimate of the annual total production of the typical household's various land use enterprises. In the case of crops, this should be presented in terms of both yield per hectare and production per household land holding. In the case of livestock, this may be presented as the number of livestock units disposed of (sales and home consumption) per year or quantities of eggs and milk produced. For the products obtained from the trees planted by the household, unless planted in commercial blocks, the production level should be estimated in terms of the total production from each of the different trees on the land holding. Figures for yields and production levels should be expressed as typical ranges rather than as precise single figures as these will vary depending on the size of individual holdings and seasonal variations in the growing conditions.

A 3.23 Household income/farm performance

It is important to determine the current returns the household gets from its on-farm enterprises and other sources. Improved farm enterprises and management practices that do not give significantly higher returns to a household are unlikely to be voluntarily adopted. All too often technically correct land use recommendations have been rejected by target beneficiaries because they are financially unattractive. Rural households can rarely afford to incur short-term costs for long term benefits. This section should estimate typical farm performance and household income using the following parameters:

- Fixed costs
- Variable costs
- Enterprise output
- Gross margins
- Net farm income
- Net farm earnings
- Household income
- Per capita income levels
- Returns to labour

The first seven of these are standard measures used in farm economics. Per capita income levels, is employed descriptively as an approximate indication for comparative purposes. Where cash is not a significant feature of the household's production activities (ie. primarily subsistence producers) the analysis should look at the returns to the amount of labour invested by the household (family and hired) in the various farm enterprises.

A 3.24 Production problems and constraints

This section should consist of a brief statement outlining the main production problems faced by the farm household, the causes and the constraints that have to be overcome. It can be illustrated with the aid of a causal diagram (See Appendix 4.5).

A 3.25 Land degradation problems

This section should provide a brief description of the major land degradation problems faced by the households (eg. gullying, overgrazing, deforestation, declining soil fertility and organic matter levels, surface compaction etc) along with an indication of the causes and the direct effects on the household members (eg. declining yields, shortage of fuelwood and fodder, deterioration in water supplies etc). Data from this section should be incorporated into the causal diagram referred to under Section 24.

A 3.26 Existing conservation practices

Most rural households will already be using a number of land management practices that are compatible with good conservation. Examples of such practices include:

- Construction of physical barriers (terraces, earth banks, fences etc)
- Minimum tillage techniques
- Use of organic fertilisers
- Agroforestry practices
- Nitrogen fixing trees
- Mulching
- Maintenance of ground cover (eg. through intercropping and sequential cropping mixes)
- Use of legumes
- Fallow periods
- Crop rotations
- Selective logging

Farmers and other rural land users are usually more responsive to adaptive improvements to what they are already doing and familiar with, than to totally new ideas. Hence recognising and building on what is already compatible with good conservation is likely to lead to more acceptable land use recommendations. This section should therefore provide a description of many existing land use practices that are beneficial and explain why they are conservation-effective.

Appendix 4. Informal surveys for assessing farm household characteristics

Appendix 4 Informal surveys for assessing farm household characteristics

A 4.1 Rapid rural appraisal

A variety of Rapid rural appraisal (RRA) techniques have been developed that can be used to analyse the circumstances of farming communities, diagnose their problems, and design conservation orientated solutions. With RRA the analysis and identification of solutions is primarily done by the experts. It is bottom-up in the sense that it is based on detailed discussions with the target land users, but it is still essentially appraisal by outsiders. RRA has been used to elicit a range and quality of information and insights inaccessible with more traditional methods, from farming and a range of other social and rural development issues, including farming systems development.

Experience from a number of countries has shown that RRA is an effective way of obtaining relevant information on rural household circumstances. It is a semi-structured activity carried out primarily in the field by an inter-disciplinary team. Key features of the approach are that it is:

Iterative: data collection, analysis and review are on going activities throughout the study. This involves learning as you go, whereby newly generated information refines the original understanding and helps to set the agenda for the later stages of the analysis.

Flexible: the sequence of activities and goals of the study are not immutably fixed before hand, but constantly under review and modified as the team realises what is, or is not, relevant.

Innovative: there is no simple, standardised methodology. Techniques are developed and modified for particular situations depending on the local circumstances and the skills and knowledge of the team members.

Interactive: all team members and disciplines work together in a way that fosters lateral thinking and inter-disciplinary insights. A systems perspective helps to make communication easy.

Informal: the emphasis is, in contrast to the formality of other approaches, on partly structured and informal interviews and discussions.

In the Community: learning takes place largely in the field and in particular farmers' perspectives are used to help define differences in field conditions

A 4.2 Participatory rural appraisal

Participatory rural appraisal PRA has recently evolved into the approach termed participatory rural appraisal (PRA). RRA has been described as mainly extractive, whereas PRA in contrast is participatory. With RRA, outside professionals go to rural areas, obtain information and then bring it away to process and analyse. With PRA outside professionals still go to rural areas, but their role is more to facilitate the collection, presentation and analysis of information by rural people themselves. PRA is an approach where the "outside experts" have to "unlearn" to realise they have no monopoly of wisdom and knowledge; where they have to sit down with farmers, to listen to and learn from them and to respect their expertise and ability.

A 4.3 Advantages of informal survey methods

Good RRA and PRA have the following features in common:

A reversal of learning – outsiders learn from and with rural people, on-site and face to face. Rural people's criteria, categories, and priorities, and their indigenous technical knowledge are respected and deliberately sought.

Learning is rapid and progressive – methods are used to explore important questions as they arise, with improvisation, iteration and probing.

Trade-offs – sought between quantity, accuracy, timeliness and relevance of information.

Triangulation – used to crosscheck and confirm data and to improve approximations, using several, often three, methods and sources of information.

Optimal ignorance is sought – meaning not trying to find out more than is needed, and not making inappropriately precise measurements. The collection of data that will not be used is avoided.

Biases are recognised and offset – for example biases of movement and contact which are spatial (where outsiders go), institutional (what organisations they visit), personal (who is met) and temporal (when they go, by seasons and time of day). Special efforts are made to meet those, often women and the poorer, who tend otherwise to be missed.

Team composition balanced – in terms of gender, discipline, and other dimensions, and team interactions are consciously managed.

Beyond these common features, PRA has added others, which have not been prominent in RRA. These include:

They do it – facilitating investigation, analysis, presentation and learning by rural people themselves, so that they own the outcomes. This often entails starting a process and then sitting back and not interviewing or interrupting.

Self-critical awareness – meaning that practitioners are continuously examining their behaviour, and trying to do better. Relaxing and not rushing - exploiting the paradox that taking plenty of time in PRA is often faster and better than trying to be quick.

Embracing error – meaning welcoming error as an opportunity to learn to do better.

Using one's own best judgement at all times – meaning accepting personal responsibility rather than vesting it in a manual or rigid set of rules.

Sharing of information and ideas – between rural people, between them and practitioners, and between different practitioners, and sharing views, training and experiences between different organisations.

A 4.4 Informal interviewing techniques

Many informal interviewing techniques are available. Some of the more useful are described below, although only a few would be applied in any particular study.

Key informant interviews

Key informants are individuals, who because of their position within the community, or specialised knowledge of a specific issue, can provide either a broad overview of the local social structures and farming systems, or specific information and insights on particular aspects of the local bio-physical and socio-economic environment. Potential key informants and their likely knowledge base are listed in Table 6.2 on page 22.

Group discussions

Group discussions with a spontaneous, non- representative assembly of farmers can yield quick understanding of farm-household situations. They can provide useful information on a wide range of topics including, for example:

- Normative information (eg. average yield) and variability.
- Features common to all farmers (eg. marketing channels, prices, general constraints).
- Community organisation and power structure.

- Local units of measurement.

- Changes in farming practices over time, perceptions of soil erosion, etc (PRA techniques, such as getting groups of farmers to draw maps, construct trend lines, do matrix ranking and scoring can be particularly useful in eliciting this type of information).

Iterative discussions
Iterative discussion is a form of communication that allows time for reflection, for both villagers and the interviewers. It can be pursued by means of village level participatory workshops in which extension agents, villagers, and technical specialists engage in a series of discussions. First, the villagers meet with everyone as a whole for an introductory session. After this, villagers may be divided into separate, homogenous groups, to discuss the same issues from the perspective of their own needs and concerns. Later the village is reassembled to discuss the issues further. At this point, the less outspoken village members, who have had a chance to speak apart from other villagers, are usually willing to air their differences and add perspectives. Several such sessions may be needed before the process is complete.

A 4.5 Additional RRA/PRA techniques

On occasion, more direct means of collecting data may be desirable. Four particularly useful methods are:

Topographic transects.
These are longitudinal or transverse sections of a particular area that show the relationship between the use and the bio-physical characteristics (soil type, drainage, slope, land form etc) of each land unit. They are particularly useful where there is a strong relationship between land use and topography, such as in mountainous areas. Whenever possible such transects should be undertaken as a participatory exercise with the planning team members and farmers walking the transect together. Such transects are useful in discussions with villagers to clarify local variations in land conditions and the corresponding differences in land management. A series of transect diagrams can be used to show major shifts in land use or land management over time.

Village mapping
A technique that is currently becoming very popular, involves asking a representative group of villagers to help in constructing a map, often by drawing it large-scale on the ground, of the main features of the village and its surrounding areas (eg. churches, health clinics and other main buildings, residences having families with specific characteristics, major roads and rivers, hills, major farming and grazing areas, major soil types, and areas of degradation). This information can then be recorded permanently on paper. This approach can be very helpful in giving information about the village, and in certain situations, could provide a useful way of drawing up a sampling frame for use in selecting farmers/fields for trials or more formal surveys.

Direct observation
The planning team, while moving through the project area, observes the farmers' fields, practices, circumstances, homes, and household activities. Such observations can be used for checking the validity of information obtained through farmer interviews. In this regard, the experience of individual team members will be critical in identifying the underlying causes of observable and stated problems. Such information often will suggest follow-up questions to reconcile any inconsistencies between farmers' statements and the team's observations. Through direct observation, major forms of land utilisation may become apparent. Buildings and other assets can serve as indicators of the wealth of a family. Nevertheless, caution needs to be exercised, because direct observation relates to one point in time and may not reflect a valid picture over a longer time perspective.

Learning by working
Physically working with farmers and doing what they do can greatly facilitate the exchange of information between technical specialists and farmers. As a result, it can lead to very meaningful collaboration. Working at farm tasks with farmers in their fields

will often elicit details a researcher or planner would not normally consider. Most farmers generally take their role as teacher very conscientiously. Learning by working can prompt changes in attitude by the technical experts. For instance would soil conservation technicians be so ready to recommend terracing if they had to do the construction themselves with only hand tools?

A number of other techniques are available that will not only ensure the collection of relevant data, but also help in its interpretation in such a way as to indicate the major characteristics and constraints in the farming systems being practised. Some of these are as follows:

Glossary of local terms
Compiling glossaries of local terms and concepts not only leads to improved communication, but often provides information vital to an understanding of local environmental conditions. The range of subjects that can be covered depends upon needs, but can include climate, time, soils, plants, topography, micro-environments, animals, insects, foods and diets, diseases, cures, pests, weeds, seasons, space, measurements, proverbs, social relations, and ceremonies. The insights obtained increase understanding of local beliefs and practices. They also improve communication through enabling staff to use categories and expressions that are locally familiar.

Minimum data sets
Minimum data sets are lists of essential aspects or indicators concerning a certain topic.
These checklists provide a framework for collecting information about that topic. Minimum data sets are developed to ensure that important aspects of a particular issue are covered. Well-defined data sets ensure that information irrelevant to the focused questions being asked is not collected to the detriment of the problems in need of analysis. Such checklists are particularly helpful when the interviewing team members are relatively inexperienced and need some guidance on the topics to be covered.

Tapping indigenous knowledge
In agricultural communities, there exists a dynamic and productive informal research and development (R&D) system. This system interacts with new technologies or organisational structures introduced from outside. Unfortunately, in the past, the importance of research and developmental activities by farmers frequently has been overlooked. However, their knowledge and contributions are now increasingly regarded as being critically important in developing solutions to the problems that are identified. Three interrelated types of information coming from informal R&D systems are:

- Technical and organisational innovations that make efficient use of resources scarce to farmers.

- Ideas for new research which scientists in the formal R&D system might start to work on.

- Methods for conducting cost-effective research and classifying knowledge.

Ranking techniques
A wide range of ranking techniques can be used to explore with farmers their perceptions of a particular topic, and to elicit the criteria by which they judge the value of particular benefits (eg. products) from on- or off-farm activities. These techniques are particularly valuable for demonstrating how the perceptions and beliefs of outsiders and informants are often radically different. Examples of the uses of ranking techniques include the following:

- Preference ranking: to make a ranked list from most preferable to least, with favourable and unfavourable criteria indicated for each item.

- Comparative ranking: to gather information quickly on seasonal or yearly patterns, indicating when a topic occurs most and least often.

- Direct matrix ranking: to rank several types of a certain item (eg. soil types, crop varieties, etc.) against a number of common positive and negative characteristics.

- Wealth ranking: to produce a ranked list of households according to wealth as perceived by the informants.

- Problem ranking: to produce a ranked list of problems and to generate a discussion about priorities.

Causal diagramming
This is a technique for determining and explaining the complex relationship between different causes and how their effects, individually or combined, lead to a particular problem. The various causal factors related to a problem can be linked into different causal chains. The causal diagram can be used to identify possible intervention points. The team, with the help of the farmers, then determines which have the greatest potential for solving the problem. It also can indicate what interventions are necessary before other potential interventions can have any effect.

Decision modelling
The reasons why farmers use certain farm practices or take certain household decisions are often complex and not readily apparent to outsiders. Modelling of farmer decisions can provide a better understanding of the decision criteria and can indicate certain “leverage points”. These are points in the farming system where there is scope for introducing improvements that are likely to be feasible and acceptable to farmers. By interviewing a number of farmers, either informally or formally, the decision criteria used for a particular decision can be identified. These criteria are then arranged in a flow chart in a logical manner, for example, in the form of a decision tree. By indicating the number of farmers that use each decision criterion, the decision model shows the relative importance of criteria in a particular decision. Furthermore, the model can be used to show how farmers explicitly weigh the relative importance of any two particular criteria.

Historical profile
A historical profile is a technique to view current problems within an historical perspective. Such a profile describes, for example, what major factors have directly or indirectly influenced land use in the area over time. These could include settlement history, increase in population levels, introduction of particular crop or livestock enterprises and practices, fluctuations in market prices for important crops or inputs, or colonial history. These factors can be plotted from a relevant time period to the present and compared with a similar historical profile that records when particular land use problems were first observed and any changes in their degree or severity since then.

Seasonal calendar
A seasonal calendar depicts those factors that are important at different times of the year in the production cycle and compares the factors to detect constraints and potentials. For instance, different land management activities can be highlighted and compared with seasonal profiles of labour needs and availability. Similarly, crop and livestock calendars can be drawn up, indicating major activities and stages in production. These can then be compared with seasonal profiles of climatic variations, ground cover, or erosion intensity.

Appendix 5. Farmer to farmer dissemination

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A5.1 The farmer field school approach

Farmers as experts
Learning by doing is the training approach used. Farmers learn by carrying out for themselves the various activities related to the particular farming/forestry practice they want to study and learn about. This could be related to annual crops, livestock/fodder production, orchards or forest management. The key thing is that farmers conduct their own field studies. Their training is based on comparison studies (of different treatments) and field studies that they, not the extension/research staff conduct. In so doing they become experts on the particular practice they are investigating.

The field is the primary learning material
All learning is based in the field. The potato/maize field, the pasture plot, the orchard, the woodlot or the forest area is where farmers learn. Working in small sub-groups they collect data in the field, analyse the data, make action decisions based on their analyses of the data, and present their decisions to the other farmers in the field school for discussion, questioning and refinement.

Extension workers as facilitators not teachers
The role of the extension worker is very much that of a facilitator rather than a conventional teacher. Once the farmers know what it is they have to do, and what it is that they can observe in the field, the extension worker takes a back seat role, only offering help and guidance when asked to do so. Presentations during group meetings are the work of the farmers not the extension worker, with the members of each working group assuming responsibility for presenting their findings in turn to their fellow farmers. The extension worker may take part in the subsequent discussion sessions but as a contributor, rather than leader, in arriving at an agreed consensus on what action needs to be taken at that time.

The curriculum is integrated
The curriculum is integrated. Crop husbandry, animal husbandry, horticulture, silviculture, land husbandry are considered together with ecology, economics, sociology and education to form a holistic approach. Problems confronted in the field are the integrating principle.

Training follows the seasonal cycle
Training is related to the seasonal cycle of the practice being investigated. For annual crops, this would extend from land preparation to harvesting. For fodder, production would include the dry season to evaluate the quantity and quality at a time of year when livestock feeds are commonly in short supply. For tree production and such conservation measures as hedgerows and grass strips training would need to continue over several years for farmers to be able to see for themselves the full range of costs and benefits.

Regular group meetings
Farmers meet at agreed regular intervals. For annual crops such meetings may be every 1 or 2 weeks during the cropping season. For other farm/forestry management practices the time between each meeting would depend on what specific activities need to be done, or be related to critical periods of the year when there are key issues to observe and discuss in the field.

Learning materials are learner generated
Farmers generate their own learning materials, from drawings of what they observe, to the field trials themselves. These materials are always consistent with local conditions, are less expensive to develop, are controlled by the learners and can thus be discussed by the learners with others. Learners know the meaning of the materials because they have created the materials.

Group dynamics/team building
Training includes communication skills building, problem solving, leadership and discussion methods. Farmers require these skills. Successful activities at the community level require that farmers can apply effective leadership skills and have the ability to communicate their findings to others.

Concepts and principles
Communications in extension have come to mean the marketing of informational packages. Messages are crafted to focus on a particular aspect, put on flip charts, the mass media, or on posters that are developed in central offices. In addition they may be disseminated to farmers via "model" demonstration farms where the farmer is effectively serving as a labourer, merely following the instructions of the research or extension worker. This is not education and use of these communication approaches does not educate a farmer, they treat him or her as a target. The farmer is used by others to implement their decisions in his or her field.

Education is the most important thing that an "extension" programme can do and the farmer is the most important person being educated. Within the educational approach, communication must take place at the field level, dealing with field issues in a dialogue with learners. The communications model cannot do this. However, it can be done within the context of the f**armer field school**. The field school deals not only with the practice that farmers want to learn about but also with farmers as farmers. Farmer Field Schools are conducted for the purpose of helping farmers to master and apply field management skills. The farmer implements his or her own decisions in his or her own field.

Problem-posing/problem-solving. Within this form of training problems are seen as challenges, not constraints. Farmers groups are taught numerous analytical methods. Problems are posed to groups in a graduated manner such that trainees can build confidence in their ability to identify and tackle any problem they might encounter in the field.

Field based education. Put farmers in a classroom and if they have been to school, what they remember is the bad times they probably had in the classroom. Education in the classroom can only mimic the natural world. Putting the classroom in the field allows the field to be the learning material and the farmer to be able to learn from real live examples. Putting the classroom in the field means that the educator (extension worker) must come to terms with the farmer in the farmer's domain.

Principles not packages. Educational programmes do not promote packages that present weekly, itemised messages. Educational programmes take a broad integrated approach to working with farmers based on the principles that farmers need to learn to be better farmers and optimise their incomes. The Farmer Field School approach teaches principles:

- any activity encompasses several principles
- principles bring out cause and effect relationships
- principles help farmers discover and learn
- principles help farmers to learn so that they can continue to learn.

Packages have nothing to do with learning and do not encourage learning, in the long run they are neither cost effective nor effective at improving the quality of farmers management skills. Skilled farmers can optimise yields independently of others. Packaged approaches increase the dependence of farmers on central planners.

Training driven research. Research must be responsive to field needs. By and large researchers have got it backwards. Research programmes in agriculture drive the extension or education programme that the research should actually be serving. What farmers need to know to be able to operate sustainably, both environmentally and economically should drive the research programme. In the Farmer Field School approach research is based on training needs or is a part of the training itself. Farmers can become a part of the research network supporting conservation farming programmes.

A5.2 Participatory information, education and communication

Participatory information, education and communication (PIEC) could be a key element in the promotion of better land husbandry within the context of participatory catchment management. PIEC would encourage the active participation of rural land users in the exchange of

information, both technical and cultural in nature, within and between rural communities. There are a number of informal and formal methods that have been used to enable farmers, rather than extension workers, to take the lead in disseminating information and directly training other farmers, notably:

Informal individual peer teaching – farmers who have developed, or adopted an improved land husbandry practice, could pass on their ideas and knowledge about the practice (through discussion, demonstration and practical teaching) to farmers in their immediate neighbourhood.

Informal group training – farmers who have developed, or adopted an improved land husbandry practice, could act as trainers for visiting groups of farmers from other villages, or they could participate as key resource persons in farmer workshops held in other communities.

Formal group training – experienced and innovative farmers could act as trainers in formal farmer training courses. This may require that they receive training on how to train other farmers and that they are involved in joint planning of the training courses (content, methodology etc).

Study tours – small groups of farmers, selected by their community, could visit local research stations, neighbouring agricultural/forestry projects, or farmers and farmer groups in other areas who have developed, or already adopted one or more improved land husbandry practices. The group would observe and discuss trials and experiences with adopting and adapting particular practices, in order to pick up ideas (about both the technology and experimental methods) they could try out in their own area. On return to their village they would share what they have learnt with others in the community.

Field days/exchange visits – field days could be arranged where by a group of farmers visit one or more farmers fields to observe and discuss the progress and results of on-farm (PTD) trials or experience with the adoption of an improved practice. Exchange visits would involve farmers from two or more different areas visiting each other's farms to observe, discuss and exchange information on what each group is doing.

Farmer workshops – farmers could be brought together within adhoc workshops to systematically assess their situation, prioritise their problems and to seek solutions. Such participatory appraisal and planning could be an important learning process for rural communities. Individual workshops may be restricted to groups of farmers selected on the basis of common problems and interests, or they may seek to be representative of the village/catchment as a whole. The latter being needed when the issues to be addressed require community, rather than individual household action (eg. the better management of communal grazing and woodland resources).

Regular group meetings (farmer field schools) – farmers involved in testing one or more potential solutions to a certain problem would meet together regularly (eg. every 2-3 weeks during the growing season for crop experiments, or critical periods for fodder availability for pasture improvement experiments). Preferably in the fields or grazing lands where an experiment is being conducted. During each meeting farmers would observe and discuss progress with the experiment and look at the possibilities for adapting and improving individual treatments. Such meetings would provide a forum for farmers to review problems with the trials and to seek possible solutions. The experience farmers gain from observing, measuring and discussing the trials could be expected to improve farmers' understanding of how and why to conduct and monitor experiments.

Community newsletters – simple cyclostyled community level newsletters could be produced by common interest groups, containing local news and information. This to be in the form of short articles, diagrams and cartoons (the latter to make the information accessible to non-literate members of the community). Such newsletters could be initiated with some external seed money and then sustained from sales

revenue, with the selling price determined by the local community. The under employed educated rural youth in the community could be encouraged to initiate and generate such newsletters along with innovative farmers and other pioneer members.

Peoples' theatre – the medium of peoples' theatre could be used to create awareness and disseminate information among farmers. This could involve small touring groups of actors or puppeteers, touring within the community and putting on performances, or members of the community themselves could be encouraged to role play and act out different scenarios in front of others. Such peoples' theatre could be low cost, popular (for both the participants and the audience) and often an effective way of putting over a message.

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