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ECONOMIC INCENTIVES FOR NATURAL RESOURCES MANAGEMENT

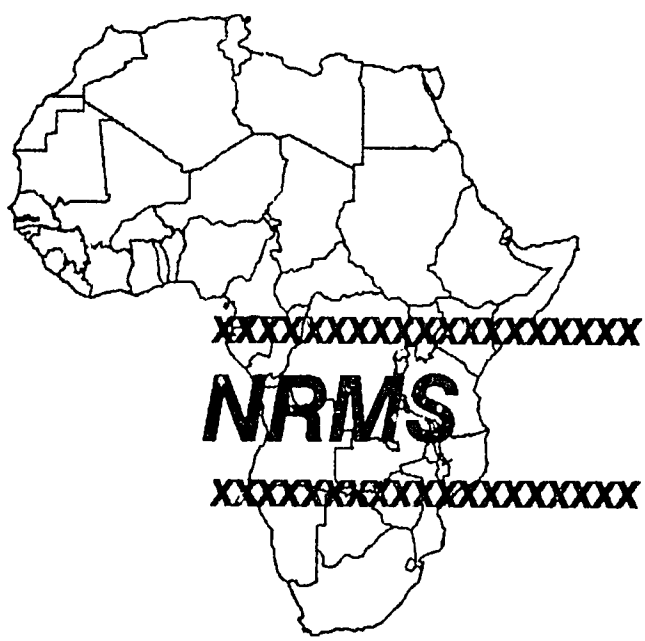
Kjell A. Christophersen, Team Leader, E/DI

G. Edward Karch, E/DI
Eric Arnould, E/DI

August 1990

Natural Resources Management Support Project
(AID Project No. 698-0467)

Contract No. AFR-0467-C-00-8054-00



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Prime Contractor:

E/DI
1400 I St. N.W., Suite 700,
Washington D.C. 20005

Principal Subcontractor:

Development Alternatives, Inc.
624 Ninth St. N.W., Sixth
Floor, Washington D.C. 20001

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EXECUTIVE SUMMARY

The purpose of this study is to foster improved designs of natural resources management (NRM) projects or programs that approach or achieve sustainable management and make local financial sense at the same time. Technical, off-the-shelf, solutions exist in abundance. Few, however, are implementable in the field because they are either too costly, too time consuming or there are policy, economic, sociological or cultural constraints that preclude their successful implementation.

In the past, project planning has suffered from inadequate attention to important detail. Too often simplistic cost-benefit calculations fail to capture differences in land quality and goals and motivations of African households. The results of such cost-benefit analyses have nonetheless been used to decide the merits of potential projects. Numerous field studies have shown that there is much more to NRM than cost-benefit analyses can accommodate. Analyses need to be richer both quantitatively and qualitatively. More planning precision from the farmer, donor and host country perspectives is required if a new generation of NRM strategies is to be credible.

The first and most important focus of the study is to understand the local perspective and to incorporate this understanding into the design of NRM projects or programs. The second and third foci are to address donor and host country investment requirements and benefits in the context of the NRM interventions to implement on-the-ground.

The emphasis of the study is economic (or financial) in the sense that the results are expressed in economic terms. Standard benefit-cost analysis is a most useful tool for assessing the relative attractiveness of alternative NRM interventions. NRM projects must and should compete with alternative investment opportunities without having to be "subsidized" to make them more attractive. The level of detail and care with which the assumptions are developed for the farmer perspective B/C analysis, however, should be considerably higher than the norm. In Africa, the difference between what will or will not work, or between financial feasibility or non-feasibility, can often be traced to one or several sociological details that many analysts would rarely consider let alone take into account in an analytical context such as the social status, age and gender of participants and the distinction between the value of wage and non-wage labor.

- Local perspective

Local farmers, herders, local village associations, etc. are the key players in the development process. They are the intended primary beneficiaries of the proposed NRM activities. Therefore, the many local realities and issues that affect the probability of success of NRM activities in Africa should be recognized and addressed by project planners. Examples include:

- Different households and household members perceive risks, uncertainties and rewards of NRM initiatives differently than those reflected by the usual assumptions employed in most project planning documents. Risk applies in more ecologically stable regions where performance of the NRM interventions is less an issue for participants than are returns to investments. Uncertainty applies to regions suffering from unpredicatble environmental stress. Here farmers have no way of knowing how proposed interventions will perform. Donor uncertainty can be reduced if the proposed practices have been successfully applied elsewhere. Success with new practices will transform farmers' uncertainty into economic risk over time. Understanding how local people respond to environmental risk and uncertainty over time will have implications for choosing target farmers for participation in NRM and for anticipating spread effects of extension work.

- Security of land and tree tenure for local participants, guaranteed by the host country government, is critical to the success of NRM interventions. Without it, people have little incentive to participate in the proposed schemes. Secure tenure does not have to be in the form of private property ownership as in the west, however. In designing NRM interventions planners need to understand and take into account resource tenure regimes in each circumstance.

- Local participation. This is an essential precondition for success with NRM interventions. Local resource managers must be involved in all steps: diagnosis, experimentation, evaluation, and diffusion. Site specific treatments should be directed by local resource managers rather than be predetermined by outsiders. Therefore, local resource managers, host country staff, and donor experts should experiment together in the field to determine which technical assistance and extensions mechanisms -- model site visits, participant-led extension, etc. -- will work best.

- Policies. Farmers' decisions to participate in NRM initiatives are often inseparable from "macro" level variables over which they have little or no control. Planners must identify and plan to defuse policies which explicitly or implicitly cause or favor resource "mining" or otherwise condition the success of NRM interventions such as tax, pricing, and legal constraints to investments in resources. The most important policy measures needed to bolster improved NRM in Africa are those which complement and reinforce the tactics which farmers and herders find most useful in coping with environmental uncertainty, including resource tenure and agricultural pricing reforms.

o Donor perspective

The NRM objective is sustained long-term improvements in management of the natural resource base. The farmer objectives include increases in crop or wood yields and income by way of improved management of natural resources. Therefore, the donors'

and host country governments' goals should be to provide the conditions (incentives) to adopt improved resource management schemes. Reducing risk, diffusing information and inputs, and providing policy and economic incentives for participation in improved resource management are key conditions.

Donor investments must be specified for all of the conditions (or "packages") to be provided. What is important is that the planner thinks through the entire process and makes adequate provision for the required donor inputs. The investments are usually made in the forms of short and long term TA, local payroll, infrastructure and supplies (buildings, vehicles, office supplies and equipment, etc.), and extension and training. Occasionally, in situations of extreme degradation or economic stress or distrust, it is also necessary to provide direct financial incentives to farmers to encourage participation in the project or program.

Planners need also to consider benefits to donors to be derived from investments. Included are reductions in food aid obligations and other forms of relief aid, and improvements in biomass and biological diversity which contribute to reducing global environmental problems.

o The host country perspective

The host country -- the third NRM partner -- is also expected to make investments in NRM. Few projects pay serious attention to the recurrent cost burdens left behind. Unfortunately, most African countries cannot provide for new recurrent costs in the national budget. Governments will continue to rely on outside donor support unless they can trace and capture some of the many benefits resulting from the NRM interventions. These benefits can be used to cover the recurrent costs of sustained commitment to NRM interventions.

Host country benefits are of two kinds: those difficult to quantify and those which the persistent analyst may and should quantify. Examples of the former include preservation and restoration of the productive resource base of the country. Examples of the second type include improved tax payment rates, and income from licenses, taxes, and other payments made on transactions and transportation involving surplus production stemming from improved NRM.

How to capture and use at least a portion of these benefits to pay for the recurrent costs is the difficult problem. New line items will have to be set up in the national accounting system to ensure that a percentage of new tax, licensing and permit revenues be used for natural resources activities.

o The spreadsheet model

In the annex of this report we have added a detailed commentary of the spreadsheet analysis version of the development

process described in the main body of the report, and a diskette. The model, including the farmer, donor and host country perspectives, provides planners with the opportunity to specify assumptions with much greater care to better reflect local field realities. Also included in the model is a random probability function to account for variability in environmental. The unknown factor is when and how hard environmental stress will hit. Good and bad years occur in patterns that are difficult, if not impossible, to predict.

1. INTRODUCTION

1.1 Background

This study presents a pragmatic approach to analyzing the financial, economic and socio-economic feasibility of investments in natural resources management (NRM) from the perspectives of the local resource manager, donor and host country. It deals with the process of transition from small to large scale NRM efforts -- what are the features, conditions and adaptations required to make small scale successes work equally well on a larger scale? In short, what are the key variables or considerations to take into account when planning NRM activities? Our aim is to facilitate and infuse practical field-level realities into the design of NRM projects and programs. While individual sources are not cited in the text, the references listed at the end of the report have been used heavily.

Natural resource management experts (foresters, agronomists, sociologists or anthropologists, wildlife experts, economists, etc.) are paid to recommend to decision makers how the stewardship of natural resources can and should be improved to achieve long-term sustainability. As they develop these important recommendations, however, the experts are faced with a complex maze of sociological, cultural and economic considerations, uncertainties and data gaps that they should consider, but often don't, because of time and cost limitations, perhaps they consider them irrelevant or insignificant, or, because the required expertise is missing from the team. Project planning has suffered from inadequate attention to important detail as a result. Too often, simplistic benefit-cost calculations that fail to capture the differences in land quality or goals and motivations of participants, have been used to decide the merits of potential projects or programs. Planning and analyses need to be richer both quantitatively and qualitatively. More planning precision from the local resource manager, donor and host country perspectives is required if a strategy is to have credibility.

The overall purpose for this study is to provide a more pragmatic and detailed approach to NRM project and program planning.

Basic to the approach is the importance of understanding the local perspective and to incorporate this understanding into project design. Analysts, planners and decision makers should understand that while technical solutions to NRM problems are abundant, only a few will actually be implementable locally and embraced with enthusiastic participation. Projects or programs designed with little participation from the local population (for whose benefit the projects are intended) almost universally do not succeed. Local participation is essential, farmers will not participate unless there is "something in it for them" (1).

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(1) For ample documentation of the merits of the "bottom-up" approach, see, for example, the Sub-Sahelian Regional Assessments, SSRA (Shaikh et al, 1988), Rochette (1988), and Segou (1989).

The report contains five sections and one annex. Section 1 lists the objectives of the Special Study and provides an overview of the approach taken. The farmer perspective of NRM interventions is discussed in Section 2. This discussion includes local level decision-making processes that affect farmers' resistance to participation in "outsider" sponsored NRM activities. Sections 3 and 4 present the donor and host country perspectives on NRM activites respectively. All of the elements are summarized in Section 5 including also some recommended next steps for USAID and host countries. The Annex presents the computer analysis planning tool including all of the elements and variables discussed in this report.

1.1.1 Objectives

The objectives of this study are:

- To improve the process of designing NRM projects or programs;

- To equip USAID and host country planners and decision makers with field oriented and pragmatic analytical tools to analyze NRM interventions;

- To show how probable investment magnitudes for farmers, donors and host countries required to achieve NRM targets should be estimated.

1.1.2 The Study Team

The study team consisted of:

- Kjell A. Christophersen, Natural Resources Economist and Team Leader;

- Eric Arnould, Cultural Ecologist;

- G. Edward Karch, Agroforestry, Forestry and Computer Modeling Specialist

1.2 Approach

1.2.1 The Analytical Mechanics

The mechanics of the analytical approach are simple -- use whatever detailed "hard" and scattered information that exists on NRM interventions under different site specific conditions to the maximum extent possible. To this end, we identify functional relationships known to exist based on field observations and documented research, and less well documented but probable functional relationships. For example, we know that properly installed contour dikes will have a near immediate impact on crop yields, but we do not know by how much except in a few isolated cases. It depends on soil type, the steepness of the slope, crops

grown, rainfall, the distances between the dikes, and many other factors. We also know that Acacia albida trees evenly distributed in farm fields will increase crop yields, but again we do not have all the data required to predict yield increases over time. We may know about isolated cases where crop yields have been shown to increase by 30 percent after seven years but we do not know when yields begin to increase, nor if and when they begin to taper off as the trees grow to maturity. The available (scarce) data tends to be site and intervention specific, limited to single observations, and does not lend itself to generalization. Further, research data is also subject to different levels of statistical confidence so that inferences drawn can never be exact.

The analytical planning tool accompanying this report provides for maximum use of available data by creating "hooks" for insertion of both existing and needed but currently unavailable data. This way, the planner will be able to simulate relationships when the data is not available. For example, if one data point is available -- 30 percent crop yield increase after seven years as a result of planting and protecting Acacia albida trees -- we can simulate crop yield changes before and after assuming that crop yields follow a sigmoidal pattern correlated with the growth and maturing process of the trees. This is not a perfect system, to be sure, but at least one that attempts to incorporate field realities into the planning of NRM activities. It certainly would be unrealistic to assume a constant 30 percent increase in crop yields over the relevant time period beginning suddenly in year seven.

1.2.2 The "Actors"

There are three main "actors" to consider when designing and implementing better NRM projects or programs: The local people (farmers, herders, woodcutters cooperatives, etc.), the donors, and the host countries.

All three are expected to make certain investments in order to realize the benefits of the proposed NRM activities. The farmer is expected to invest his or her time and money (putting in windbreaks, contour dikes, living hedges, etc.); the donors will "prime the pump" by investing in technical assistance, institutional strengthening, training and extension, infrastructure, etc., and the host country will provide land, key personnel and, most importantly, commit to covering the recurrent costs of the project to ensure that project activities continue in the future.

1.2.3 The Process

The process (covering all three actors) is summarized in the following three steps:

1. Identify NRM interventions that are practical and implementable locally and assess the technical and financial feasibility from the perspectives of local resource managers. This is the most important step. The local resource managers (farmers,

herders, etc.) are the ones to be convinced that our proposed improved land management schemes are worth their while or are realistically implementable. If we propose something to which they are not attracted, they will not participate.

2. Determine donor costs and benefits. It is not sufficient to design projects to replicate only the technical NRM interventions that may have proven to be successful locally. Successful NRM interventions are site specific because they are applied under different conditions. Their success depends on the biophysical (land, flora and fauna), economic (capital and labor), social (land-use practices, customs) and political (management rules) resources which vary between sites, regions and countries. The conditions that made the interventions successful in the first place must also be addressed and, if necessary, replicated. For example, farmers will be more prone to participate in land improvement schemes if they are assured of secure land and tree tenure. Added to this condition are the assurances of markets for any surplus production and, perhaps most importantly, the availability of a critical mass of trainers in the "how-to's" of the intervention(s) proposed. Most of these conditions necessary to attract participation can probably be met through short- and long-term technical assistance, extension and training, policy reform -- whatever it takes to implement effective NRM interventions. Counted as returns on investments to the donors may be the impacts the interventions have on global warming, and projected reductions in food aid distribution because of the increase in sustainable farming. These impacts are quantifiable to some degree and could be included in the spreadsheet analyses.

3. Determine host country costs and benefits. This step addresses the issue of sustainability. The donors provide funding for only a relatively short period of time, after which the host country should continue with the activities. Donors will leave behind vehicles, infrastructure and key personnel (extension agents, etc.) which have recurrent cost implications. Vehicles will have to be maintained and eventually replaced. Buildings will have to be maintained, office equipment will eventually have to be replaced, and office supplies will have to be replenished, etc. When the donor support ends, the recurrent cost burdens begin.

How to pay for the recurrent costs is the major problem. Benefits from the interventions accruable to the host country must somehow be captured and channeled back to cover the recurrent costs of managing the resource base. The process outlined in this report identifies many benefits to the host country from investments in NRM interventions. They include, for example, reductions in the default rate on taxes, reductions in emergency relief and relocation expenditures since farms will be operating on a more sustainable basis, increased revenues from transaction (marketing) fees taxes, increased revenues from transportation taxes and fees, and others. As these benefits are quantified and counted, the door is also opened to capture at least a portion of the benefit stream to pay for the recurrent costs of the project. The process developed in this study will allow planners the flexibility to

analyze several donor investment/host country recurrent cost scenarios to determine the recurrent cost implications of the investment packages proposed.

The end product of this effort is a decision-making and management tool that should be continuously updated as new information becomes available. The text of the report provides the context, the annex provides detailed commentary on the analytical model -- the management tool. This tool allows use of available empirical information to the maximum extent possible and identifies important data gaps. Project planners will be able to trace the probable economic and/or financial consequences (tradeoffs) of the NRM scenarios they wish to test. They will be able to tailor the donor's approach and unblock identifiable constraints to successful replication of interventions on a larger scale.

1.2.4 The Menus

The different land-improvement options from which local resource managers, woodcutters associations, herders or other local resource managers can choose, comprise the "menus" of NRM interventions to be analyzed. For the farmer, the options considered fall into two broad categories: soil and water conservation interventions, and soil fertility enhancement interventions. The former includes water harvesting schemes such as contour dikes or check dams, and the latter, fertilizer (organic and chemical) and agroforestry (alley cropping, windbreaks, field trees, living hedges) schemes. The intensity of the interventions will vary with different sites. Some sites require the installation of highly labor-intensive interventions, others can get by with much less. The analyst should determine which categories of interventions to apply, in which combinations, and at which levels of intensity.

A second "menu" refers to the donor and host country provision of conditions necessary to ensure success in the field. The analyst must identify which conditions will be necessary and the best way to provide them. To this end, the analyst will plan for timely long- and short-term technical assistance, provision of necessary infrastructure (buildings, vehicles, etc.) and any required extension and training.

1.3 The Dilemma of the "Non-Quantifiables": A Cautionary Note

Adoption of a NRM perspective on the part of donors and host countries implies that planners and decision makers acquire a better understanding of the results -- the net present values (NPV). For many, if not most NRM projects, these results are not bottom line answers on which decisions should be based, although they are often interpreted as such.

NPV results are only a reflection of the data used -- the quantifiable costs and benefits. Crop and wood benefits, for example, are easily quantifiable because they are physical quantities multiplied by real market prices. Forest-related

benefits (medicines, vitamins, food, forage, beauty products, etc.) are quantifiable to the extent they are sold in local markets.

Costs and benefits that are impossible or too costly to quantify, however, are just as real and important, yet they do not contribute to the NPVs. For example, forest-related values -- scenic, religious or symbolic values -- are nearly impossible to quantify accurately, as are watershed management benefits where upstream activities impact downstream agricultural productivity. Indeed, many NRM interventions may be suitable for local resource managers whose goals and motivations often differ from those of donor and host country analysts, planners and decision makers. Ex ante performance of a project should be judged not only by productivity (that which can be quantified and used in NPV calculations), but also sustainability, stability (constancy of production), and equity (distribution of investments and products among participants in the resource management systems).

Planners and decision makers should be provided with as much information on the non-quantified elements of the project as possible. Analysts should be rigorous, therefore, in listing and describing these elements so that they enter into the decision-making process, perhaps strengthening the competitiveness of investments that may have low rates of return based on the quantifiable information alone. NRM projects with low or negative NPVs, therefore, should not be automatically rejected (2).

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(2) In addition to the NPV, the internal rate of return (IRR) is also a commonly used measure of a project's attractiveness. One should be cautious when using this approach, however, since it is flawed and may give wrong answers. Under certain cash flow patterns, for example, (positive cash flows followed by negative cash flows) it is possible that the IRR approach produces multiple answers.

2. LOCAL PERSPECTIVES ON INVESTMENTS IN NRM

2.1 Introduction

In this section we discuss the development process from the local perspective -- what has been learned about the many social factors and local level issues that condition the success of NRM interventions. These social factors and local issues must be given due consideration in the planning process.

Local people (farmers, herders, village associations, etc.) are the key players in the development process -- the primary beneficiaries of the proposed NRM interventions. They are not homogeneous groups or organizations, however, which should be recognized and addressed by project planners. Several important issues concerning the heterogeneity of African households, that analysts should consider, are discussed below. Some of these factors or issues lend themselves to quantification, some do not.

2.2 African Households

Planners must understand and account for the varied complexities of the African households' decision making-processes.

African households are the ultimate stewards of the natural resource base. Unless they are involved in the planning and implementation processes from beginning to end, the NRM interventions will suffer for lack of local participation. It must be their project, conceived for them with their participation, with something concretely "in it" for them before a donor or host country can be assured that local participation will be forthcoming.

African households are not identical, of course, which complicates the analytical process. Individual and/or collective household stewardship of natural resources differs widely depending on the quality of the resources, local needs, and social and cultural practices. These differences in management -- the social nuances between different local groups that determine why an activity will work well in one area and not in another -- are all site- and case-specific differences. They must be understood and taken into account by planners to ensure realism in the development strategies proposed. We cannot use simple averages or aggregates because they have little meaning to farmers in their local decision- making process. Different households perceive risks and rewards differently than those reflected by the usual assumptions employed in most project-planning documents.

Understanding the differences in NRM from the household perspective is complicated at best. Households in different regions produce crops, pool, redistribute, and transfer resources, build shelters, and consume natural resources in different ways. Their management systems often consist of nested use, management and inheritance rights, and nested benefits. Benefits and costs of

NRM are often overlapping, or communal so that no single household can easily take individual NRM action without affecting others.

For example, the introduction of improved sorghum varieties may make perfect sense from the researcher's perspective, but not necessarily from the collective households' perspective. It may have to be an all or nothing decision -- all farmers participate or no one does -- because of bird damage to the crops on both the early and late maturing varieties. Since farmers usually plant and harvest at the same time they lose roughly equal shares of their crops per hectare from bird damage. If some varieties mature early, the distribution of birds in the region will first concentrate on early maturing varieties and then on the later maturing varieties. Everybody loses. This illustrates that one cannot always count on local participation if an element of the proposed NRM program is unrealistic.

Also important to consider by the planners are the interwoven sets of rights and benefits which tend to vary by productive task both on and off the farm and often by season. Group membership, rights, obligations, benefits, and tasks will change over time as household groups form, evolve, and eventually disappear. These intricate patterns of overlapping rights often constrain NRM investment decisions in many ways. What is important to understand is that every NRM intervention proposed will probably have both winners and losers. The winners pose no problem, the losers do. For example, the conversion of floodplain areas into irrigation perimeters will identify irrigation farmers as winners and herders as losers if the floodplain areas are also used traditionally for dry season grazing. How to compensate the losers becomes a key element in the decision-making process if the interventions proposed are to have credibility.

2.3 Resource Tenure

Secure land and tree tenure for local participants, guaranteed by the host country government, is critical to the success of NRM interventions.

Without secure land and tree tenure, people have little incentive to participate in the proposed schemes. Secure tenure does not have to be in the form of private property ownership as in the west, however. Historically, African households have cooperated in systems to manage both private and common property resources (forest, rivers and pastures) in ways not based on the principles of western property ownership.

In the present, such collaborative local control and management of natural resources is more the exception than the rule. Competition for the shrinking resources is closely correlated with rapid increases in human and livestock populations and persistent economic stagnation. The "tragedy of the commons" is very much in evidence where common property resource rules are disputed and resources are overused, sometimes to the point where restoration becomes impossible. Sets of access and use rights and

responsibilities granted by the state to the households or user groups need to be well defined and institutionalized before sustainable NRM can be achieved. Transfer of usage rights from the state to the user groups is best accomplished through contracts including clauses ensuring sustainability of land management.

Security of tenure is not necessarily resolved with the registry of formal titles to land or trees, or simply changing the rules of resource use rights. Accompanying any such new rules are the costs of their enforcement, often far too high. Further, attempts to impose patterns of resource use different from local tradition may trigger increased or decreased use of resources based upon criteria developed at "the top" rather than at the village or regional level.

In designing NRM interventions, therefore, planners need to understand and take into account resource tenure regimes in each circumstance. For example, water harvesting installations on uphill fields may have both positive and negative effects on downhill holders (reduced threat of erosion or preventing water from moving downhill during droughts). Open access resources must be protected against exclusive use attempts and steps must be taken to avoid degradation caused by overexploitation. Overgrazing by livestock belonging to absentee owners is an example of the type of abuse that needs correction. Management regimes, rules of access, exclusion and partitioning proposals will have to be negotiated. Often, considerable political will must be exercized to establish and enforce new rules. In some cases, donors may have to seek alliances within host country governments and use the attainment of policy benchmarks and conditions precedent to release funds for project activities in order to gain compliance with management plans.

To resolve these complex tenure issues, budgets should be included for technical assistance to redraft rules concerning natural resource management, access, and partitioning. The concepts of "amenagement de terroir villageois (management of village land resources)," watershed management units, and the like are promising developments in common property resource management which do not arbitrarily impose western concepts of private property on local African resource managers. They may be contrasted with top-down systems of land resource allocation which often provoke conflict.

The redrafted tenure rules should seek to reinforce the traditional household and communal relationships and procedures to ensure that conflicts among the resource users (individual households or communal user groups) are minimized. Where reformed systems of resource management and access rules can be negotiated, people are more apt to invest since investments in social relations are characteristic of African economies. Guaranteed access to a resource by a given group of users is the best incentive for members of that group to participate in mangement and upkeep costs. Access need not be exclusive, but without it, participation may be expected to be lower and costs higher. New NRM projects are bound

to experience difficulties in setting up such systems. A good place to start, however, is to support and adopt innovative systems already established and in use by local organizations in the region, if they exist.

The resource tenure issue is always addressed and studied by project planners as something that must be resolved to ensure a successful project. Few, however, suggest concrete ways of resolving the problem other than through sweeping policy changes that are impractical in the short run. What may work instead are specific negotiated and contractual agreements between local resource user groups and the affected ministries that grant secure tenure to participants in the target region only, as a pilot effort. If such experiments work well they can be expanded to other areas, and eventually throughout the country. Although this process may take a long time, it is a more realistic way of fostering policy change. The special agreement between the Government of Niger (GON) and the Guesselbodi National Forest woodcutters cooperative, for example, took several years to achieve. Now that the experiment has succeeded, similar agreements are being executed between cooperatives and the GON for other national forests. This is a process that allows both the government and the local participants to make necessary adjustments over time in resource allocation and management.

2.4 Decision Making and Benefit-Cost Analysis

Use standard benefit-cost (B/C) analysis as the tool for assessing the relative attractiveness of alternative NRM interventions.

The argument often made that economic efficiency rules should be suspended or relaxed for NRM projects is self deceiving. NRM projects must and should compete with alternative investment opportunities without having to be "subsidized" or otherwise receive special treatment to make them more attractive. What is different about NRM projects, however, are the many benefits that cannot contribute directly to the NPV results because they cannot be quantified, or are too costly to quantify, as discussed in Section 1 above. It would be incorrect to reject a low, or perhaps even negative NPV NRM project on the basis of the quantifiable information only when there is more value in the project than indicated by the NPV results.

We can quantify benefits where there are markets. Local resource managers, however, may have totally different priorities than to produce commercially marketable products. From their perspective, they may wish to manage for religious reasons (sacred woods, etc.) or to promote species that have high local market values or high substitute costs (traditional medicines, for example). The NPV results in these cases will understate the value of the activities because of the fact that the values generated, although very much in evidence, are not readily quantifiable. Planners should use the quantifiable information to the maximum extent possible, but also recognize that the NPV only gives a

partial result which should be supplemented with detailed qualitative discussions of the additional non-quantifiable benefits of NRM interventions.

The level of detail and care with which the assumptions are developed for the local perspective B/C analysis should be high. In Africa, the difference between what will or will not work, or between financial feasibility or non-feasibility, can often be traced to one or several sociological details that many analysts would rarely consider let alone take into account in their analyses.

One such detail may be the issue of social status. For example, villagers considered to be the original inhabitants may have the right to plant trees, make investments in or derive certain benefits from the land that later arrivals may not have.

Another detail is the issue of gender and age of the available labor force and whether group rather than individual labor is more appropriate for the activities considered. Analysts will normally assume that a particular activity will take, say 100 days at a cost of $2.00 per day and that the activity will take place in year 1, without regard to the gender and age or group versus individual labor issues. Men, women and children are not equally efficient workers; their wages differ, and, most importantly, they are not always available to do the work. Availability of labor is seasonal and determined by gender and age.

Suppose the proposed NRM intervention calls for weeding in the forest during the rainy season, and only the women (never men) in that village weed. Chances are that women will not be available because they are too occupied on their farms. Or, if the women are available, but their cost per day is $3.00 reflecting a higher opportunity cost of labor, perhaps because of the availability of better alternative employment opportunities for women (marketing or making crafts, beer, etc.), the cost of the activity should be $3.00 per day, not the $2.00 as assumed above. Often, women's groups work where individual labor fails because of group dynamics, sense of purpose, rallying to achieve a target, etc. The groups may receive a collective reward for its work which may differ from the "going wage rate" for individual labor. These labor value differences can make or break the financial feasibility of the NRM intervention for the farmer or local resource manager. The assumptions used in the analyses, therefore, must reflect a thorough understanding of the local perspective.

Another detail that should be considered by the analyst is the valuation of non-wage labor -- family members -- who work but are not paid. Many would argue that imputing monetary values to non-monetary costs such as family labor does not reflect the decision making process of African households. Where non-wage labor is mobilized for NRM interventions, for example, productivity (efficiency) is often lower and does not conform to what one would expect from a farm based on wage labor. Further, investment decisions will be based on the compromise among the needs and

resources of all members of the household, not the household head alone.

That non-wage labor is often used and is perhaps less efficient but more reliable than wage labor, can be reflected in the model's assumptions if the analyst is aware that this condition is, in fact, realistic for the project region. Similarly, investment decisions based on communal (not individual) needs should not pose any analytical problems. The point is that the degree of confidence one can place in a B/C analysis will vary with the analyst's sophistication in dealing with such variables as the homogeneity and level of value consensus of the local population, age and gender based distinctions in labor costs, and the alternative preferences of young and old, men and women, household heads and others. In general, what cannot be quantified in a cost/effective manner should nonetheless enter into the analyst's judgement so that the kinds of interventions proposed are practical and implementable locally.

Assumptions are expressed in monetary terms, even though actual cash often does not change hands. There is a cost associated with non-wage labor (man, woman or child) at least equal to what they could earn through alternative employment opportunities. The values we impute to man, woman or child labor depends on the season and on alternative employment opportunities. When the labor force is occupied, during the farming season, for example, non-wage labor costs may be derived on the basis of the value of the crop(s) produced by accounting for the number of man, woman and child days it takes to produce the crops. Total value of the crops divided by the number of man, woman and child days, equals the average value of time. During the off season, the value of time can be based on alternative employment opportunities such as roadside selling of fuelwood, marketing, wage labor, etc. for the target participants.

In summary, while there is no reason to analyze NRM activities in any different or preferential way, decision makers should recognize the limits of the NPV results. In addition, analysts must develop all farmer level input assumptions with great care so that the assumptions reflect local realities. Analysts should be aware of and account for the gender, age and availability of labor when estimating labor costs. As mentioned earlier, farmers are usually asked to make their investments in the form of their (and their families') time. These time investments will vary depending on the intervention, the season, availability of alternative employment and who will do the work (gender and age). Other, less quantifiable, complexities of African households such as the efficacy of decision making authority, as they relate to labor availability and costs, should be described qualitatively.

2.5 Decision Making Over Time in Response to Environmental Stress

Include random probability function to account for variability in environmental stress.

The purpose of NRM interventions is to reduce the probability and severity of environmental stress. The unknown factor is when and how hard the environmental stress will hit. Good and bad years occur in patterns that are difficult, if not impossible, to predict. Planners should, however, account for the eventuality of both good and bad years by including random probability functions in the analyses. Analysis of the same NRM interventions using identical cost and benefit assumptions, therefore, may generate different results. With this approach, planners will also be able to determine the investment levels required to "cover" the bad years and minimize risks to participants and host governments.

Deal with questions of risk and uncertainty, who will be the key NRM innovators under different levels of environmental stress.

When developing NRM strategies, planners must deal with not only risk, but also with farmer uncertainty about how the new practices will work. Risk refers more to ecologically stable regions where performance of the NRM interventions is less of an issue than are the investment returns. Uncertainty refers to regions suffering from unpredictable environmental stress where farmers have no way of knowing how well the proposed interventions will perform. Uncertainty can be reduced if the proposed practices have been successfully applied in regions where conditions are similar. Success with the new practices will begin to transform uncertainty into economic risk over time. In situations where uncertainty prevails, poorer farmers are more likely to innovate than richer farmers. They have less to lose. Where economic risk is the dominant factor, some well-off farmers are more apt to adopt new practices.

It is probable that adoption of NRM interventions will eventually taper off. As farmers in degraded ecosystems become convinced that their improved NRM efforts will enable them to obtain the cultural minimum subsistence standard of living, they will have incentives to adopt the NRM interventions. Once they produce this amount, however, there will be less incentive to invest additional resources to do more of the same. Some households, especially larger ones, may begin to invest their labor resources elsewhere. Adding new NRM activities will then enable people to diversify and increase their benefits. Supposing the existence of market outlets for products of NRM investments, some, but not all farmers will make further NRM investments.

Understanding how local people respond to environmental risk and uncertainty over time will have implications for choosing target farmers for participation in NRM and for anticipating spread effects of the extension work.

2.6 Macro-Micro Linkages

Identify and defuse policies which explicitly or implicitly cause or favor resource "mining" or condition the success of NRM interventions.

Farmers' decisions to participate in NRM initiatives are often inseparable from "macro" level variables over which farmers have little or no control. If policies which either explicitly or implicitly favor resource mining are in part responsible for ecological deterioration, as seems clear in the literature, then policies do indeed condition the success of NRM initiatives, their maintenance, diffusion and replication. A number of important conditions critical to the design of NRM projects or programs are listed below:

o The structure of government levies. For example, discretionary fining for alleged violations of government resource use rules promotes antagonistic relationships between local resource managers and government authorities. Fees for extension services rendered by agents are apt to promote a more conducive climate of cooperation to good resource management;

o Rules of entry, access, partitioning, and exclusion related to land and other resources. When rules are imposed from above, they frequently wreak havoc with traditional or local level rules of resource use. All things being equal, security of tenure is the sine qua non of successful NRM investments;

o Farmers' access to rural financial markets, i.e., credit. Without credit of some form, investments in NRM become impossible for most farmers, especially women farmers;

o The assurance of access to markets for the products from the NRM interventions. Such assurance makes the proposed NRM interventions that much more attractive;

o Agricultural import and export policies often affect producer prices. If prices are set too low to clear markets in a timely fashion there will be little incentive to participate in the proposed NRM interventions. Cheap urban food prices discourage people from investing in increased production.

2.7 NRM Technical Assistance Delivery Mechanisms

Work closely with local resource managers to determine NRM needs and how best to resolve them through extension and technical assistance.

As discussed earlier, local participation is an essential precondition for success with NRM interventions. Local resource managers must be involved in all steps from diagnosis of the problems to diffusion of the technologies. Site specific treatments should be decided locally rather than be predetermined by outsiders. Local resource managers, host country staff, and donor experts should experiment together in the field to determine the best technical assistance mechanisms. A strong link is needed between the local participants and project staff, particularly the extension staff. The capacity of projects and extension workers to meet the local participant needs will depend on how well the

technical interventions are packaged and accommodate the kinds of conditions discussed in Section 1 above. They include the establishment of local institutional structures as needed, a favorable policy environment, etc. -- which, in turn, are dependent upon an adaptive, iterative bottom-up approach to implementation.

NRM extension can be based upon a combination of techniques including model sites (visiting other sites where the interventions have succeeded), and user-driven extension. The model sites technique involves bringing potential participants to a site to observe first hand "what can be". The model (site) may be anything that has worked well -- the innovations of an individual farmer, a successful demonstration farm -- etc. Field days are an example familiar to agronomists. Site visit participants include both extension agents and potential farmer participants. Local consultants (i.e., farmers and extension personnel) explain the intervention to the visitors. After the model site visit, it is anticipated that participants will be predisposed to undertake similar initiatives if other conditions are present. There is no better extension worker than the farmer/herder who has participated in a successful activity.

Successful NRM activities usually involve user-driven extension techniques. The user-driven approach entails local training in packaged extension modules. Modules are developed from needs expressed by the population to extension personnel. Village area diagnostic evaluations of NRM problems are one forum for identification of this kind of extension need. Unlike the model sites approach, trainers and training are brought to participants by extension personnel. Key elements of the approach include: extended diagnosis of environmental problems, identification of extension needs; creation of voluntary participant groups; identification of local group leader/contact; elaboration of input needs by participating group; modification of the extension module; training of trainers; regular extension visits over the course of the activity; monitoring and follow-up; group evaluation of the extension exercize.

3. THE DONOR PERSPECTIVE

3.1 Introduction

In this section we change the analytical focus from the farmer to the donor. When reaching this level we will have analyzed the proposed interventions from the farmers' perspective and determined that they are (or are not) financially feasible and socially acceptable. The donor perspective begins where the local perspective ends. To successfully mobilize local investments (by farmers, herders, etc.), however, the donors must do their part. They must help host countries provide the conditions in order for the technical packages to work in the field.

3.2 Donor Funded Conditions

What are the conditions? They represent the "packaging" of the technical NRM interventions, or the investments required (in addition to those made by the local resource managers) to ensure that the technical interventions will achieve the objectives of the investments. The NRM objective is sustained long term improvements in management of the natural resource base. The farmer objectives include increases in crop or wood yields and income by way of improved management of their farm fields.

The goal of the donors and host country government should be to provide the conditions (incentives) for local resource managers to adopt the proposed improved resource management schemes.

These conditions may include (but are not limited to):

o Secure tenure or usufruct rights over the products of improved resource management;

o Training and education

o Reduction of risk through the provision of credit or grain banks or other means;

o Convenient access to markets;

o Assurance that host government enter into good faith partnership arrangements with local farmers, producers' associations or cooperatives.

o Opportunities for farmers to make informed decisions about intervention options based on visits to model sites.

o Strengthening local organizations that contribute to economic development. This may include long term 3rd country training for host country personnel, provision of some infrastructure (vehicles, buildings, equipment, etc.), aid to local NGOs and farmer groups and short term training for extension staff.

3.3 Donor Investments

Costs must be determined for all of the conditions (or "packages") listed above, to be provided by the donors. What is important is that the planner thinks the entire process through and makes adequate provision for the required donor inputs. The investments are usually made in the forms of short and long term technical assistance (TA), local payroll, infrastructure and supplies (buildings, vehicles, office supplies and equipment, etc.), and extension and training. Occasionally, in situations of extreme environmental degradation, economic stress or distrust, it is also necessary to provide direct financial incentives to farmers to encourage participation in the project or program. If the interventions are financially feasible on their own merit, the donors should not have to provide any direct financial incentives. If not financially feasible on their own merit, opportunities will be identified so donors can share the costs of the interventions with the farmers to the point where they become financially attractive to the latter. Following are brief discussions on the kinds of investments required for each of the conditions listed above.

3.3.1 Secure Tenure

Unless farmers are assured that they own the fruits of their labor they will have little incentive to participate in the proposed interventions.

In many African countries, there is no secure land and tree tenure and farmers have little interest in land improvement schemes. If sustained management of natural resources is to be accomplished, the condition that farmers fully benefit from the land improvements they carry out must be guaranteed. In this case, the donor may have to budget for TA to carry out special studies that provide implementable solutions. Tenure and protection issues will have to be resolved through negotiation with all affected resource users. Restrictions on access may have to be imposed.

3.3.2 Training and Institutional Strengthening

Local resource managers are the ultimate stewards of the natural resource base. They must receive appropriate training in the "how-to's" of improved stewardship of the resources under their control.

To give an example of how this process works, suppose the NRM objective is to achieve sustainable management of rainfed agriculture in a region covering 250,000 cropped hectares. The region contains 100,000 farm households for an average of 2.5 ha of farm land per household. Suppose also that it has been determined that the optimal "prescription" for achieving the objective over a 20-year time frame consists of a combination of contour dikes, windbreaks and Acacia albida plantation and protection. This recommendation will have been derived after extensive study of successful small scale efforts in the region, financial feasibility

studies, etc., where farmer perspectives have been incorporated. In other words, all of the important guidelines and issues discussed in Section 2 above will have been addressed.

The farmer perspective analyses will show the technical details of what to do at the farm level, when, how much it will cost the farmers in terms of time and cash, and the expected flows of benefits over time. What should be the role of the donor? An obvious area of donor investment is in extension and training. If 100,000 farm households are to be asked to practice improved land management by way of contour dikes, windbreaks and Acacia albida, they must be trained in the appropriate technologies. It follows then that the project will also have to provide a critical mass of trainers who can, in turn, work with the farmers in their fields. Training of the extension staff, therefore, becomes one of the conditions that can be financed by the donor.

To provide the appropriate training, we must know how many extension agents to train; how long, where, when and how often to carry out the training, what the extension agents will need to do their jobs -- material, equipment, and transportation needs, etc. -- and how many retraining sessions will be required when and where. But it does not stop there. Extension agents trained and funded by the project for the project's duration must (ideally) be absorbed by the host country government after the project. They will need regional supervisors who, in turn will be supervised by ministry level department heads, etc. For X extension agents there should be Y supervisors and Z supervisor managers and so on up the pyramid structure.

The strengthening of institutions must occur at all levels so as to avoid implementation bottlenecks after the donor support has ended.

As we move up the pyramid, donor funded training of the supervisors or the managers will be of a different nature. Supervisors may attend workshops locally or in third countries. Managers may obtain graduate degrees in US or European universities, etc., all with donor funding.

All of the above have cost (investment) implications for the donor. Technical assistance may be required to conduct the initial training and retraining sessions where budgets must be prepared for the consultants' salaries, travel and per diem, rental of workshop facilities, per diem for the participants, field trip costs during the workshop period, etc. Budgets must also be prepared for the provision of the agents' salaries and other needs until the host country government and/or local associations are prepared to assume a share of the recurrent costs.

3.3.3 Reduction of Risk

Donors must recognize and account for the element of risk in farmer decision making processes.

Subsistence level households are typically risk averse. They know that their present farming systems will produce enough to feed their families under normal conditions, but rarely any surplus to sell. Now, if someone from the "outside" comes to the village with proposals to increase farm productivity, it is not certain that farmers will embrace the proposals with enthusiasm. Why? Because anything new and unknown implies a risk. And, if the experiment fails, there is no insurance against the risk.

There are many ways donors can reduce farmer risks: providing direct financial incentive by paying farmers to participate (UNSO project in Niger where farmers are paid for Acacia albida seedlings protected); providing matching grants (USAID reforestation project in Senegal where USAID shares the cost of tree planting with farmers); providing funds on credit to construct and stock grain banks to take advantage of volatile grain price fluctuations during the year, and train personnel in grain bank management; providing funds to establish rural credit systems that allow farmers to purchase necessary inputs and to pay back the credit after harvest.

3.3.4 Access to Market

Without convenient access to markets, increased production of food, wood, or other products as a result of the application of NRM interventions, has little meaning.

Another key condition is to ascertain that products (increased crop and wood yields, etc.) will have readily accessible markets. The "economic engines" of the NRM development strategies are monetary benefits generated from increased productivity. These values are important incentives that attract participation. The challenge for the donor is to ascertain that the economic engines are real, not fictitious. A garden project to grow onions and tomatoes as cash crops, for example, will not be meaningful if no effort is made to locate convenient markets. Efforts to increase orange production in the Fouta Djallon region of Guinea may have been highly successful technically, but what has really been gained when half of the orange crop rots every year for lack of access to markets? The planner must consider this and other conditions and make the necessary provisions such as improvement of rural roads, fabrication of carts to haul the products to market, construction of temporary storage facilities, establishment of crop banks, etc., in short, whatever it takes to realize the full benefits from the interventions.

Donor assistance to improve access to market may entail a package including: TA to determine rural road improvement and other transportation, and infrastructure needs (warehouse facilities, etc.); budget for actual road improvement work (local labor requirements, rental of heavy equipment, if necessary, etc.), construction of warehouse facilities, acquisition of required vehicles (carts, etc. provided through a credit system or some similar arrangement), commercial loans to haulers and transporters and training of warehouse managers.

3.3.5 Partnership Arrangements

Special project specific partnership arrangements between local resource users and the government will often be required to bridge the gap between current policies that may be be contradictory to the application of improved NRM practices, and the eventual change in the policy itself.

Donors may also find it necessary to budget for technical assistance to explore ways of securing special partnership arrangements between resource users (households or cooperatives) and the government where current legislation or policy does not adequately cover the proposed NRM interventions (1).

3.3.6 Model Sites

Interaction between local resource managers in different regions is often a most effective extension tool.

Bringing farmers from region X to model sites or model farmers in region Y to observe, up close, where, how and under which conditions certain NRM practices can be successful is one of the most effective extension tools available. One example is Malian farmers traveling to Maggia Valley in Niger to observe the CARE windbreak interventions and to receive TA in the how-to's of establishing windbreaks in their fields when they return. Donors should budget for this kind of technical assistance.

3.4 Donor Benefits

Identifying and accounting for benefits accrued directly to the donors as a result of the NRM interventions may increase donors' willingness to fund the proposed activities.

Are there other incentives for the donors to make the NRM investments in addition to achieving development goals? If the donors "prime the pump" by financing the conditions that accompany the technical interventions, it seems that they cover costs only and receive none of the direct benefits. The direct economic benefits accrue to the intended beneficiaries -- the farmers, local organizations and the host country.

USAID (and other donors), however, may also benefit directly from NRM investments. Two obvious benefits are briefly discussed below:

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(1) Examples include: a) USAID's Forest and Land Use Project (FLUP) in Niger where a special agreement was signed between a Ministry and the local woodcutters association permitting the latter to carry out sustained yield, controlled exploitation of the Guesselbodi National Forest, and b) special permission to carry out prescribed burning when the law explicitly prohibits burning, as in the Dinderesso National Forest near Bobo Dioulassou, Burkina Faso.

o The gradual reductions in food aid distributions to the country as sustained management of the resource base is achieved over time. Freed up food aid supplies can therefore be distributed elsewhere.

o The extent to which the NRM interventions have an impact on the problem of global climate change. The majority of NRM interventions involve trees, naturally regenerated or planted, which fix carbon and, therefore, help alleviate the global warming problem. Every new ton of woody biomass grown may contain as much as 500 kilos of carbon which offsets 500 kilos of carbon released through the burning of fossil fuels. When adding the potential millions of hectares in Africa where natural forest management, tree planting and/or agroforestry schemes can be applied, that much more carbon fixing biomass will be produced. The problem at this stage, however, is determining the value of each ton of carbon fixed from the donor's perspective and what this may mean in terms of a donor's propensity to fund NRM projects in Africa on the basis of this perceived value.

The analytical planning tool accompanying this report (in the annex) incorporates the long term impact the interventions may have on both food aid distribution and global climate changes. It allows the project planner to factor these benefits into the analysis by assigning values to the food aid supplies saved and the tons of carbon fixed over time.

4. THE HOST COUNTRY PERSPECTIVE

4.1 Introduction

The host country -- the "third actor" or NRM partner -- is also expected to make investments. During the donor supported phase, the host country will provide (make available) land, some personnel, and perhaps office space, the usual host country contributions to a donor supported project. In this section we discuss host country investments with a particular emphasis on the recurrent costs after the donor support has ended. Also discussed are the many qualitative and quantitative benefits the host country can expect to receive as a result of NRM interventions in addition to those accrued to the local resource managers directly.

4.2 Recurrent Costs

Few projects pay serious attention to the recurrent cost burdens left behind. This important issue has been treated far too lightly. Examples of recurrent costs include:

- Continued operating, maintenance, and eventual replacement of donor provided vehicles, equipment, buildings and other infrastructure;

- Absorption of project funded personnel such as extension agents and supervisors;

- Continuing retraining workshops where appropriate;

- Continuing long term third country training of professional personnel to compensate for the natural attrition of personnel over time.

It is reasonable to say that all activities provided by the donor, even the expatriate long term technical assistants, have recurrent cost implications. There are flexibilities, to be sure, such as getting by with fewer, less expensive and more economical vehicles when the donor provided vehicles need to be replaced. The pressure will always be to minimize the recurrent costs. What is important is that all recurrent cost implications of a set of proposed NRM activities should be held clearly in focus by the project planners.

Ideally, the donor's role is to make the necessary investments to get things started -- "priming the pump" -- over a relatively short period of time, after which the host country continues without any outside donor support. If the project or program planning is done carefully, proper account will be taken of the recurrent cost burdens of the proposed activities and provisions made to include them as line items in the national accounts when the donor support ends.

The ideal, however, is rarely attained. In most African countries, provision for recurrent costs will rarely be made in the national budget because the funds are not available.

Governments will continue to rely on outside donor support unless they can trace and capture the many benefits resulting from the NRM interventions, in addition to those accruing to the local resource managers directly.

These benefits thus captured can be used to cover the recurrent costs. The direct benefits to the farmers include harvesting bigger crops, being able to take advantage of seasonal crop price fluctuations by way of the grain banks, having easy access to credit, and being able to keep their current farm fields in production much longer. The benefits accruing directly to the government are discussed below.

4.3 Host Country Benefits

The host country will benefit substantially from successful NRM investments aimed at achieving sustained management of the natural resource base.

Host country benefits are of two kinds, those difficult or too costly to quantify, and those which the persistent analyst may and should quantify.

Benefits of the first type are of capital importance. They are often the basis for the quantifiable benefit stream, and, in fact, provide much of the rationale for NRM investments.

4.3.1 Qualitative Benefits

o Preservation and improvements in the productivity of the resource base. The most important benefit to the host country is the preservation of the national resource base which is the primary source of national wealth for most African nations. This has been recognized by many governments in recent legislation aimed at reducing resource degradation.

o Improvements in inter-ethnic relations and relationships between government and citizens. Improved and more secure access to resources, and heightened, sustained resource productivity will reduce conflicts between resource users that often result in resource mining and over-exploitation. Improved management regimes, based on cooperation between government agents and local resource managers, reduce enforcement costs and increase popular support for national regimes.

o Reduction in the extent and duration of rural-urban migration. Improvements in the productivity and income generating potential of rural resources contribute to stabilizing rural populations and reduce the relative attractions of city life (cheap

food, cash income) for them. Limiting urban growth limits the burden on government to provide urban services (water, sanitation, health, electricity).

o Reduction in social welfare costs associated with the consequences of persistent enivronmental stress. Innovations in resource management which contribute to the ability of local populations to cope with environmental stress lead ultimately to a reduction in social welfare costs which accrue to host country governments (relief supplies and logistical support, resettlement costs, costs of treatment of nutrition related diseases).

o Improvements in local economic activity and standard of living. Where NRM interventions have been successful, the impact of the financial engines on local economic activity have in some cases been substantial. For example, revenues from sesame production and transformation in The Gambia, wood-cutting at Guesselbodi (Niger) and cotton production in southern Mali have resulted in increased local economic activity in addition to investments in the resource base.

4.3.2 Quantitative Benefits

A number of the benefits which accrue directly to host governments can and should be quantified (but usually are not). Project planners should derive baseline revenue data from annual statistical yearbooks and the like to project the impact of successful NRM on national accounts. Some of these quantifiable benefits include:

o Marketing fees. Agricultural economists estimate that from 10 to 20 percent of agricultural production in Sahelian countries enters the market economy. Agricultural produce is subject to market fees levied on virtually every transaction involving the product. Taxes are collected at every level -- farmers who sell to bulk agents who sell to wholesalers who sell to retailers. As NRM interventions improve agricultural yields, it may be expected that increments to production above subsistence requirement (e.g., 260 kgs/millet/person/year) will end up in the market system. If the current rate of taxation is known or can be calculated on a per unit basis, the increased benefits accruing to the government from increased productivity can also be calculated.

o Licenses and fines. Improved natural forest management as practiced at Guesselbodi in Niger released a series of benefit streams for the national forest service. Included were a share of the cutting permits sold to wood cutters, transport licenses issued to wood transporters by the wood cutters cooperative, and fines levied against herders and woodcutters who violated the terms of the co-management agreement. The forest service accrued several thousand dollars annually from these sources while significantly reducing its management and enforcement burden; the cooperative policed itself and the forest. Other income could be derived from the sales of contract grazing permits in this or in less degraded natural forests. Estimates of potential income based upon the

comparative productivity of forests that are currently being managed in Africa could provide a basis for calculating potential benefits from new interventions. Licenses and fees could be calculated on the basis of production per stere, tonne or cubic meter.

o Commercial permits. Governments issue commercial permits to transporters and wholesale merchants that are usually subject to annual renewal. It is possible to develop ratios of the number of transporters and wholesale merchants who operate relative to the weight or volume of commodities produced and/or the population in an area. Projected increments in yield of crops, wood, or forage could be expected to increase the number of transporters and wholesale merchants proportionately. On this basis government can project revenues through new permits and licenses and highway taxes.

o Tourism. Departments charged with management of the national parks keep records of the number of tourists who visit them, as do hotels. Improvements in parks management, with resultant increases in natural fauna and flora may be expected to draw increased numbers of tourists. Hotel occupancy rates will go up. Visting fees and hotel taxes will go up accordingly. The multiplier to apply to each tourist dollar spent should be determined to estimate its contribution to the local economy in the production of goods and services.

o Reduction in the tax default rate. In many agriculturally based African countries, the default rate on the flat rate tax is often high. People do not have the cash to pay the tax. It stands to reason, therefore, that if sustained management of and increased incomes for the region containing 100,000 farm households (as in the example above) are achieved, there will be a gradual reduction in the tax default rate as more farmers adopt the land improvement practices; i.e., more people will pay their taxes. Assuming a head tax of $5.00, a default rate in the region before the project of 40 percent, and a projected default rate with the project of 35, 30, 25, and 20 percent for each five-year segment of the project, the direct benefit to the government will be a total of $1.25 million over the 20-year period. The information on the initial default rate is probably available. The assumed reductions in the default rates over time would have to be estimated.

4.4 Capturing The Benefit Stream

How to capture and use at least a portion of these benefits to pay for the recurrent costs is the difficult problem. The beneficiaries are widely disbursed, not easily identifiable and therefore cannot be billed or taxed directly for services rendered as one can for electricity and water consumption. The difficult task will be to convince governments to establish line items in their national budgets to provide for the recurrent costs of donor funded NRM activities. Local forestry funds, for example, where the revenues from the forests are directly linked with the management of the forest, are a step in the right direction. It is

important to determine (by way of well designed studies) the extent to which NRM interventions will add to the state's treasury (in addition to the increase in the economic well-being of the region), and thus to provide well-researched and documented reasons for the argument that at least a small percentage of the (now richer) national treasury be made available to cover the recurrent costs of the NRM activities.

5. STEPS IN THE PLANNING PROCESS: SUMMARY

5.1 Introduction

The planning process presented in this study reflects a much more detailed set of functional relationships (between the inputs required for the interventions and the outputs) to allow project planners and decision-makers to test the realism of NRM scenarios and to determine the level and type of support required to assure local particpation.

This section summarizes the steps of the planning process as discussed in the text of the report. The summary can be used as the checklist of the kinds of information the analyst must collect in the field. Additional details for specifying variables and relationships are provided in the annex commentary on the model spreadsheets.

The planning process developed in this study is imperfect, to be sure, and should be updated, revised and adjusted as new and better information becomes available. Recommendations to this end are also included in this section. For the time being, however, the computer model accompanying the report can accommodate the best information available and should be used to guide the analytical process.

5.2 The Steps

5.2.1 The NRM Assessment From the Local Perspective

This is the project identification stage -- the assessment of the environmental, economic and social problems and identification of possible NRM solutions.

o The assessment will identify interventions that have succeeded on a small scale as proposed "first cut" interventions to replicate and adapte on a much larger scale. Windbreaks, for example, may work well in Region A and will probably work well in region B if the windbreak technology and the donor "packaging" of the technology are adapted to region B socio-economic and biological realities. The technology adaption may consist of different species, or different spacing between the trees, etc. The "packaging" adaption may be in the form of securing tenure and usufruct right over the trees, or some other condition that will have to be fulfilled before the intervention will have a chance to succeed. The analyst must be aware of and take these differences between regions A and B into account.

o The analyst must fully specify the farmer costs -- cash outlays and time -- of establishing and maintaining the interventions. How much labor will it require, when, what kind of labor (gender and age), how often, etc. If seedlings have to be purchased, how much will they cost delivered to the site (nursery cost of the seedlings plus the labor cost to carry X seedlings from the nursery to the planting site).

o The analyst should list and attempt to quantify the benefits (to the local resource managers) generated by each option.

o The analyst should conduct a number of runs of the data combining various menu options to determine their impact on crop yields. Recall that the model uses a random number generator keyed to expectations about variation in key environmental variables such as rainfall to determine impacts on productivity over a 20-year time horizon.

o The analyst should consider the availability of labor for all proposed NRM interventions. This includes careful study of the characteristics of the farm households in the target region and match them with the interventions to be analyzed.

5.2.2 Define Target Area

At this stage we know which technical NRM interventions or combinations of interventions have a reasonable chance of succeeding. The next step is to define the target area -- where the potential for improved management of the natural resource base is high. The definition should include information drawn to a large extent from the NRM assessment (step 1), with the addition of more region specific details such as:

o No. of hectares
o Land types (soils, slopes)
o Use patterns (arable land, natural forests, range, etc.)
o Cropping patterns, associations and crop yields
o Natural forests, species composition, stocking densities
o Range characteristics, carrying capacity, animals currently using the range
o Land use conflicts
o Environmental problems including salinity, alkalinity, fertility, erosion, etc.
o Rates of resource degradation over time

5.2.3 Policy Dialogue

Many will probably argue that policy dialogue should be the first step in the process. In this study, however, we have chosen to include it as a third step, following the field assessments and recommendations on what to do from the technical standpoint. The policy dialogue, therefore, enters <u>in the context</u> of what you propose to do to improve NRM -- to flesh out if and where effective implementation of the proposed set of interventions may infringe on or be constrained by, current policies or laws. It is self-evident that local resource managers will not be inclined to participate in NRM interventions if there are no incentives to attract their participation. The major incentives, of course, are the increased crop and wood yields resulting from improved land management. But, these are not real incentives if the farmers have no secure right to receive the fruits of their labor. It has to be clearly demonstrated to the local resource managers that the host country

will provide the necessary incentives to attract participation. Through dialogue with key government officials, therefore, answers to the following several questions must be obtained by the analyst:

o Tenure. Do resource users perceive themselves to have tenure or usufruct over the resources to be exploited? If not, what are the policy options for securing tenure in return for responsible management?

o Credit. Are there mechanisms in place to reduce the financial risks (credit or cost sharing) from investments in the NRM interventions, especially those having medium and long term effects? Access to credit for farmers is already well established in some countries, in others it exists but is weak, yet in others it is non-existant. Where it exists but is weak, the donor may have to strengthen it to increase its effectiveness. Where it is non-existant, the donor may have to support the creation of a project specific credit system.

o Private Sector. To what extent are local cooperatives, associations, or other private sector initiatives supported by the host country as a means to encourage local resource managers to participate in improved land management schemes? Does the government encourage the development and implementation of contracts and partnerships with local communities involved with the management of natural resources, as was done in the Niger Guesselbodi project, for example? All of the elements or "packaging" to allow this experiment to succeed were created for the project.

o Fines or extension. Is the government more apt to enforce regulations (fines) or provide services (extension)? Fines are often a source of direct revenue for both the collecting agent and the government. Income depends on the occurrance of violations. The higher the incidence of violations and fines, the higher the revenues -- a vicious circle. The option is to reduce the incentive to violate the law through improved NRM. If so, the income from fines will decrease. Certainly, this is not what the fine collectors would want since they are allowed to keep a portion of the fine as an incentive to catch the violators, nor what the government would want unless the void from the reduced revenues can be replaced by revenues from other sources. The burden on the project planner, therefore, is to identify direct and quantifiable benefits resulting from the NRM interventions. These include (also discussed in Section 4 above), but are not limited to, a probable reduction in the tax default rate, increased revenues from permits, transaction fees, etc. as the increased crop and wood yields are sold and transported through market channels.

o Model site visitations and other extension activities. Does the government encourage (backed up by funding capability) innovators to develop and adopt new technologies and encourage farmers to visit other innovators so that they can make informed decisions? This question also relates to the government's

propensity to work with local resource managers to encourage them to practice improved NRM.

o Analytical capacity. Does the government have the expertise to analyze the costs and benefits of policy options? What sort of training or technical assistance will be necessary to help them develop this capability? Every policy question addressed in the preceeding paragraphs has benefit and cost implications. Where the policy is too weak, it must be strengthened to accommodate the proposed NRM interventions to make success possible.

Who determines what needs to be done, and what are the benefit and cost implications of the actions required? These questions are the very reason for this study. The planning tool accompanying this report facilitates the process of analyzing the benefits and costs of options to determine what is or is not financially feasible from the perspectives of the local resource managers, donors, and host countries. This same analytical capability should be present among host country personnel and not always be provided by the donors. One should not continue to rely on expatriate short term "experts" to design projects or programs and carry out the analytical work -- to come up with "solutions" based on a three-week tour of the country -- and expect them to succeed when implemented. First, qualified host government experts must be bona fide members of the design teams. Second, the host country, not the donor experts, should have the best understanding of the problems, suggest approaches to resolve them, and be able to identify the benefits and costs of the proposed activities.

5.2.4 General Information Requirements

At any point in the process, the planning team should collect detailed information for each NRM intervention to be tested on several variables such as real discount rates applicable to local resource managers and the donor and host country, all relevant price and cost information and real cost and price appreciation/depreciation rates over time. Real rates should be distinguished from nominal rates. Real rates are not influenced by inflation. For example, although the price of a good may have increased nominally by 10 percent per year, the real price will actually have declined if the average rate of inflation during the same time period was higher than the average nominal price increase.

5. Donor Perspective

Next, the analyst must determine where and how much the donor will have to invest. For each component of the project or program, the following information on the cost side must be sought:

o Long and short term TA needs by kind of expertise, for how long and when, to ensure that project components function smoothly.

o Long and short term training needs by kinds of expertise required, to which educational level, for how long and when. As discussed in previous sections, there is a "pyramid" strengthening of institutions that must take place. Extension agents must have supervisors, who, in turn, must be managed by trained personnel higher up the ladder. Ignoring this "pyramid" strengthening will ultimately create bottlenecks in the capacity of the host country government to carry on with the activities once the donor support has ended.

o Infrastructure costs as they pertain to the requirements of the project/program. This includes estimation of turnkey building costs per m3, CIF costs of any materials, vehicles, to be procured; gasoline, diesel prices per liter, etc. and the operating costs associated with procured materials (maintenance, replacements, etc.).

o Wage rates for donor funded payroll, per diem and overhead costs.

On the benefit side, the analyst should estimate (as discussed in Section 3):

o Reduction in food aid commitments in the target region to the extent of increased food production in the region in response to the NRM interventions.

o NRM forestry interventions (agroforestry, natural forest management, etc.) increase the production of carbon fixing biomass and thus help alleviate the global changing climate problem.

5.2.6 Host Country Perspective

On the cost side we estimate the recurrent cost burdens for the host country after donor funding has ended. Whatever the donor provides has recurrent cost implications as discussed in previous sections. Essential personnel funded by the donor must be absorbed in the national budget, vehicles, equipment and other infrastucture must be maintained and eventually replaced, extension agents must go through refresher courses, etc.

The analyst should also identify benefits to the host country as a result of the interventions. If the benefits to the host country are not higher than the recurrent costs over the long run, there is little incentive for the host country to support the activities regardless of how attractive it may appear from the farmers' or donors' perspectives. Several host country benefits for which information should be collected by the analysts include:

o Tax default rate over time. What is the current head tax rate and what is the default rate. Assumptions will have to be developed and justified how the default rate will decrease over time as the NRM interventions are applied.

o Licences, fees, permits and taxes (from entrepreneurs, transporteurs, etc.). As productivity in the target region increases so will the collection of licences, fees, permits and taxes. The analyst should determine the current ratio of entrepreneurs (from whom these revenues are collected) to the volume of product (crops) transacted through markets. This ratio can be applied to the increased productivity in the region as a result of the NRM interventions to determine the influx of additional entrepreneurial capacity in the region.

5.3 Next Steps

The recommended next steps are of two types. Those related to improved specification of variables and relationships included in the planning tool, and those related to testing the model.

5.3.1 Variables and Relationships

Land rent is included as an investment cost in the options menu. It is a difficult variable to understand, however, since it often relates to customs and traditions, not only to the economic use value of the land. The present model only provides the "analytical hook" for including land rent without providing for any understanding of which kinds of payments may be required in various circumstances and to what extent such payments resolve the constraints to investment associated with various land and resource tenure arrangements.

A great many questions remain about the impacts of extension efforts. The model assumes that extension effectiveness is a curvilinear function through time, gradually tapering off after some time. We do not know, however, what shape this curve may take in different contexts and with different interventions. We also need more information on the spread of innovations between farmer-innovators and other farmers. What is the expected life of an extension program when donor support ends? What is the impact of any retraining of extension agents upon a national extension system when donor support ends?

We have attempted to identify and account for benefit streams to donors and host countries. A lot more work could be done to develop other ideas and to more fully specify the values involved. What is the head tax default rate in a given context? What would a decrease in the default rate mean in actual dollars?

While the tool is designed to model interventions which will improve the productivity and sustainability of resource management, we are not, in fact, able to quantify important dimensions of these processes. How much will a given set of interventions reduce the rate of soil degradation, crop lodging, evaporation, nutrient loss? At what point, if any, do interventions, return more to the non-human environmnent than they remove?

A major benefit of providing many analytical "hooks" in the model is the attention it automatically focuses on the many data gaps which become evident as the project planner prepares the cases for analysis.

5.3.2 Testing the Tool

USAID should finance testing of the NRM project planning tool in several locations. Field teams should revisit several of the successful NRM sites reported on in the Sub-Saharan Reginal Assessments (SSRA), in Rochette, or at the Segou Conference. Specific data should be collected in order to complete the model to make it as useful as possible.

USAID should finance research to determine impacts of NRM interventions on productivity and production over a series of years from data available in the field. Arrangements with local project staff to collect simple indicators of productivity and production at selected sites should be made.

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ANNEX 1: DISCUSSION OF THE SPREADSHEET

This annex describes the analytical planning tool that accompanies the report. The software used is QUATRO PRO which is compatible with Lotus 123. We assume that the user has an IBM compatible computer with at least a 20 MB hard disk, 640 K RAM and the Quatro Pro software. The model can be installed on the hard disk by creating a NRM subdirectory and copying all the files from the diskette (accompanying this report) to it. Alternatively, use the diskette by setting the default directory to drive A (or B).

All functional relationships discussed in the report have been hooked up in the model and discussed further in this annex where appropriate. Note that the figures appearing in the tables presented in this annex are dummy data and are used for illustrative purposes only.

The modeling framework is menu driven, consisting of three major modules:

1. Soil and moisture conservation module;
2. Labor module;
3. Project planning module.

The "engine" is the soil and moisture conservation module. The interventions to implement on-the-ground dictate the kinds of labor needed and the kinds of investments required from the donors and host countries. The soil and moisture conservation and labor modules should be activated first since they address the technical and local perspective elements of the NRM interventions to be analyzed. The planning module should be activated once we know which NRM interventions to recommend for implementation by whom, and how. The orientation of the model is economic (or financial depending on how the assumptions are specified). The results are expressed in net present value (NPV) terms based on detailed input assumptions reflecting local field realities or alternatively, in terms of breakeven quantities of crop or wood yield increases required to recover the investments.

We emphasize that the model is not the end product, or the "centerpiece" of this special study, it only facilitates the analytical process. We emphasize also that field observations should not be confined only to the data the model can accommodate. The model will allow the planner to infuse a great amount of detail into the analyses, but perhaps not all he/she feels is needed. Additional refinement of the model should be made following field testing of the current version when additional information has become available. For the time being, the model is useful in that it provides a detailed and extensive checklist of the kinds of information a planner should ideally have at his/her disposal to carry out realistic analyses.

The model provides as many "hooks" as possible for inputing data we know to exist, or need but do not yet possess. Examples include the provision for including crop or wood yield changes over

time in response to NRM interventions even though such detailed information is rarely documented in sub-Saharan Africa. As discussed elsewhere in this report, the analyst may be able to synthesize yield functions if one or two hard data points are available using research results obtained from similar experiments, theory and local knowledge about the productivity of the site where the interventions are to be implemented. A major benefit of providing many analytical "hooks" in the model is the attention it automatically focuses on the data gaps that become evident as the project planner prepares a case for analysis.

I. Soil and Moisture Conservation Module

A. What You See on the Screen

The soil and moisture conservation module is contained in 13 basic tables. The input assumptions tables, reflecting details the analyst must consider when planning for NRM interventions, start in cell A1 and continue downward using the "page down" button. The results tables begin in cell K1 and continue to the right as you use the "tab right" button.

Table I-1 is the interventions menu -- the NRM options available for analysis. Table I-2 is a general assumptions table (not intervention specific) covering economic, crop yields and prices, and soil degradation and climatic assumptions are given in Table I-3. Table I-4 show input assumptions for the interventions (only one is illustrated and discussed in the text below). Table I-5 shows the assumptions pertaining to the synergetic impacts on crop yields attributable to different combinations of interventions. Tables I-6 - 13 show the results. Tables I-6 and I-7 show the behavior of the physical crop yields over time without and with interventions respectively. Tables I-8 and I-9 show the incremental and total dollar value changes, by crops, over time attributable to the interventions respectively. Table I-10 shows the incremental dollar value increase over time by intervention. The investments required to realize these incremental value increases are shown in Table I-11. The farmer perspective investments and cash flows over time, including the farmer perspective NPV, are shown in Table I-12. The last table in this module, Table I-13, shows the break-even results. These results are applicable when there is little or no confidence in the anticipated (assumed) crop yield increases attributable to the NRM interventions.

B. Discussion of the Module

The soil and moisture conservation module is designed to trace the changes in the productivity of agricultural lands as a result of NRM interventions. Other modules that may be added later include natural forest management (tracing the changes in the productivity of dry tropical forests and grazing land), and a biodiversity module (tracing the changes in the productivity of faunal communities in conjunction with the economies of their human user and managers).

o Table I-1: Interventions menu

The intervention menu consists of several proven field NRM interventions from which project planners can choose (Table I-1):

TABLE I-1 ON FARM AGROFORESTRY & SOIL AND MOISTURE CONSERVATION MODULE

Intervention Menu			
Field trees	FT	on	NPV
Organic fertilizer/compost	OF	off	$86
Chemical fertilizer	CF	off	
Alley cropping	AC	off	
Crop residue application	CR	off	
Soil and moisture conservation	SM	on	
Hedge rows, living fence	HG	off	
Windbreaks	WB	off	
Vegetation Bunds	VB	off	

The interventions can be switched on or off in any combination to determine their individual or collective impact on the environment. The list may be extended later to also include interventions such as: bee-keeping, sesame seed production and oil extraction, fruit orchards, salt intrusion dams, green manuring, and others. The NPV in the upper right hand of the table gives a quick glance at the result applicable to all "on" interventions.

o Table I-2: Financial assumptions

Table I-2 lists financial (or economic) assumptions not specific to any particular NRM intervention. It includes the discount rate, price and cost appreciation rates, fuelwood and pole prices and land rent. The discount rate reflects farmer perceptions of risk and uncertainty. The more innovative the proposed intervention, the higher is perceived the risk, and the higher should be the discount rate applied to the investments.

TABLE I-2 FINANCIAL ASSUMPTIONS

Labor cost appreciation rate/yr		0.0%
Material cost apprec. rate/yr		0.0%
Exchange rate	1$ = CFA	280
Discount rate:		25%
Real price appreciation rate		0.0%
Pole price each	1000 CFA	$3.57
Fuelwood price/M3	1500 CFA	$5.36
Wood price/M3	0 CFA	$0.00
Forage price /Tonne	4000 CFA	$14.29
Avg. land rent/ha.	0 CFA	$0.00

The price, labor cost and material cost appreciation (or depreciation) rates reflect any real increases or decreases over time. Over a 20-year period any real price or cost increase may have a substantial impact on the feasibility of the proposed investments. Real rates are not disturbed by the influence of inflation. For example, "...although the price of a good may have increased nominally by 10 percent per year, the real price will actually have declined if the average rate of inflation during the same time period was higher than the average nominal price increase" (Christophersen, 1988).

Pole, fuelwood and forage price assumptions are included since most of the interventions listed in Table I-1 are associated with trees and wood production. Living fences, for example, involve planting trees to protect an area against livestock intrusion, or to delimit farm fields, etc. It is assumed that the living fence will also generate some economic pole and fuelwood benefits over time.

The table also allows inclusion of land rent to reflect what the farmer has to pay or give up to retain the right to use the land. He may have to pay rent in cash or in-kind to some absentee landowner, or to local chiefs, village founders, lineage elders, former nobles or others before he is free to make the NRM investments. These "rents" may be paid on an annual or one time forfeitary basis. They should not be ignored (but often are) as they represent real costs to participants. The land rent variable should be used with caution, however. The farmer presumably pays his/her land rent regardless of whether any NRM interventions are applied. The cell should be activated only when there is reason to assume that the interventions will cause the land rent to increase <u>over and beyond</u> what the farmer already pays without any interventions.

- Table I-3: Yields, prices, soil degradation and climate assumptions

This table deals with assumptions pertaining to crop yields, farm gate prices and cropping patterns and associations. Up to five different crops can be used in any combination over the 20-year analytical time period. The crop yields assumed are those anticipated immediately after a fallow period -- when the land is assumed to be most productive. Crop prices per kilo reflect farm gate prices any time during the year, to be determined by the analyst. The number of crops per year are expressed as fractions of one since the unit of analysis is one hectare. For example, if the average size per farm in the region is three hectares -- two hectares fonio and one hectare peanuts -- the area for each crop grown on a per hectare basis becomes 2/3 (66.6 percent) fonio and 1/3 (33.3 percent) peanuts. It is also possible to have 100 percent of two crops if they are grown in combination, i.e., on the same field at the same time. The percent of total return row shows calculated values reflecting the relatve economic importance of each crop. The crops listed (fonio, rice, peanuts, and sorghum) are illustrative only and can be changed by the analyst. When they

are changed in Table I-3 they will also automatically change elsewhere in the entire spreadsheet.

TABLE I-3 YIELD ASSUMPTIONS

Crops	Millet	Niebe	Peanuts	Sorgo	Rice
Normal yield	1300	1500	300	0	0
Farm gate price/kg	$0.54	$0.54	$0.63	0	0
No. crops per/yr	0.85	0.14	0.01	0	0
Return	$591.96	$112.50	$1.88	0	0
% of total return	84%	16%	0%	0%	0%
Soil and Climate Assumptions					
Normal soil degradation rate					6%
Percent slope					12%
Slope effect rate					100%
Calculated degradation rate					18%
Climatic effect			off		1.00
Climatic variation					15%

The second block in Table I-3 lists soil degradation, slope and climatic assumptions. The soil degradation, percent slope, slope effect rate and calculated degradation rate variables are all interconnected.

The soil degradation variable measures the extent to which crop yields will decline per year, on flat land, if none of the NRM interventions are applied. Thus, the 30 percent assumption means that the rice harvest will decline from 1500 kg/ha in year 1 to only 1150 kg in year 2, 30 percent less, and so on. Second, if the land is not flat but is sloped (12 percent as assumed in the table), the soil degradation factor may also increase because sloped land is more prone to runoffs and erosion problems. How much of an increase in the degradation rate is measured by the slope effect rate. If we assume that the slope effect rate is 100 percent, as in the table, the calculated soil degradation rate becomes 42 percent (30 percent degradation rate for flat land plus 12 percent slope factor). If the slope effect rate is assumed at 50 percent, the calculated degradation rate would only be 36 percent (30 percent degradation rate for flat land plus .50 x the 12 percent slope factor).

The soil degradation and slope effect variables are included despite the fact that reliable (documented research) information on these effects is virtually non-existant in sub-Saharan Africa. The fact remains, nevertheless, that some decline in productivity should be factored into the analyses. With the inclusion of these variables, the analyst will at least be able to say something about how big the "gap" between net benefits with and without project will have to be, over time, in order to attain feasibility. Moreover, there often is unpublished field information available on productivity declines over time without interventions, tucked away

in project field offices, with local farmers, with NGOs, etc. for analysts to consider when specifying this assumption.

The climatic effect and variation variables address the issue of the unpredictability of environmental stress in many African countries, particularly in the Sahel. To this end, we have included a switch in the model that, when on, generates random fluctuations (the climatic variation variable) around a mean crop yield figure for each year independently of every other year. The limit of variation (15 percent in this example) can be adjusted to accommodate different prevailing patterns of key environmental conditions, such as rainfall variation. For example, if field trees, windbreaks, or alley crops are planted in a year with above average rainfall, establishment will be quicker, replanting costs lowered, and at the the time period to payoff decreased. Alternatively, planting in a bad year will raise total investment costs and lower expected paybacks. A sequence of good years after a single bad year may more than compensate for the effects of the bad year, and returns to investment may exceed predictions based on "average" years. In the case of chemical fertilizers, on the other hand, economic risks are higher and potential losses are greater because the value of chemical fertilizer applies only to the year in which it is applied. A subsequent good year does not make up for the investment squandered in a bad year. Finally, there are some interventions which are environmentally insensitive. Established field trees and compost pits are relatively insensitive to climatic fluctuations.

The climatic switch is also important because local resource managers may be expected to make investments based upon patterns of recent experience with climate and agricultural outcome. If random fluctuations produce less than expected results too often, farmers will hesitate to continue making investments. The climatic factor gives a feel for best and worst case situations over time.

o Table I-4: Field interventions assumptions

Table I-4 lists input assumptions for one of the field interventions (field trees in this example). The first line identifies the intervention on the left. The number 1 appearing on the right indicates that the intervention is switched on (from the interventions menu, Table I-1). A 0 instead of 1 appearing on the right would indicate that the intervention is switched off and any values (input assumptions) appearing for that intervention will be multiplied by zero.

The fuelwood, pole and other non-crop benefit variables allow the analyst to account for benefits in addition to the anticipated crop benefits for which the intervention is intended. Field trees, for example, are promoted for the positive impacts they have on soil productivity, not for their wood values. Nevertheless, when the trees mature there will be some poles and fuelwood to harvest on a regular basis which should be accounted for in the analysis.

TABLE I-4 FIELD INTERVENTIONS ASSUMPTIONS

Field Trees					1
Fuelwood M3/yr		2		Cost/seedling	$0.29
Poles/yr		0		Space occupied (m2)	1.5
Other products/yr		100		Pres stocking/ha	15
Return/unit		$0.25		Opt. stocking/ha	70
Investment		**Start**	**Stop**	**Yield Increases:**	
Material	$15.71	0	1	Yr 0-5	0%
Planting	$233.18	0	1	Yr 6-10	15%
Maintenance	$5.48	1	5	Yr 11-15	85%
				Yr 16-20	75%
Non-Crop Benefits		**Start**	**Stop**		
Wood	$10.71	5	20		
Poles	$0.00	5	20	Remaining area	99%
Other	$25.00	5	20		

The non-crop benefits have monetary values ascribed to them to the extent possible. Under the option field trees (Acacia albida or other nitrogen fixing trees), for example, non-crop benefits may include leaf fodder, pod fodder, poles, tool handles, and kindling. Under the windbreak option, substantial benefits from a decrease in crop lodging and dessication of sprouts provoked by wind and dust storms may be expected. This translates into a lowering of reseeding rates, and hence, a reduction in seeding costs. The non-crop benefits of a number of NRM options include improvements in biodiversity such as the re-emergence of wild legumes and/or medicinal plants. In most cases, it should be noted, the analyst will probably not have enough time to pursue the analysis to this level of detail, unless the non-crop benfits are clearly evident and easy to monetarize. If so, Table I-4 makes provision for their inclusion. If not, the cell should receive a zero value in the model. It is emphasized, however, that any benefits and costs of which the analyst is aware but cannot quantify, should be identified and discussed qualitatively.

Other input variables include seedling costs, the cultivable space occupied by each tree, present and optimal stocking densities of field trees per hectare, and the rate of natural regeneration of field trees. If the present stocking density is 15 trees per hectare, 55 trees short of the optimal density of 70 trees per hectare, then the farmer will have to buy and plant the 55 seedlings (materials investment of 55 seedlings x $.13, or approximately $7.10 as calculated in the investment summary section of the table).

The investment summary section show calculated values of the investments made for each intervention (materials, labor and maintenance), non-crop benefits, and when during the 20-year period that labor and materials costs will be incurred. Materials (field

tree seedlings, for example) will be purchased in year 0 only, planting will take place in year 0, and maintenance (protection against damage from livestock) will begin in year 1 and continue for five years. Fuelwood, pole and other benefits will begin in year 5 and continue through the 20-year period. The summary labor requirements are calculated in and transferred from the labor module (discussed below) for each intervention.

The measurable impacts of the NRM interventions are the increases in crop and/or wood yields over time. Yield assumptions are difficult to specify, however. Hard information on yield responses to NRM interventions over time rarely exists except for single or few scattered data points. Huge data gaps are the rule rather than the exception. We do know that NRM interventions have favorable impacts on the rate of soil degradation, but not by how much and when. For this reason, the model makes provision for analysts to use the best available information, however scattered and incomplete it may be, to estimate the impact NRM interventions or combinations of interventions may have on yields. Here is perhaps our biggest challenge -- collecting reliable data over time to be able to accurately project the impacts of NRM interventions on crop and wood yields.

The percentage crop yield increase estimates appearing in Table I-4 are calculated in a sub-module and transferred into the table as discussed immediately below.

Finally, the "remaining area" row relates to the remaining cultivable area after the intervention. Planting trees occupy some space, in the case of field trees 1.5 m2 per tree as assumed in the table. The 1.5 m2 multiplied by 55 trees to plant becomes 83 m2 in trees rather than crops. The remaining cultivable area, therefore, becomes 10,000 - 83 = 9,917/10,000 = 99 percent. The impact on cultivable area is considerably higher for the windbreak, alley cropping and vegetation bunds interventions.

o Table I-5: Synergetic impact on crop yields

This is an input table in the soil and moisture conservation module designed to estimate the synergetic impacts on crop yields as a result of applying one or several NRM interventions at the same time. The table is accessed by pressing Alt A to get the main menu from which you can access the "Yield" table (Table I-5). The table allows the analyst to assume how crop yields change as interventions are applied in combinations with each other.

Before discussing the table in detail, we raise a note of caution. Whereas the assumptions made in this table dictate the magnitudes of the major benefits of the interventions, there is little researched and documented information available on which to base the assumtions. We do not generally know how different interventions interact when applied simultaneously on a given farm field and cannot, therefore, accurately predict the synergetic impact on crop yields. We can, however, be imaginative and derive the assumptions based on local, unpublished information and

intimate knowledge about the productive capacity of the site. It is also recommended that the analyst, in deriving these assumptions, use conservative estimates -- the minimum one can expect as a result of the interventions -- to be on the safe side in the analyses. The table should only be accessed by experts who can back up the assumptions they make without the benefit of published research data.

It is also emphasized that this most important element of the model is also its weakest link. This is where we need hard information -- on the synergetic impact on crop yields as a result of applying several different assumptions on the same farm field simultaneously. Whereas the model makes provision for analysts to make the assumptions in Table I-5, we also state emphatically that assumptions thus made must be carefully explained and results qualified if they are not based on documented research. If the date used is "soft" the analyst is well advised, as mentioned above, to use conservative assumtions to be on the safe side. Alternatively, if there is no way to derive assumptions and have any reasonable confidence in the results, the model also provides the analyst with the opportunity to opt for a break-even approach which will be discussed later in this annex.

TABLE I-5 SYNERGETIC IMPACTS ON YIELDS, COMBINATIONS OF INTERVENTIONS: YEARS 0-5

Intervention Menu	FT	OF	CF	AC	CR	SW	HR	WB	VB
FT Field trees	0%	0%	0%	0%	0%	0%	0%	0%	0%
OF Organic fertilizer	0%	20%	10%	10%	20%	10%	10%	10%	10%
CF Chemical fertilizer	0%	10%	60%	10%	10%	5%	5%	5%	5%
AC Alley cropping	0%	10%	10%	30%	10%	10%	0%	0%	10%
CR Crop residue	0%	20%	10%	10%	20%	10%	10%	10%	10%
SW Soil and water cons.	0%	10%	5%	10%	10%	15%	0%	0%	15%
HR Hedge rows, live fence	0%	10%	5%	0%	10%	0%	5%	5%	0%
WB Windbreaks	0%	10%	5%	0%	10%	0%	5%	5%	0%
VB Vegetation bunds	0%	10%	5%	10%	10%	15%	0%	0%	15%

Now for the details of Table I-5 -- the percentages assumed represent the analyst's best judgment on the probable behavior of crop yields as interventions are applied in combination with each other. The table shows impacts on yields over the first five-year period -- from year 0 to 5. The model also includes (but not shown here) tables reflecting the impacts on crop yields for years 6-10, 11-15 and 16-20. The assumed percentages are listed in the northeast half of the table and copied symmetrically (mirror image) in the southwest half with the line of division running along the diagonal. The percentages along the rows are additive to the extent that the interventions are "on." For the first five years, for example, organic fertilizer by itself is assumed to have a 20 percent impact on crop yields as assumed in the table. If organic and chemical fertilizer are combined, the impact on crop yields will be the total of the percentages assumed along the OF row, 20 plus 10 percent, or a total of 30 percent.

Note that confidence in the results declines rapidly if more than two interventions are "on" at the same time. It is probable that several runs of the model will be required to cover an entire target region making sure that no more than two interventions are combined. For example, in a 250,000 ha target region, 10 percent may be a candidate for windbreak and organic fertilizer interventions, 30 percent may be a candidate for the Acacia albida intervention, and the rest for the contour dikes and vegetation bunds interventions. The model should be run for each sub region as delineated and the results can be added in the end to obtain the impact in the region as a whole.

o Tables I-6 through 12: Results

Tables I-6 and I-7 show how crop yields "without" and "with interventions" behave over the 20-year period respectively. Yields decline over time in both tables according to the soil degradation assumptions given in Table I-3. The yields shown in year 0 are the "normal yields" in Table I-3 occurring immediately after fallow multiplied by the percentage of the unit hectare occupied by the individual crops.

TABLE I-6 NO INTERVENTION YIELDS, KG/HA

Year	Millet	Niebe	Peanuts	Sorgo	Rice	0	Total
0	1105	210	3	0	0	0	1318
1	906	172	2	0	0	0	1081
2	743	141	2	0	0	0	886
3	609	116	2	0	0	0	727
4	500	95	1	0	0	0	596
5	410	78	1	0	0	0	489
6	336	64	1	0	0	0	401
7	275	52	1	0	0	0	329
8	226	43	1	0	0	0	269
9	185	35	1	0	0	0	221
10	152	29	0	0	0	0	181
11	125	24	0	0	0	0	149
12	102	19	0	0	0	0	122
13	84	16	0	0	0	0	100
14	69	13	0	0	0	0	82
15	56	11	0	0	0	0	67
16	46	9	0	0	0	0	55
17	38	7	0	0	0	0	45
18	31	6	0	0	0	0	37
19	25	5	0	0	0	0	30
20	21	4	0	0	0	0	25

TABLE I-7 INCREMENTAL INTERVENTION YIELDS, KG/HA

Year	Millet	Niebe	Peanuts	Sorgo	Rice	0	Total
0	139	4	0	0	0	0	144
1	114	4	0	0	0	0	118
2	94	3	0	0	0	0	97
3	77	2	0	0	0	0	79
4	63	2	0	0	0	0	65
5	52	2	0	0	0	0	53
6	71	2	0	0	0	0	73
7	58	2	0	0	0	0	60
8	48	1	0	0	0	0	49
9	39	1	0	0	0	0	40
10	32	1	0	0	0	0	33
11	205	6	0	0	0	0	211
12	168	5	0	0	0	0	173
13	138	4	0	0	0	0	142
14	113	4	0	0	0	0	116
15	92	3	0	0	0	0	95
16	58	2	0	0	0	0	60
17	48	1	0	0	0	0	49
18	39	1	0	0	0	0	40
19	32	1	0	0	0	0	33
20	26	1	0	0	0	0	27

Tables I-8 and I-9 show the incremental and total dollar value increases (farm gate prices multiplied by crop yields increases), by crops, attributable to the interventions. Table I-10 shows the incremental dollar value increases by interventions where the total added by row (not shown) equals the total in Table I-8 (intervention values by crops). Tables I-11 and I-12 summarize the results into farmer perspective NPVs by interventions (Table I-11) and by the total of all interventions (Table I-12).

o Table I-13: Break Even

The last table (Table I-13) in the soil and moisture conservation module shows break even results of the investments -- how many additional kilos of different crops must be produced per year in order to at least break even on the investments made. This analytical approach should be activated if crop yield changes in response to interventions cannot be predicted with any degree of confidence; i.e., the analyst chooses not to specify any crop yield change assumptions in Table I-5. The results show how much more the farmer must produce per hectare, per crop, in order to a) recover the investments made, b) make up for the cultivable land area lost (if any) as a result of the interventions, and c) make an accounting profit equal to the discount rate.

TABLE I-8 INCREMENTAL INTERVENTION VALUES ($)

Year	Millet	Niebe	Peanuts	Sorgo	Rice	0	Total
0	75	2	0	0	0	0	$77
1	61	2	0	0	0	0	$63
2	50	2	0	0	0	0	$52
3	41	1	0	0	0	0	$42
4	34	1	0	0	0	0	$35
5	28	1	0	0	0	0	$29
6	38	1	0	0	0	0	$39
7	31	1	0	0	0	0	$32
8	25	1	0	0	0	0	$26
9	21	1	0	0	0	0	$22
10	17	1	0	0	0	0	$18
11	110	3	0	0	0	0	$113
12	90	3	0	0	0	0	$93
13	74	2	0	0	0	0	$76
14	60	2	0	0	0	0	$62
15	50	2	0	0	0	0	$51
16	31	1	0	0	0	0	$32
17	26	1	0	0	0	0	$26
18	21	1	0	0	0	0	$22
19	17	1	0	0	0	0	$18
20	14	0	0	0	0	0	$15

TABLE I-9 TOTAL VALUE (BASE PLUS INTERVENTION)

Year	Millet	Niebe	Peanuts	Sorgo	Rice	0	Total
0	667	78	1	0	0	0	$746
1	547	64	1	0	0	0	$612
2	448	52	1	0	0	0	$502
3	368	43	1	0	0	0	$411
4	301	35	1	0	0	0	$337
5	247	29	0	0	0	0	$277
6	218	24	0	0	0	0	$242
7	179	20	0	0	0	0	$199
8	146	16	0	0	0	0	$163
9	120	13	0	0	0	0	$134
10	98	11	0	0	0	0	$110
11	176	12	0	0	0	0	$188
12	145	10	0	0	0	0	$154
13	119	8	0	0	0	0	$127
14	97	7	0	0	0	0	$104
15	80	5	0	0	0	0	$85
16	56	4	0	0	0	0	$60
17	46	3	0	0	0	0	$49
18	38	3	0	0	0	0	$40
19	31	1	0	0	0	0	$31
20	25	0	0	0	0	0	$26
AVG	$296	$22	$0	$0	$0		

TABLE I-10 INCREMENTAL VALUE INCREASE BY INTERVENTION ($)

Year	FT	OF	CF	AC	CR	H2O	HG	WB	VB
0	0	0	0	0	0	77	0	0	0
1	0	0	0	0	0	63	0	0	0
2	0	0	0	0	0	52	0	0	0
3	0	0	0	0	0	42	0	0	0
4	0	0	0	0	0	35	0	0	0
5	0	0	0	0	0	29	0	0	0
6	23	0	0	0	0	16	0	0	0
7	19	0	0	0	0	13	0	0	0
8	16	0	0	0	0	11	0	0	0
9	13	0	0	0	0	9	0	0	0
10	11	0	0	0	0	7	0	0	0
11	49	0	0	0	0	64	0	0	0
12	40	0	0	0	0	52	0	0	0
13	33	0	0	0	0	43	0	0	0
14	27	0	0	0	0	35	0	0	0
15	22	0	0	0	0	29	0	0	0
16	16	0	0	0	0	16	0	0	0
17	13	0	0	0	0	13	0	0	0
18	11	0	0	0	0	11	0	0	0
19	9	0	0	0	0	9	0	0	0
20	7	0	0	0	0	7	0	0	0
AVG	14.8	0	0	0	0	30.2	0	0	0

TABLE I-11 NET CASH FLOW BY INTERVENTION ($)

Year	FT	OF	CF	AC	CR	H2O	HG	WB	VB	Total
NPV	-$303	0	0	0	0	$389	0	0	0	$86
0	-249	0	0	0	0	-198	0	0	0	-447
1	-254	0	0	0	0	-48	0	0	0	-303
2	-5	0	0	0	0	74	0	0	0	69
3	-5	0	0	0	0	65	0	0	0	60
4	-5	0	0	0	0	57	0	0	0	52
5	30	0	0	0	0	414	0	0	0	444
6	59	0	0	0	0	401	0	0	0	460
7	55	0	0	0	0	368	0	0	0	423
8	51	0	0	0	0	365	0	0	0	417
9	49	0	0	0	0	364	0	0	0	412
10	46	0	0	0	0	362	0	0	0	408
11	85	0	0	0	0	419	0	0	0	504
12	76	0	0	0	0	407	0	0	0	483
13	69	0	0	0	0	398	0	0	0	467
14	63	0	0	0	0	390	0	0	0	453
15	58	0	0	0	0	384	0	0	0	442
16	52	0	0	0	0	371	0	0	0	423
17	49	0	0	0	0	368	0	0	0	417
18	47	0	0	0	0	366	0	0	0	412
19	45	0	0	0	0	364	0	0	0	408
20	43	0	0	0	0	362	0	0	0	405

TABLE I-12 RESULTS: FARMER PERSPECTIVE, US$

Year	Net Cash Flow	Investment
0	-$447	$524
1	-$303	$2
2	$69	$1
3	$60	$1
4	$52	$1
5	$444	$1
6	$460	^1
7	$423	$0
8	$417	$0
9	$412	$0
10	$408	$0
11	$504	$0
12	$483	$0
13	$467	$0
14	$453	$0
15	$442	$0
16	$423	$0
17	$417	$0
18	$412	$0
19	$408	$0
20	$405	$0
NPV	$86	

TABLE I-13 BREAKEVEN INCREMENTAL KG/CROP/HA/YEAR

Year	Millet	Niebe	Peanuts	Sorgo	Rice
0	1045	199	3	0	0
1	24	5	0	0	0
2	21	4	0	0	0
3	21	4	0	0	0
4	21	4	0	0	0
5	21	4	0	0	0
6	21	4	0	0	0
7	20	4	0	0	0
8	20	4	0	0	0
9	20	4	0	0	0
10	20	4	0	0	0
11	20	4	0	0	0
12	20	4	0	0	0
13	20	4	0	0	0
14	20	4	0	0	0
15	20	4	0	0	0
16	20	4	0	0	0
17	20	4	0	0	0
18	20	4	0	0	0
19	20	4	0	0	0
20	20	4	0	0	0
AVG	69	13	0	0	0

II. Labor Module

A. What You See on the Screen

The labor module is contained in four basic tables reflecting details the analyst must consider when planning for NRM interventions. The input assumption tables start in cell A1 and continue to the right using the "tab right" button. Tables II-1 and II-2 show different labor rates at different times during the year. Table II-3 shows the labor requirements for one of the several NRM interventions on the menu (discussed in conjunction with the soil and moisture conservation module below). The output of the labor module is the summary table (Table II-4) presenting the cumulative total of labor required for establishment and maintenance of all activated interventions. The table shows total labor requirements, by rate category, by month and the overall weighted average labor costs per day. The calculated labor rates feed into the soil and moisture conservation module discussed in Section I above.

B. Discussion of the Labor Module

o Tables II-1 and 2: Qualitative differences reflected in labor rates

The most important input farmers will be making will be their labor -- time. Labor rates are listed in monetary equivalents although the analyst should bear in mind the qualitative differences between wage and non-wage labor in African contexts. Three different labor rates are employed to capture the qualitative differences of labor inputs -- primary, secondary and teriary (Table II-1).

TABLE II-1 LABOR RATES

RATES		Currency CFA
Primary rate:	Full rate per day	692
Secondary rate:	75% of primary	519
Tertiary rate:	50% of primary	346
Seasonal low primary rate		150
Start low season	27-Mar	
End low season	22-Aug	

The primary rate refers to the highest income earner in the household regardless of gender or age. It should be based on the highest productive alternative use of labor within the local context. This detail is included to avoid the incorrect, but often used assumption that farm labor has a zero opportunity cost. Typically farm households allocate labor over a range of activities with varying returns. The secondary and tertiary rates (second and third level income earners) are expressed as percentages of the primary rate as they are documented in the literature or determined through household interviews. Also factored in are the seasonal variations in the three labor rates since the opportunity costs for labor vary through the year. For example, the opportunity cost for household labor for anything other than subsistence agriculture goes up dramatically during peak agricultural season. The result of this process is that the qualitative differences in the available labor force are reflected in one, weighted average, labor rate which changes every month as a result of seasonal variations (Table II-2).

Men, women and children comprise the labor force, they all work but may have different assignments and different alternative employment opportunities during the year, hence, their labor rates may differ. For example, establishing compost pits or contour rock berms may require skilled or heavy labor. However, maintenance of the berm or replenishing the vegetative matter and manure and water in a compost pit may simply require the casual labor of a child, equivalent to the tertiary rate.

TABLE II-2 MONTHLY LABOR COST FLUCTUATIONS (CFA)

DATE	RATE/DAY	DAYS FULL	DAYS LOW	DAYS TOTAL
31-Dec				
31-Jan	692	31	0	31
28-Feb	692	29	0	29
31-Mar	622	27	4	31
30-Apr	150	0	30	30
31-May	150	0	31	31
30-Jun	150	0	30	30
31-Jul	150	0	31	31
31-Aug	307	9	22	31
30-Sep	692	30	0	30
31-Oct	692	31	0	31
30-Nov	692	30	0	30
31-Dec	692	31	0	31
Wght Avg	474			

Inclusion of qualitative dimensions is also important for the reason that not all household members are equally available for work on any given intervention. Different household members have different annual labor schedules. Furthermore, the opportunity cost of labor may differ between men and women. Finally, the production group or farm unit head may not be able to command labor however he or she sees fit. Thus, the analyst with a working knowledge of the degree of authority over household labor typical of household heads in an area can use this knowledge to construct reasonable tables of possible labor allocations. This will also prevent the inclusion of NRM interventions that are not practical locally because of conflicting labor demands. Planned interventions should be complementary to ongoing activities, or they should be scheduled during troughs in the prevailing labor calendars of participants. Overall, there should be an inverse relationship between the labor requirements for the NRM intervention and the extent of prior mortgaging of participant labor.

How to determine the magnitudes of the seasonal primary, secondary and tertiary labor rates and alternative employment opportunities, requires good judgment. What constitutes alternative employment opportunities? The range certainly is as broad as one's imagination can allow. A farmer can choose to place rock contour dikes in his fields at someone's suggestion being convinced that his crop yields will increase by X percent, or he can choose instead to dig for gold with a one in a million chance of finding the mother lode. Is the gold digging alternative a viable alternative employment opportunity? Would it be if the chance were one in 500? The analyst must use his/her judgment based on insight into the goals and motivations of the participants.

There is also a time dimension to consider. Suppose the NRM interventions "win" -- the farmers choose to install the contour

dikes with donor and host country assistance, and benefit from the higher yields. What happens later? As farms approach sustained yield management, participating farmers also experience more financial breathing room and their perceptions about risk and uncertainty change. They acquire a higher propensity for risk taking than before and may now find it easier to choose the gold digging option. The point is that the donor can expect that farmer participation will taper off over time as the interventions pay off. Participating farmers who have succeeded with the initial interventions may be increasingly difficult to convince to participate with yet further improvements because they have already acquired a financial cushion. (This "tapering off" phenomenon is factored into the analysis in the Planning Module discussed in Section III below).

- Table II-3: Labor requirements by field interventions

Labor assumptions specific to each field intervention listed in Table I-1 above are specified for the field trees intervention in Table II-3 below. The table distinguishes between the primary, secondary and tertiary rates, by months and by the establishment versus maintenace labor requirements for the intervention. The analyst will first have to estimate the magnitudes of the primary, secondary and tertiary rates, and second, based on the local field realities, estimate the number of days required in each rate category, and in which month the work will be carried out. The total cost column shows the total investment requirements by month for the intervention. Also included is a weighted average cost per day for the intervention. The labor cost values transferred to and used in the soil and moisture conservation module are the total establishment and the labor maintenance costs.

TABLE II-3 LABOR REQUIREMENTS: FIELD TREES (CFA)

	ESTABLISHMENT				MAINTENANCE			
DATE	PRIMARY	SECOND.	TERT.	TC	PRIMARY	SECOND.	TERT.	TC
Total Establishment				65291	Total Maintenance			1535
31-Dec	20			13846	1			692
31-Jan	25	1		17827				0
01-Mar	30	7	5	23493				0
01-Apr	30	30	30	10125				0
01-May				0				0
01-Jun				0	1			150
01-Jul				0				0
01-Aug				0				0
01-Sep				0				0
01-Oct				0				0
01-Nov				0	1			692
01-Dec				0				0
Weighted average cost/day				367	Weighted average cost/day			512
Initial labor requirement				178	Annual labor requirement			3

o Table II-4: Summary

The summary table (Table II-4) is the aggregate version of Table II-3 showing the total labor requirements for all of the "on" interventions in Table I-1.

TABLE II-4 CUMULATIVE TOTAL (CFA)

	ESTABLISHMENT				MAINTENANCE			
DATE	PRIMARY	SECOND.	TERT.	TC	PRIMARY	SECOND.	TERT.	TC
Total	314	184	242	183281	9	48	85	35876
31-Dec	50	7	5	39981	1	0	5	2423
31-Jan	35	1	0	24750	0	10	6	7269
01-Mar	53	22	45	57255	0	10	7	6846
01-Apr	111	94	104	35025	0	10	8	1725
01-May	52	34	58	15975	0	0	9	675
01-Jun	12	19	6	4388	3	2	11	1500
01-Jul	0	4	0	450	2	2	14	1575
01-Aug	1	3	20	4074	2	7	7	3305
01-Sep	0	0	0	0	0	2	7	3462
01-Oct	0	0	2	692	0	5	5	4327
01-Nov	0	0	2	692	1	0	3	1731
01-Dec	0	0	0	0	0	0	3	1038
Weighted average cost/day				248	Weighted average cost/day			253
Initial labor requirement				740	Annual labor requirement			142

III. Project Planning Module

This module finalizes the planning process. It is activated when we know the farmer perspective results of implementing certain NRM interventions or combinations of interventions. This step involves planning for the larger scale replication of the interventions including donor and host country provision of incentives or "pump priming" investments. It addresses the investments made by the donors and host country in the "packaging" of the NRM techniques. The module builds on the farmer perspective soil and moisture conservation results. Following these detailed, sociologically and economically conscious analyses, we can be reasonably confident that the proposed sets of interventions are realistic for the target region and that they have a high probability of succeeding if implemented.

A. What you see on the screen

The planning module is contained in 15 basic tables reflecting details the analyst must consider when estimating the magnitudes of donor and host country investments in NRM activites. The input assumption tables start in cell A1 and continue downwards using the "page down" button. The results tables begin in cell K1 and continue to the right using the "tab right" button. The kinds of investments to be funded by either the donors or the host country fall into five broad categories:

- Long term technical assistance
- Short term technical assistance
- Long term training
- Short term training
- Infrastructure support

Table III-1 shows the general input assumptions generic to all of the model components. Tables III-2 and 3 show the long term technical assistance (TA) and long term training requirements. Table III-4 represents one (of five) program input components of the module, all described in greater detail below: financial mechanism, rural credit, co-operatives, environmental education and extension. These components can, of course, be changed to anything the analyst requires. The input assumptions are standardized for all of the components to include short term TA, short term training, buildings and other infrastructure, staff and supply requirements. Tables III-5 and 6 summarize the anticipated donor and host country investments. Table III-7 addresses the issue of, and allow analysts to quantify, the effectiveness of training or extension efforts. The identification and analysis of host country benefits are shown in Table III-8. The results are given in Tables III-9 through 14. Table III-9 recalls the farmer perspective results from the soil and moisture conservation module. Tables III-10 and 11 summarize the donor investments and benefits respectively. Tables III-12, 13 and summarize the host country investment and benefits respectively. The final table, Table III-15, restates the host country benefits by product (wood, crops, etc.) rather than by category of benefit.

B. Discussion of the Planning Module

o Table III-1: General inputs

This table shows several inputs common to all of the components of the module. All components have standardized input categories such as TA, training, infrastrucure and supplies. The magnitudes of these assumptions, of course, will vary between the components as required. Each component, for example, may require some short term TA. How much, what kind of expertise, and how often, will vary between the components. The generic aspect of this assumption is that TA will incur travel and per diem costs which can be assumed in Table III-1. The duration of the TA, the expertise required, etc. are component specific variables discussed in greater detail in other tables below. Similarly, different module component may require the use of heavy equipment. Again, how much, which kind, and how often will vary between the components. The operating costs per hour of the heavy equipment can be assumed in Table III-1. Other generic assumptions include gasoline and diesel costs per liter, salaries for (temporarily) donor funded host country staff (support, supervisory and field staff), building construction costs and contractor overhead costs. Any or all of these assumptions could receive 0 values if not applicable.

TABLE III-1 GENERAL INPUT ASSUMPTIONS

Discount rate:	15%		
Bulldozer oper. cost/hr	$70	RT air fare	$2,500
Road grader oper. cost/hr	$50	RT in-country travel	$40
Tractor oper. cost/hr	$25	Gasoline/l	$0.50
Support staff, sal./yr	$5,000	Diesel/l	$0.30
Superv. fld staff, sal/yr	$3,000	Per diem/expats, ST TA	$100
Field staff, sal/yr	$2,500	Local per diem	$10
Turnkey cost/m2 construction, buildings			$150
Contractor OH on LT and ST labor			70
Contractor OH on TA travel, procurement of veh. and equip.			20
Characteristics of Target Region:			
Ha. cultivated in region			10000
No. farms in region			2500
No. ha/farm			

An important assumption in this table is the discount rate. This rate does not, and probably should not, equal the discount rate used for the farmer perspective analysis. This is because farmers have a completely different perspective on risk and uncertainty than do donors and host countries. A farmer tends to be much more risk averse than a donor or host country, because he or she does not have a diversified investment portfolio over which risks can be spread. Donors and host countries, on the other hand, have divesified portfolios and lower discount rates can be justified.

The "characteristics of the target region" part of the table allows the analyst to input assumptions about the number of hectares and farms in the region to transfor the analyses from a per hectare basis (as in the soil and moisture conservation module) to a total area basis.

o Table III-2: Long term TA

Does the proposed project or program require the presence of long term technical assistants? If the required expertise is not available locally, the needs can be specified in Table III-2. The table makes provision for the analyst to assume the number and expertise of the TA team, depending upon the specific project profile.

The table also addresses whatever else will be needed to support the long term TA team such as a moving and support allowance, vehicles and fuel, host country support staff and supply requirements.

o Table III-3: Long term training

African administrations are usually short on appropriately trained resource managers. Improved skills are needed in forestry, wildlife, economics, planning, and anthropology/sociology. Each

project may find it necessary train or retrain some cadre in these disciplines. Table III-3 permits the analyst to make assumptions about how many people should be trained in which disciplines, to which level, for how long and the costs (including travel, tuition and support costs).

TABLE III-2 LONG TERM TA ($)

Expertise	Years	Sal/Year	Allowance 50%	Internat. RTs No.	Internat. RTs Cost	TC
Team Leader	3	60000	30000	8	20000	483000
Biologist	2	50000	25000	5	12500	270000
Social scientist	3	45000	22500	6	15000	362250
	0	0	0	0	0	0
Volunteers	4	6000	3000	4	10000	46000

Vehicles	No.	Fuel Type	Cost Each	Freq. of Replacem.	Maint %/yr	Fuel L/yr	Hours Operated	TC
4wd	1	d	20000	5	7%	2,000	0	46000
Sed	2	g	15000	4	7%	1,500	0	69600
	0		0	0	0%	0	0	0
	0		0	0	0%	0	0	0
	0		0	0	0%	0	0	0

Host Country Personnel Attached to LT TA		
Support staff	10	50000
Field staff	0	0
Supervisory field staff	0	0

Supplies	No.	Units	$/Unit	Replace	Maint/Yr	TC
Off supl	1	Budget/yr	10000	0	0%	10000
Utilit.	1	Budget/yr	30000	0	0%	30000
Off eqp	1	Budget/yr	8000	0	10%	8800
	0		0	0	0%	0

TABLE III-3 LONG TERM TRAINING ($)

No.	Expertise	Level	Per. yrs	Cost/yr	Int. RTs	Travel	TC
1	Ag.econ.	MS	2	10000	1	2500	20000
1	Res.econ.	PhD	3	15000	1	2500	45000
2	Nat.sci	MS	2	12000	2	5000	48000
1	Soc.sci	PhD	4	15000	1	2500	60000
1	Res.plan.	MS	2	13000	1	2500	26000
5	Nat.sci.	BS	2	9000	5	12500	90000
11			15	74000	11	27500	289000

o Table III-4: Project/program components

This is a series of tables, represented here by the "Financial Mechanism" table, reflects the several NRM components or conditions required to successfully deliver NRM interventions. Examples of these components include (but are not limited to):

- A financial mechanism: for example, the establishment of grain banks to take advantage of seasonal crop price variations, and/or other similar enterprises (sesame oil extraction, bee keeping, wood cutting, or vegetable gardening, etc.) that generates short and long term benefit streams for participants and for reinvestment in NRM interventions.

TABLE III-4 FINANCIAL MECHANISM ($)

ST TA	P. day	Sal/dy	Int	Trips	Trav Cst	TC
Economist	50	250	3	9000	36250	
Fin. mgr	40	230	2	6000	26440	
Engineer	20	260	1	3000	14240	
Sociolog	40	100	0	0	11600	

Training	Initial (Donor)	Retrain (HC)
Days per workshop	10	5
No. trainees/workshop	10	3
No. times wkshop taught over 20-yr	3	20
Misc. costs/wkshp (supplies, etc.)	$500	$250
TC (including travel & per diem)	$5,700	$10,400

Buildings	500	m2	75000
Maintenance	8%	Per year	6000

Vehicles	No.	Fuel Type	Cost Each	Freq. of Replacem.	Maint %/yr	Fuel L/yr	Hours Operated	TC
Car	20	d	250	3	5%	0	0	11250
4wd	2	g	20000	5	7%	1,500	0	92300
0			0	0	0%	0	0	0

Support staff	5	25000
Field staff	8	24000
Supervisory field staff	1	2500

Supplies	No.	Units	$/unit	Replace	Maint/Yr	TC
Fence	7000	meters	1.50	5	10%	46200
Tools	4	each	3000.00	6	5%	12000
Pumps	3	km	35000.00		10%	115500
Other	0		0	0	0%	0

- Rural credit: the Opportunities study (Shaikh et al, 1988) and other studies have shown that access to capital is a key constraint to NRM investments in the rural areas. Credit is often needed "to prime the pump" so to speak since decades of environmental degradation have left many small holders with negative equity. In many successful cases, NGOs have provided credit in cash or kind to provide initial financing for interventions. Financial mechanisms then pick up and generate benefits to repay credit and generate new funds;

- Rural co-operatives: the social goal of NRM interventions is to generate and capture a stream of benefits for investments both in the resource base and in human resources. Successful local resource management requires that local populations mobilize and invest local savings and develop collective rules for resource management. Thus the sustainability of NRM is often dependent upon the successful establishment of rural organizations with credit and cooperative functions. These associations concentrate and manage part of the benefit flow accruing from improved resource management for reinvestment and popular benefit. Contrary to popular stereotype, however, African societies have no special disposition to "communal" action, and the skills of outside specialists are often required.

- Extension: a fundamental component of any NRM project or program is the need for extension of the "how-to" techniques from the experts to the farmers. This is probably the major bottleneck to successful implementation. While there may be expatriate or local experts who are knowledgable about the improved NRM technologies recommended for diffusion, there usually are far too few extension personnel to diffuse the technologies to the farmers on a long term and sustained basis. There is not a critical mass of competent trainers. If this is the case in the target region, the donor and/or the host country will have to fund and supply the training of trainers.

The kinds of inputs for all of these components are standard including short term training, infrastructure support (buildings, vehicles, etc.), host country staff and supplies.

o Table III-5: Summary, average donor investments per year

In this table, the costs of the elements which make up each component of the donor investment, i.e., technical assistance, training, materials, buildings, and vehicles, are summarized and averaged. The results reappear as average donor investments by year in Table III-10 discussed below. The last row of Table III-5 identifies the final year of donor support in any of the investment categories.

TABLE III-5 SUMMARY TABLE: AVERAGE DONOR INVESTMENTS PER YEAR ($)

	TA	Training	Vehicles	Bldngs	Host Co. Support	Staff Field	Supplies
General							
LT TA	232250		23120		50000		48800
LT Trng		57800					
Functional							
Fin. Mech	17706	3220	20710	11571	25000	26500	203700
Rur. credit	34081	1176	19120	11250	25000	26500	157500
Coops	19206	3600	19120	11250	25000	26500	96275
Env. educ.	19206	3600	19120	11250	25000	26500	96275
Extension	59730	3600	19120	11250	25000	26500	96275
Total	382179	72996	120310	56571	175000	132500	698825
Final Yr	5	5	5	7	5	3	7

o Table III-6: Summary, average recurrent costs/year for host country

This table summarizes the anticipated recurrent cost burden for the host country as a result of the NRM project or program. As donor financing is withdrawn, host countries must assure the continuity of the activities. The results reappear as host country investments in Table III-12 also discussed below. The last row of Table III-6 identifies the first year of host country funding of the activities.

TABLE III-6 SUMMARY TABLE: AVERAGE RECURRENT COSTS/YEAR FOR HOST COUNTRY ($)

	Retrain Workshops	Vehicles	Bldngs	Host Co. Support	Staff Field	Supplies
Fin. Mechanism	2080	20710	6000	25000	26500	203700
Rur. Credit	416	19120	3750	25000	26500	157500
Cooperativ.	2440	19120	3750	25000	26500	96275
Env. Educ.	2440	19120	3750	25000	26500	96275
Extension	2440	19120	3750	25000	26500	96275
Total	9816	97190	21000	125000	132500	650025
Start Year	6	6	8	6	4	8

o Table III-7: Effectiveness of short term training (demonstration effect)

The aim of this part of the module is afford the analyst the opportunity of building in some reasonable expectations about the efficacy of short term training and extension in NRM projects. While a critical mass of trainers may be reached by short term training to improve their abilities to extend proven NRM techniques, the ability of agents to extend effectively at the farm

level varies as a matter of extension context and agent personality.

TABLE III-7 EFFECTIVENESS OF SHORT TERM TRAINING (DEMONSTRATION EFFECT)

No. of farms where extension is judged possible	70%	17500
Percent of farm units contacted by ext. agents/year		25%
Percent of target population for whom training is effecti		15%
Percent demonstration effect (person to person spread/yr)		10%
Percent training effectiveness loss/yr		3%

Whatever the agents' capabilities, of the percentage of farmers reached by extension agents in a given year, extension will be effective for only a portion of them. Obviously, rural African households are heterogeneous with widely different motivations and means to invest in NRM activities. Given these differences, it is certain that less than 100 percent of the total number of farmers in the region will be receptive to the proposed interventions. For this reason, the table makes provision for the analyst to assume that the target population for whom extension is deemed feasible is a percentage of the total population in the region.

Further, It cannot be assumed that every farmer contacted will absorb and follow the advice given. Another dimension of extension efficiency is the probability that for every farmer reached successfully by extension agents directly, a number of other farmers will be indirectly reached. When farmers see their neighbors engaged in innovative activities they may adopt and copy these interventions without any direct contact from the extension agents. Of course, the degree of "over-the-fence" diffusion varies from context to context. Some groups guard information closely and avoid interfering in their neighbors affairs; others are more inclined to share information freely and widely. Sometimes men and women farmers share information, more often they do not. The planner needs to make a determination of the prevailing degree of information sharing in the area where NRM interventions are proposed.

There is yet another factor which should enter into any estimate of the efficiency of extension. This is the fact that enthusiasm for an innovation will taper off in time, and usually before total treatment of a target area or total coverage of a participating group by extension workers. This has been reported from a number of the older NRM sites in Africa and was certainly commonplace in an earlier generation of integrated rural development projects. Thus, there is an inevitable deterioration of extension effectiveness over time. In economic terms, the marginal utility of the intervention declines. The only remedy for this is the inclusion of successful new techniques in the package of NRM options extended to farmers. Such themes should be identified in the course of the iterative extension partnership which develops between agents and farmers.

o Table III-8: Host country benefits

Many of the benefits that accrue to particpants and the host country are difficult to quantify as discussed several times elsewhere in this report. Security of tenure and stabilization of productivity leads to improvements to the quality of life of private sector participants. These same benefits lower the costs to host government and donors of caring for farmers who might otherwise become refugees and destitute. The host country enjoys improvements based on heightened productivity and social stability. Thus, host countries may expect fewer defaults on taxes, and increased demand for consumer goods which indirectly (through import taxes) improve the treasury. International public relations benefits also accrue to donors and host countries from stemming famine and adding biomass.

TABLE III-8 HOST COUNTRY BENEFITS ($)

Market Benefits	FEES	PERMITS	MKT TAX	FINES
Transactions				
Crops/kg	0.15	0.01	0.02	0.01
F.wood/stere	0.05	0.60	2.00	0.01
Poles each	0.05	0.05	0.05	0.01
Logs/m3	0.10	0.10	0.10	0.01
Fodder/tonne	0.05	0.05	0.05	0.01
Other	0.02	0.02	0.02	0.01
Transport				
Crops/kg	0.01	0.01	0.01	0.01
F.wood/stere	0.01	0.01	0.01	0.01
Poles each	0.01	0.01	0.01	0.01
Logs/m3	0.01	0.01	0.01	0.01
Fodder/tonne	0.01	0.01	0.01	0.01
Other	0.01	0.01	0.01	0.01

Benefits From Private Sector	
Individuals normal tax/year	$5.00
Current tax default rate	40%
Tax default rate with project	25%
Coop private extension service per farm	$10.00
Commerce permit/year	$10.00
New grain traders enter market	1 for every 100 tonnes

This section represents a key innovation in project design. In this section the benefit flow from the options menu is brought back into the picture to illustrate the extent to which the host country <u>can</u> be expected to pick up the recurrent costs of continuing with project activities after donor funding has ended.

There are basically two types of benefits which accrue to the host country: product and non-product benefits. Product benefit streams can be tapped by the government every time a product of a NRM investment is moved or exchanged. Taxes, fees, and permits are

generic examples of the kinds of product benefits the host country can expect. Wood-cutting licences, transport taxes, warehousing costs and the like are specific examples. Non-product benefits are essentially levies such as taxes, fees and permits. Specific examples include head and income taxes, market fees, extension fees paid to government cadre for specific extension advice, wood-cutters permits, grazing permits, and fines for violations of management agreements such as those associated with deferred grazing or cutting schemes, etc. All of these levies are imposed on a per unit (kg, m3, ha, steres, person) and/or per annum basis. These levies represent various percentages of the productivity increases associated with successful NRM investments. Tripartite management agreements (private sector/farmers, donors, host country) spell out a fair share distribution of benefits such as the Guesselbodi and Maggia Valley (both in Niger) plans. Planners need to identify what kind, where, how, and how much of these levies can be captured by interested agents of the host government.

As NRM investments begin to pay off the proportion of government levies obtained through fines declines as the proportion of levies obtained from permits, licenses, and taxes increases. This is so because local resource users will have more incentive and greater capability to police adherence with resource management plans.

- Table III-9: Results, farmer perspective

This table shows NPV calculations (over a 20-year period) for the private sector participants based upon data brought in from the soil and moisture conservation module and from calculations of the effectiveness of extension and rural credit (Table III-7). The "no. of farmers" column shows the cumulative total of the number of farmers successfully reached per year as a result of the extension efforts.

- Tables III-10 and 11: Results, donor investments, benefits and net cash flows

These tables summarize the investment, benefits and net cash flows from the donor perspective. Table III-10 shows the investment requirements by year and category for as long as donor support will be required. Table III-11 includes donor benefits such as freed up food aid supplies a result of higher food production in the target region, and the global climate change values of fixing carbon.

TABLE III-9 RESULTS: FARMER BENEFITS ($)

Year	No. of Farmers	$Cash Flow/Ha	TOTAL
0	656	-447	-1173345
1	1356	-303	-1641355
2	2104	69	580139
3	2901	60	691769
4	3751	52	779852
5	4659	444	8272757
6	5627	460	10352410
7	6661	423	11261148
8	7763	417	12946009
9	8940	412	14738597
10	10195	408	16649844
11	11534	504	23235157
12	12963	483	25059250
13	14488	467	27040280
14	16115	453	29195235
15	17500	442	30919720
16	17500	423	29599520
17	17500	417	29193434
18	17500	412	28860444
19	17500	408	28587391
20	17500	405	28363488
NPV (at farmer persp. disc. rate)			18086808

TABLE III-10 RESULTS: DONOR INVESTMENTS ($)

Year	TA	Training	Vehicles	Bldngs	HC Staff	Supplies	Tot. Inv.
0	382179	72996	120310	56571	307500	698825	1638381
1	382179	72996	120310	56571	307500	698825	1638381
2	382179	72996	120310	56571	307500	698825	1638381
3	382179	72996	120310	56571	307500	698825	1638381
4	382179	72996	120310	56571	175000	0	807056
5	382179	72996	120310	56571	175000	0	807056
6	0	0	0	56571	0	0	56571
7	0	0	0	56571	0	0	56571
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0

TABLE III-11 RESULTS: DONOR BENEFITS AND NCF ($)

Year	Food Aid	Carb. lock	TB	NCF (B-C)
0	202289	303	202591	-1435790
1	342867	626	343493	-1294889
2	436007	970	436977	-1201404
3	493016	1338	494354	-1144028
4	522818	1730	524548	-282508
5	532431	2149	534580	-272476
6	879836	2596	882432	825860
7	853939	3072	857011	800440
8	816136	3581	819717	819717
9	770643	4123	774766	774766
10	720655	4702	725358	725358
11	5213332	5320	5218652	5218652
12	4804582	5979	4810561	4810561
13	4403169	6683	4409852	4409852
14	4016056	7433	4023489	4023489
15	3576234	8072	3584306	3584306
16	2256034	8072	2264106	2264106
17	1849948	8072	1858020	1858020
18	1516957	8072	1525029	1525029
19	1243905	8072	1251977	1251977
20	1020002	8072	1028074	1028074
NPV				1079437

- Tables III-12, 13 and 14: Results, host country investments, benefits and net cash flows

Host country benefits and costs are summarized in Tables III-12, 13 and 14. Table III-12 shows the investment requirements by year and category after donor support has ended. Note that the host country investments become zero after year 14 in this example. This is because the upper limit of "farms where extension is judged possible" (17,500 farmers in Table III-7) will be reached that year as shown in Table III-9. Tables III-13 and 14 include the full range of host country benefits considered in this study -- non-product benefits such as fees, permits and taxes as a result of higher food and wood production in the target area. Tables III-13 and 14 benefits make up the Total Benefits column in Table III-14. Table III-15, the last results table in the planning module, restates the dollar value benefit stream to the host country by product -- crops, wood, poles, logs, forage and other products.

TABLE III-12 RESULTS: HOST COUNTRY INVESTMENTS ($)

Year	Training	Vehicles	Bldngs	HC Staff	Supplies	Tot. Inv.
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	650025	650025
5	0	0	0	0	650025	650025
6	9816	97190	0	257500	650025	1014531
7	9816	97190	0	257500	650025	1014531
8	9816	97190	21000	257500	650025	1035531
9	9816	97190	21000	257500	650025	1035531
10	9816	97190	21000	257500	650025	1035531
11	9816	97190	21000	257500	650025	1035531
12	9816	97190	21000	257500	650025	1035531
13	9816	97190	21000	257500	650025	1035531
14	9816	97190	21000	257500	650025	1035531
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0

TABLE III-13 RESULTS: HOST COUNTRY BENEFITS, PRIVATE SECTOR

Year	Increased Tax Payment	Commerce Permits	Coop Extension	Total Private Sector Benefits
0	492	37760	6563	44815
1	1017	64002	13565	78584
2	1578	81388	21036	104001
3	2176	92029	29008	123213
4	2814	97592	37514	137920
5	3494	99387	46590	149471
6	4221	164235	56274	224730
7	4996	159401	66607	231003
8	5822	152345	77632	235799
9	6705	143853	89396	239953
10	6746	134522	101948	244116
11	8651	973150	115341	1097142
12	9722	896851	129631	1036204
13	10866	821921	144879	977665
14	12086	749660	161148	922894
15	13125	667560	175000	855685
16	13125	421124	175000	609249
17	13125	345322	175000	533447
18	13125	283164	175000	471289
19	13125	232194	175000	420319
20	13125	190399	175000	378524

TABLE III-14 RESULTS: HOST COUNTRY BENEFITS AND NCF ($)

Year	Fees	Permits	Mkt Tax	Fines	TB	NCF (B-C)
0	82204	10275	15413	10275	162983	162983
1	288154	36019	54029	36019	492805	492805
2	407975	50997	76495	50997	690465	690465
3	518604	64826	97238	64826	868706	868706
4	624038	78005	117007	78005	1034975	384950
5	816973	102122	153183	102122	1323870	673845
6	1082989	135374	203060	135374	1781526	766995
7	474899	59362	89043	59362	913670	-100861
8	480705	60088	90132	60088	926812	-108719
9	484804	60601	90901	60601	936859	-98672
10	488591	61074	91611	61074	946465	-89066
11	2339986	292498	438747	292498	4460872	3425341
12	2201321	275165	412748	275165	4200603	3165072
13	2067475	258434	387652	258434	3949661	2914130
14	1941402	242675	364013	242675	3713659	2678128
15	1789267	223658	335488	223658	3427757	3427757
16	1252780	156578	234896	156598	2410121	2410121
17	1087760	135970	203955	135970	2097101	2097101
18	952443	119055	178583	119055	1840426	1840426
19	841483	105185	157778	105185	1629952	1629952
20	750496	93812	140718	93812	1457363	1457363
NPV						5090360

TABLE III-15 RESULTS: HOST COUNTRY BENEFITS BY PRODUCT ($)

Year	Crops	Wood	Poles	Logs	Forage	Other
0	118168	0	0	0	0	0
1	200287	0	0	0	213935	0
2	254695	0	0	0	331768	0
3	287997	0	0	0	457497	0
4	305406	0	0	0	591649	0
5	311022	12859	8573	0	734709	107157
6	513960	15532	10354	0	887520	129430
7	498832	18383	12256	0	0	153196
8	476749	21426	14284	0	0	178553
9	450174	24673	16449	0	0	205610
10	420974	28138	18758	0	0	234480
11	3045390	31834	21223	0	0	298152
12	2806616	35778	23852	0	0	333221
13	2572129	39987	26658	0	0	370641
14	2345996	44477	29651	0	0	402505
15	2089072	48300	32200	0	0	402500
16	1317871	48300	32200	0	0	402500
17	1080871	48300	32200	0	0	402500
18	886137	48300	32200	0	0	402500
19	726632	48300	32200	0	0	402500
20	595838	48300	32200	0	0	402500