INTERNATIONAL CONSULTING DIVISION

PD-ABI-152

CHEMONICS

MALI FORESTRY SECTOR REFORM PROGRAM

FINANCIAL AND ECONOMIC ANALYSES AND OVERVIEW OF NATURAL RESOURCES MANAGEMENT ACTIVITIES

Delivery Order No. 15

ENVIRONMENT IQC

Contract No. PDC-5517-I-00-0103-00

Prepared by:

G. Edward Karch
Jon Anderson

Prepared for:

U.S. Agency for International Development
Bamako, Mali

March 1994

2000 M St., N.W.
Suite 200
Washington, D.C. 20036

Tel: (202) 466-5340 or 293-1176
Fax: (202) 331-8202
ITT Telex: 1440361 CHNC UT

TABLE OF CONTENTS

			Page
FOREWORD			i
SECTION I	FINANCIAL AND ECONOMIC ANALYSES		I-1
	A.	Summary	I-1
	B.	Overview of Economic Analysis Concepts	I-2
	C.	Economic Analysis of the Non-project Assistance Component	I-3
	D.	Analysis of the Project Assistance Component	I-3
	E.	Part 5: Limitations of Cost-Benefit Analysis for Natural Resources Investments	I-16
SECTION II	THE NATURAL RESOURCES MANAGEMENT PROCESS		II-1
	A.	Experience to Date: Models for Support to Local Communities	II-1
	B.	The Decentralized NRM Process and Possible Project Support	II-15
	C.	Examples of Natural Resources Management Technologies	II-18
	D.	Improved Agronomic Practices	II-28
	E.	Improving Soil Fertility through Manuring, Fertilizer Use, and Increased Fallow	II-29
	F.	Controlled Burning and Firebreaks	II-30
	G.	Integrated Forage Crop Production and Pasture Management Schemes	II-31
	H.	Summary	II-31
	I.	Proposal: Conditionality on a Process of Policy Analysis and Reformulation	II-32
	J.	Restructuring the Forest Service	II-33
	K.	Research and Study Component	II-34
	L.	Ideas for a Section about Rule Making	II-37
	M.	Local-level Monitoring	II-38
	N.	Development of an Effective Management System for Public Lands	II-39
	O.	Ideas for Training	II-41
	P.	USAID Experience: Village Reforestation Project	II-42
SECTION III	NOTES ON THE LOI D'ORIENTATION		III-1

FOREWORD

This document includes financial and economic analyses for the Mali Forestry Sector Reform Program and an overview of natural resources management activities in Mali. In Section I, economic analyses were carried out to determine if the program is a worthwhile investment for Mali from an economic standpoint. The financial analyses were performed to ascertain if the program is viable and if costs can actually be met by program participants.

The first part of Section II reviews and assesses the natural resources management process to date in Mali and attempts to portray lessons learned from these experiences. The second part of Section II describes various approaches to field-level NRM and discusses technologies that might be used to improve such activities.

This report was written in accordance with the scope of work for delivery order no. 15 of Chemonics International's Environment and Natural Resources IQC, contract no. PDC-5517-I-00-0103-00. Prior to the award of this delivery order, Chemonics was assured by USAID/Mali that the scope of work for this assignment had been developed to deliberately restrict the activities of the design team and thereby prevent any potential conflicts of interest. The work contained in this report was submitted to the mission in draft form and it was agreed that the final document would be further developed and finalized by direct-hire personnel. As per agreement with the mission, Chemonics' personnel did not engage in detailed budgeting, they did not write statements of work or evaluation criteria for the PIO/T or other procurement documents related to the implementation contract, and they did not assign specific levels of effort for technical assistance. These activities were or will be undertaken by USAID personnel.

Finally, all documents generated by Chemonics to assist the design of the Forestry Sector Reform Program will be made available by the USAID contracts officer to all potential bidders for the implementation contract.

SECTION I
FINANCIAL AND ECONOMIC ANALYSES

A. Summary

This section covers both the financial and the economic analyses of the Mali Forestry Sector Reform Program. The purpose of an economic analysis is to determine if a project is a worthwhile investment for the country, i.e., are the outputs from the project sufficiently valuable to warrant the expenditure of scarce resources.

The financial analysis, on the other hand, has two purposes. One is to determine if the project is financially viable and has a monetary value to the participants (i.e., is the stream of benefits sufficiently larger than the stream of costs to provide a financial incentive to the Malian farmer to participate). The second purpose is to determine if the stream of projected costs can actually be paid for by participants, as envisioned in the project implementation schedule (see USAID Handbook 3).

As discussed below, a cost-benefit analysis of the non-project assistance component of the Mali Forestry Sector Reform Program is unnecessary. The results of the project assistance portion of the program show a positive net present value at a discount rate of 10 percent, and an internal rate of return of 20 percent for the financial analysis and 24 percent for the economic analysis . These rates are sufficient to recommend project implementation.

There are three parts to this economic section: Section B presents an overview of economic analysis concepts; Section C discusses the economic analysis of the non-project assistance component of the Mali Forestry Sector Reform Program (as will be explained, a cost-benefit analysis is unnecessary); and Section D presents an analysis of the project assistance component of the program. Section D is divided into discussions on the evolution of the cost-benefit model used in the analysis, and the operation of the model, including the following sections:

- Overview
- Partial Budgets for Crop Production
- Partial Budgets for Agroforestry Practices
- Partial Budgets for Soil and Water Conservation Practices
- Partial Budgets for Natural Forest Management
- Application of Biological Production and Soil Degradation Functions
- Extension and the Spread Rate
- Results of the Financial Analysis
- Results of the Economic Analysis
- Sensitivity Analyses

B. Overview of Economic Analysis Concepts

As defined in USAID Handbook 3 and the USAID Manual for Project Economic Analysis, the purpose of economic analysis is to measure the social profitability of a project, that is, the relationship of the costs incurred to the benefits obtained by the society as a whole. The underlying principle of economic analysis is to compare the real benefits of any given project with its real costs. The larger the discounted benefits for a given set of costs, the more worthwhile the project. The primary task of economic analysis is to measure these costs and benefits in terms of a common yardstick. This involves measuring the real value of any input or output, and comparing inputs and outputs across time.[1]

Financial analysis compares the stream of nominal benefits from any project to the stream of nominal costs. Nominal costs and benefits generally involve the use of local market prices. If the present value of benefits is substantially larger than the present value of the costs, then the project is profitable. Financial analysis is used to measure private profitability, i.e., whether a project is profitable from the point of view of the participants, in this case farmers. Farmers face market prices, pay taxes, receive subsidies, etc. If the financial analysis results in an adequate financial return, i.e., above what might be earned by alternative use of resources, then it is likely that participants will behave in ways projected by the project design.

The most common of the discounted measures used to determine if a given project is economically worthwhile are the net present value, the internal rate of return, and the discounted benefit cost ratio.

Net present value is calculated by discounting the value of all future incremental net benefits or incremental cash flows to their present equivalent value using the opportunity cost of capital. A positive net present value indicates that the project returns more to society than it consumes and should be accepted.

The internal rate of return is the discount rate that equates discounted costs and discounted benefits (i.e., it reduces the present value of the incremental benefit stream to zero). The higher the internal rate of return, the more profitable the project. A project cannot be justified on economic grounds if the internal rate of return is below the opportunity cost of capital.

The benefit-cost ratio is the sum of all of the discounted benefits divided by the sum of all of the discounted costs. If this ratio is higher than one, the project is economically viable. This analysis of the Mali Forestry Sector Reform Program does not include a benefit-cost ratio, *per se*, since costs are netted out during the analysis and only incremental

---

[1] When outputs are quantifiable, but not easily reduced to monetary values (e.g., the protection of wilderness areas), economic analysis can permit project designers to identify the least-cost design from among alternative designs. In least-cost analysis, the smaller the costs for any given set of benefits, the more worthwhile the project.

values are dealt with. Nevertheless, if the net present value is positive, the benefit-cost ratio will be greater than one.

The project planning horizon defines the beginning and ending points covered by the analysis. The beginning point coincides with the start-up of the project. The ending point selected for this analysis is 50 years. All gains and long-term practices will be effective within this period of time. While a longer planning horizon is justified, particularly for projects with long lasting environmental costs or benefits, the discounting process causes future benefits to have diminishing present values in the latter years. Normally, benefits realized far into the future will not have a significant impact on the analysis. The stream of benefits and costs beyond the terminal year of the project are included in the analysis at their discounted value, as environmental effects do not stop or reverse at the end of the project.

C. Economic Analysis of the Non-project Assistance Component

There are two parts to the economic analysis of the Mali Forestry Sector Reform Program. These are the economic analysis of the non-project assistance component and the economic analysis of the support project assistance (i.e., technical assistance, training, nongovernmental organization grants, etc.). The actual benefit of the policy reforms themselves are accounted for in the returns generated by the adoption of natural resources management practices. As non-project assistance only deals with society as a whole and not with individuals, a financial analysis of the non-project assistance is not appropriate.

For cash transfer under the non-project assistance component, a cost-benefit analysis is also not appropriate. The cost of non-project assistance cash transfer is the opportunity cost of $5 million invested at an assumed rate of return of 10 percent per year. The benefit to Mali of the dollar is equivalent to the amount of the dollar transfer converted into local currency at the shadow price of foreign exchange. Since the exchange rate for the CFA Franc is pegged to the French franc and set by a free market, there is no shadow rate. At the resulting one-for-one ratio, the net present value of non-project assistance payments will always be zero.

Therefore, neither an economic nor a financial cost-benefit analysis of the non-project assistance component of the Mali Forestry Sector Reform Program would be meaningful.[2]

D. Analysis of the Project Assistance Component

For project assistance activities, the analyses are more complicated. Both the economic and the financial analyses are based on a model of costs and benefits called a partial farm budget with and without analysis. This type of analysis compares net returns of the production of crops (the without case) with the incremental net returns from natural resources management practices plus net returns from the base crop production, adjusted for any effects from the natural resources management practices (the with case).

---

[2] Smith, James, "Cost/Benefit Calculations of NPA Programs," AID/AFR/DP, 1991.

3

In order to compare these two practices the costs of doing either practice have been previously deducted by removing an equivalent amount of benefits. The value remaining is the net benefit. Thus, the value with the natural resources management practice is higher than without. The analysis has been broken down into modules that consider different aspects of the analytical process. The modules are:

- budget module
- practices module
- bio-time module
- extension module
- results module

D1. Evolution of the Cost-benefit Model Used

This analysis uses the standard cost-benefit approach. It is based on a model that relies on relatively solid data and incorporates a strong analytical understanding of the biological and economic relationships of resources-conserving technologies in the Sahel. This data and analytical underpinning are the result of a series of modelling efforts of such technologies in the Sahel conducted for USAID, beginning in 1987 and based on earlier work done under the USAID-funded Energy Initiatives for Africa project, 1983-1987.

The model was initially developed to analyze the results of a study of successful natural resources management initiatives in the Sahel.[3] The third volume of that report contains the results of the first modelling attempts. The model was developed by Karch, Christophersen, and McGahuey. The model was further refined during background work for preparing USAID's *Sahel Sub-Regional Strategy to Sustain Productivity.*[4]

This model was again modified and used in the preparation of a series of natural resources management action plans and action programs prepared under the USAID Natural Resources Management Support Project. This specific model was used in preparing the action plans and programs for USAID missions in The Gambia, Senegal, Guinea, Mali, and Uganda.

The framework was refined in 1990 to ensure that the biological assumptions more accurately reflected yield increases over time from resources-conserving technologies and was used as the basis for a USAID study of the Economic Incentives for Natural Resources Management.[5] This report served as input for the identification of impact indicators for several missions involved in natural resources management.

---

[3] A. Shaikh, et al, *Opportunities for Sustained Development: Successful Natural Resources Management in the Sahel*, 3 volumes, U.S. Agency for International Development, 1988.

[4] USAID, *The Sahel Sub-Regional Strategy to Sustain Productivity.* USAID/AFR/TR/ARD, Washington, 1989.

[5] Christophersen, Karch, and Arnold, *Economic Incentives for Natural Resources Management*, Special Study No. 4 of the NRMS project, August 1990.

The model served as a framework for analyzing resources-conserving technologies in Senegal in 1991.[6] During that effort, research and project results were collected from a wide range of sources on the biological and economic relationships of resources-conserving technologies, and reviewed by a committee of agroforesters and resources economists. The effort resulted in the biological production functions used in this cost-benefit analysis.[7] The Senegal effort, which was under the auspices of the USAID-funded Senegal Reforestation project, involved the financial analysis of a variety of agroforestry practices being used in the Peanut Basin. The purpose was to identify those practices that were financially most profitable and hence showed the greatest potential for acceptance by farmers.

The model was peer-reviewed at an international workshop on agroforestry economics in Hawaii in 1991.[8] Following the workshop, the model was revised to permit the simultaneous analysis of a number of practices, rather than each practice independently. This combination package approach was tested during an economic and financial analysis of the USAID-funded Haiti Agroforestry II project. At the same time, nongovernmental organizations working in Haiti were trained in the use of the model to enable them to report on the economic impact of their agroforestry activities.[9]

The model was further refined and used for the economic and financial analysis in the design of the Gambia Agriculture and Natural Resources Program in 1992. It was again peer-reviewed by economists from the University of Maryland and the Environmental Planning and Training project. Suggestions from that review have been incorporated into this version of the model.

---

[6] Karch, *Comparison of Agroforestry Practices in Senegal Using Financial Analysis*, 1991.

[7] The information collected included costs, production, prices, techniques, and so forth. For example, information on windbreaks came from research in Nigeria, Niger, and Senegal. Information on field trees came from Senegal and were based on research by the French over a 20-year period. Data on field border plantations came from East Africa and the Senegal Agroforestry Research Station. Information on pole plantations came from the Senegal Reforestation project and the Village Reforestation project in Mali. Alley cropping information came from the Senegal Agroforestry Research Station. Plant competition data on windbreaks came from Niger and northern Senegal. Live fence information came from the Village Reforestation project in Mali. Data on the production of leafs and pods from field trees came from Senegal. Data on field reclamation and land stabilization came from the Village Reforestation project in Mali and the Dutch-funded Soil Conservation project in Mali.

[8] Karch, G.Edward, 1992, "Comparison of Agroforestry Practices in Senegal Using Financial Analysis," in *Financial and Economic Analyses of Agroforestry Systems*, Nitrogen Fixing Tree Association, USAID/U.S. Forestry Service (Forestry Support Program), Environment and Policy Institute, East-West Center, Honolulu, Hawaii.

[9] Kent Fleming and G. Edward Karch, *Economic Indicators of Agroforestry II Strategy Implementation: Farm Income Analysis to Agricultural Project Analysis*, SECID/Auburn Agroforestry Publication No.37, 1992.

D2. Operation of the Model

D2a. Overview: Creation of Farm Budgets

The analysis begins with the creation of partial farm budgets (the Budgets Module). These are minicost-benefit analyses of each crop. Because each crop has different input requirements and yields and sells for a different price, it is treated separately and the results are later aggregated. For each crop budget, information was collected on the costs of tillage, planting, weeding, and harvest.

Tillage involved estimating the cost and amount of human labor needed, as well as the cost of any animal traction. Planting involved these same costs, plus the cost of seed, dressing, and fertilizer. Weeding involved human labor and, in some cases, animal traction and possible herbicide costs. Harvest involved human labor and animal traction. The combination of input factors varied by crop.

The cost of animal traction was calculated based on the costs of feeding, maintaining, and training the animals, and the cost of required tools. It is assumed that half of the farmers have access to animal traction, either through ownership, rental, or mutual exchange. It is further assumed that the cost of ownership of animal traction is the same as the cost of rental.

General Assumptions: Farmgate prices

1$=	300 cfa
Labor rate 1	500 cfa
Labor rate 2	0 cfa
Pole price/M	1,000 cfa
Pickets	50 cfa
Wood Price/stere	2,000 cfa
Round wood/M3	2,000 cfa
Fodder/pod	50 cfa
Gathered	270 cfa
Millet	75 cfa
Sorghum	75 cfa
G.nut	35 cfa
Cotton	85 cfa
Maize	75 cfa
Rice	188 cfa
Meat	155 cfa
Milk	100 cfa

Table I-1

The primary source for the crop budgets used in this analysis was the Institut d'Economie Rural. These budgets were calculated based on the collection of field data. The data contained in the crop budgets were adjusted by averaging mechanized and traditional practices. Data on crop yields and farm gate prices came from a variety of sources listed in the bibliography.

Yields and prices are used to calculate gross returns per hectare per crop. From the separate crop budgets one can obtain total costs and subtract those from the gross returns. The result is the net returns that are then input into the practices module. Also inputed into the practices model are the hectares cultivated for each crop and an estimate of hectares intercropped. These figures, averaged from 1985-1993 Famine Early Warning System data, are use to calculate the percent of land area used by each crop.

The practices module contains all of the basic assumptions, such as prices, degradation rate, land-use allocation, and natural resources management budgets. One of the general assumptions is an annual decline of 3 percent in soil productivity, based on estimates from previous analysis in Mali. This percentage decline is used as a proxy of the soil productivity decline or soil degradation rate.

Base-case Hectare: Net Return per Hectare: 17815 cfa

Crops	% Total Ha	% Agric Ha	Net Return	Net/Ave Ha
Millet	5.9%	57.3%	56,156	3,317 cfa
Sorghum	3.4%	32.6%	49,593	1,667 cfa
G.nut	0.8%	8.0%	10,223	84 cfa
Cotton	0.2%	2.2%	40,106	91 cfa
Maize	0.6%	6.2%	87,624	560 cfa
Rice	0.7%	6.9%	112,742	802 cfa
Intercrop	3.7%	35.9%	52,874	1,957 cfa
%Total 10%		Crops Net Value/Ha:	8479 cfa	

Forest			Price/Unit	Value/Ha
Poles M/ha	2	annual	1,000 cfa	1,786 cfa
Stakes, Lath	25	annual	50 cfa	1,116 cfa
Fuelwood St/ha	1	annual	2,000 cfa	1,786 cfa
Roundwood Cu M/ha	1	annual	2,000 cfa	1,786 cfa
Gathered	3	annual	50 cfa	121 cfa
%Total 89%		Forest Net Value/Ha:	6,595 cfa	

Grazing					
0.10 TAU/Ha	Kg/TAU	Kg/Yr	Price/Kg	Farm Gate	
10% offtake	250	2.5	155 cfa	353 cfa	
	L/TAU	Days	L/Year	Price/L	Farm Gate
1.5 L. milk	0.05	350	26	100 cfa	2,389 cfa
%Total 91%					

Table I-2

In the practices module, a base-case hectare without natural resources management practices is calculated. The base-case hectare serves as a common denominator for the with and without analysis. This is the current net farm income per hectare. The base-case hectare incorporates all three base activities: crops, forest, and grazing. The percentage of each type of land use was taken from land-use types in the forest inventory. These are: 10 percent for crops, 89 percent for forest, and 91 percent for grazing. This totals 201 percent of the land use. This reflects the fact that there are often several uses of land occurring on the same area at the same time. Few practices are exclusive users of land. Land is intercropped and double cropped, and there is off-season grazing on cropland and grazing in forests throughout the year. If the same base percentages are used for both the with and without calculations, the actual percentage does not effect the analysis outcome.

Cropland is broken down into the percentage of land under each crop. This breakdown comes from Famine Early Warning System production statistics and is adjusted to the 10 percent total crop area. The breakdown is seen in Table I-2.

For cropland the net value per hectare is multiplied by the percentage of land under each crop. The result is totalled for all crops, giving the net value per hectare for these crops. This constitutes the crops portion of the base-case hectare.

Forest lands constitute 89 percent of the manageable land area in Mali. Of this, 9 percent is in national forest, parks, or réserves de faune. Thus an estimated 89 percent of the manageable land in Mali is forest land that has a

Land Classification	Hectares	% of Manageable Land
Domaine Classé		
Forêt Classé	1,329,823	2.6 \
Parc National	350,000	0.7 9.0
Réserve de Faune	2,945,440	5.7 /
Domaine Protégé		
Woody Vegetation*	32,587,735	63.6 \
Agricultural Reserve	8,582,744	16.7 - 80.3
Domaine Agricole		
Cultivation & Fallow	5,481,654	10.7
Total Manageable Land	51,277,396	100.0

Table I-3

productive use. To estimate the forest portion of the base-case hectare, the amount of fuelwood and other forest products gathered is estimated. The labor entailed in gathering these products is deducted to come up with a net value, which is then multiplied by 89 percent to arrive at the forest portion of the base-case hectare.

To calculate the grazing contribution to the base-case hectare, the number of animals (in terms of tropical animal units), is calculated together with meat and milk production and pricing The cost of labor is then deducted. This provides a net value from grazing. This value is multiplied by 91 percent to get the grazing contribution to the base-case hectare.

The crop, forest, and grazing portions of the base-case hectare are combined to create a base-case hectare. This is essentially the net return per hectare in Mali, based on current land management practices (the without case).

Percent of Land Practices under Management Plans	
2.0%	Field Trees
0.1%	Block Plantation
0.01%	Windbreak
0.1%	Live fence
0.1%	Border (field)
4.0%	Land stabilization
4.0%	Field reclamation
10.3%	Agroforestry and soil and water conservation
89.3%	Natural forest management
91.0%	Grazing management
201%	Total land area managed

Table I-4

The next step is to calculate partial farm budgets incorporating the use of natural resources management practices (the with case). Natural resources management practices considered are presented in Table I-4. Estimates were made of the percent of land use for each practice. These percentages were estimated based on practices already underway in Mali.

A natural resources management budget was prepared for each practice. Examples illustrating the format are seen in Tables I-5 to I-7. It must be kept in mind that the values included in these tables are not static. Changes in inputs outside of the table can affect the values within them. Essentially, these tables represent integrated formulas. The values therein are the outcome resulting from the assumptions made earlier in the analysis. Modifying the assumptions will necessarily change the values in these tables.

D2b. Partial Budgets for NRM Practices

Each natural resources management budget assumes that the normal practice is crop production in most cases and that

9

```
Border (field)
Trees/ha, 5x5 spacing, 1 row: 80/ha
Cropping space lost: 6 m2/tree
500 m2 total = 5.00% of land area

Fencing                        0 cfa
Plants    25               2,000 cfa
Transport                      0 cfa
Tools                          0 cfa
Pesticide                      0 cfa
Fertilizer                     0 cfa
Labor (3 days, rate 1)     1,500 cfa
Establishment Total        3,500 cfa

  X 1% (area effected by practice) = 35 cfa

Maintenance
Spot (2 days in years 1,2)   1,000 cfa
Annual (0 days)                  0 cfa
Maintenance Total            1,000 cfa

  X 1% = 10 cfa

Benefits
Poles M/tree      0 per coppice (1,000 cfa) =       0
cfa
Pickets          10 per coppice (50 cfa)    =     500
cfa
Fuelwood St/ha   10 per coppice (2,000 cfa) =  20,000
cfa
Roundwood M3/ha   0 per cut (0 cfa)         =       0
cfa
   (coppice is each 5 years, starting in year 7)
Total Benefits per coppice = 20,500 cfa
  X 1% = 205 cfa

Net Crop Value/ha (practce has no effect:     0 cfa
Fodder and pod (100 kg/yr)                  300 cfa
Total Annual Benefits/year                  300 cfa
  X 1% = 3 cfa
```

Table I-5

any introduced practice takes up area currently dedicated to crop production and therefore will entail additional costs.

The analysis contained in these NRM budgets is illustrated using the case of field borders seen in Table I-5. It is assumed that there is 5x5 meter spacing in a single row all around the field, or 80 trees/hectare. At 6 square meters per tree, this is roughly 500 sq meters of land lost to production, or 5 percent of the total land area.[10] Costs are calculated for the trees themselves, the labor involved in planting and protecting them, and their maintenance (assumed at 2 days/year in years 1 and 2). In terms of benefits, production is estimated at 10 pickets and 10 steres of fuelwood per hectare in year 7 and every five years thereafter. The trees will be lopped for fodder during the dry season, and a value is estimated for that. The quantity of each output is multiplied by the price to get a gross value per hectare from the border plantings.

The net value per hectare for borders is calculated by reducing the base-case hectare by 5 percent to compensate for lost land, and multiplying it by the percent of land under the particular practice (in this case 1 percent for border trees). This gives an interim crop value per hectare from this particular natural resources management agroforestry activity—one that does not yet deal with the impact of border trees on crop yield, e.g., from nitrogen fixation or competition. This will be estimated later in the analysis.

Using the above approach, interim crop values per hectare are calculated for each natural resources management agroforestry activity.

---

[10] The actual land requirement of a border tree is estimated at 12 square meters, but half of that in on someone else's hectare or a footpath. In the field tree partial budget, field trees are assumed to take up 4 square meters each. This lower figure comes from assuming that the tree species used for field trees is *Faiderbia albida*. Since *F. albida* drops its leaves during the rainy season and thus does not shade growing crops, the only significant effect on land availability is the trunk.

D2c. Partial Budgets for Soil and Water Conservation Practices

Partial budgets were also created for soil and water conservation practices.

Field reclamation. Field reclamation is the reclaiming of former agricultural lands that have degraded to the extent that they are no longer usable. This is done by the use of zais, vegetative bands, seeding, termite mound reclaiming, fertilization, mulching, and other techniques. Benefits are the new production of the reclaimed land. Inputs are usually provided by the individual farmer.

Land Stabilization on 4% of Crop Land (gulley plugs, cordon pierre, fascine, digettes)	
Transport	2,000 cfa
Tools	500 cfa
Labor (0 individuals @ 120 (group rate 2))	0 cfa
Establishment X 4%	100 cfa
Maintenance (5 days @ rate 2)	0 cfa
Maintenance X 4%	0 cfa
Crop value (218 cfa/ha/year)	9 cfa
(Value of 10% (crop land) of the base hectare = 218 cfa X 4% = 9 cfa)	
Field Reclamation (digettes, demilunes, zai, mulch, seeding)	
Labor (2 individuals @ rate 1)	1,000 cfa
Establishment X 4%	40 cfa
Maintenance (1 day @ rate 1)	0 cfa
Maintenance X 4%	0 cfa
Crop Value (218 cfa/ha/year)	9 cfa
Fodder and pod (360 cfa x 4%)	14 cfa

Table I-6

Land stabilization. This is the improvement of the productive capacity of the land using filter dikes, gulley plugs, grass strips, facines, and other soil and water conservation techniques. Benefits are increases in yields from increased water infiltration and decreased runoff and erosion. Inputs may be individual or group actions.

D2d. Partial Budgets for Natural Forest Management

No crop value is considered for natural forest management. Labor costs are estimated for early burning and patrolling to control access. These are the two major forms of management presently seen in Mali. Forest production is in the form of poles, pickets, roundwood, fuelwood, and gathered materials (medicinals, honey, etc.).

D2e. Partial Budgets for Grazing Management

Grazing management is a resultant increase in animal production from other land use practices that increase vegetation used for feed, along with some cases of stabling and feeding for the production of manure, milk, and animal traction. Contra-season grazing on crop lands is not managed. Farmers are not specifically producing the residue for fodder. Grazing returns are in the form of meat and milk. The values are based on a higher carrying capacity per hectare. Production levels and prices were calculated based on data from the TAMS Annex III (1983) and interviews with USAID livestock personnel.

D2f. Application of Biological Production Functions and Soil Degradation Rates

The bio-time module applies biological production functions to the interim crop values to obtain cash flows per hectare. The biological production functions represent the changes in yield (or value) over time due to specific practices. Introducing the time factor is necessary, since the effects of natural resources management practices will vary over time. For example, the effect of windbreaks on crop yields will be low in the early years, when the trees are small. As the trees mature their impact in terms of conserving soil moisture (by reducing wind) increases, but they also begin to compete with crops for soil moisture. Eventually, the negative effect of competition outweighs the positive effect of the moisture protection. Thus the biological production function for windbreaks is a bell-shaped curve.

Natural Forest Management on 89% of Manageable Lands

Establishment	Ha	Price/Unit	Total
Delimitation	0		0 cfa
Fencing	0		0 cfa
Firebreaks	0		0 cfa
Burning	0		0 cfa
Planting	0		0 cfa
Establishment Total			0 cfa
X 89% = 0 cfa			
Labor (105 person-days @ rate 2)			0 cfa
Total			0 cfa
X 89% = 0 cfa			
Maintenance			
Spot (0 days)			0 cfa
Annua (10 person-days @ rate 2)			0 cfa
Total			0 cfa
X 89% = 0 cfa			
Benefits			
Poles M/ha	5 annual	1,000 cfa	X89% = 4,465 cfa
Pickets	50 annual	50 cfa	2,233 cfa
Fuelwood St	4 annual	2,000 cfa	7,144 cfa
Roundwood M3	2 annual	2,000 cfa	3,572 cfa
Gathered	5 annual	270 cfa	1,206 cfa
Total			18,619 cfa
Crop value (0 cfa) = 0 cfa			

Table I-7

Bio-economic Functions: Percent Change

Year >	0	1	2	3	4	5	6	7	8
Live fence incr. in yield		4%	7%	12%	17%	20%	20%	20%	20%
Leaves/pods (%of full prodn.)		0%	0%	0%	2%	3%	5%	7%	9%
Field reclamation prodn.	120%	120%	120%	120%	120%	120%	120%	120%	120%
Land stabilization prodn.	120%	120%	120%	120%	120%	120%	120%	120%	120%
Windbreak increase in yield		4%	7%	12%	17%	19%	20%	20%	20%
Net windbreak increase in yield		4%	7%	11%	14%	14%	10%	5%	1%
C increase in yieldompetition		0%	0%	-1%	-3%	-5%	-10%	-15%	-19%

Table I-8

Table I-8 provides the biological production functions for each agroforestry or soil conservation practice considered in this analysis. These functions reflect percent changes in normal crop yields due to the practices over the entire Project Planning Horizon. As noted earlier, these biological production functions are the result of an in-depth analysis of experience with resources-conserving technologies in Africa, particularly in the Sahel. (Due to space limitations Table I-8 only presents data for the first nine years.)

For each practice, the incremental crop value is derived from the application of the production function to the interim crop value. Other costs and benefits are allocated to the time space in which they occur. The soil degradation rate is applied to the net crop value of the without case over time, which results in a declining yield over time.

D2g. Extension and the Spread Rate

The without case from the bio-time module and the with case from the bio-time module are compared to find the incremental value, the difference between the with and without natural resources management cases. This incremental value is multiplied by the spread rate. This process is illustrated in Table I-9.

The spread rate is the rate at which this technology is projected to be adopted, either due to extension or demonstration. In the present case, the spread rate is an arithmetic function that would cover all manageable lands in Mali in a period of 20 years. The spread rates used in this analysis are considered conservative. Spread rates will probably differ for different practices since farmers will show preferences and changes in policy will effect rates. As this can not be foreseen, a flat rate has been chosen for all practices.

Table I-10 presents the format for this analysis that extends for 50 years in the model. This combines the spread rate with annual incremental value to calculate final cash flow that is discounted to gives the net present value. These calculations involve a number of steps:

- In year 1, the number of new hectares is multiplied by the incremental value to give an aggregate incremental value for that year.
- In year 2, the number of new hectares is multiplied by the incremental value in year 1, and the number of original year 1 hectares is multiplied by the incremental value in year 2, to give an aggregate incremental value for year 2.

Extension and Spread Rates

Year	0	1	2	3	4	5	6	7	8	9
Ha affected	4000	6400	10240	16384	26214	41943	67109	107374	171799	274878
New ha	4000	2400	3840	6144	9830	15729	25166	40265	64425	103079
% of Land Practices under Management Plan										
Field Trees	80	128	205	328	524	839	1342	2147	3436	5498
Block Plantation	4	6	10	16	26	42	67	107	172	275
Windbreak	0.4	0.6	1.0	2	3	4	7	11	17	27
Live fence	4	6	10	16	26	42	67	107	172	275
Border (field)	4	6	10	16	26	42	67	107	172	275
Land Stabiln.	160	256	410	655	1049	1678	2684	4295	6872	10995
Field Reclamati	160	256	410	655	1049	1678	2684	4295	6872	10995
Subtotal	412	660	1056	1689	2703	4324	6919	11070	17712	28340
Natural Forest	3572	5715	9144	14631	23409	37455	59928	95885	153416	245466
Grazing Mgt.	3640	5824	9318	14909	23855	38168	61069	97711	156337	250139

Table I-9

12

Mali Forestry Sector Reform Program
PAAD Economic and Financial Analysis Projecttion and Results

Multipliers of Economic and Financial Sensitivity

1.0	shadow price	Proj. budget:	$10,200,000
1.0	Price	Proj. budget:	3,060,000,000 cfa
1.0	Tax	Discount:	10%
1.0	Crop production	NPV:	454,671,938,011 cfa
1.0	Labor sensitivity	NPV:	$50,519,104,223
1.0	Labor opportunity cost	IRR:	20%
1.0	Spread rate (60%)		

Year	0	1	2	3	4	5
NET RET/Ha						
w/o NRM	17185	17280	16762	16259	15771	15298
w/ NRM	-16602	17056	17051	17051	25088	25087
incr. value	-34417	-225	289	792	9317	9789
Ha affect.	4000	6400	10240	16384	26214	41943
new ha	4000	2400	3840	6144	9830	15729
Tot incr.	-137667222	-1436873	2960600	12970943	244227337	410588974
Project Cash Flow	749,667,222	695,498,379	743,542,876	820,458,352	911,433,964	477,203,660
Project Costs	612,000,000	612,000,000	612,000,000	612,000,000	612,000,000	
YEAR						
0	-137667222	-898046	1156485	3166734	37266134	391568161
1		-82600333	-538827	693891	1900041	22359681
2			-132160533	-862124	1110225	3040065
3				-211456853	-1379398	1776360
4					-338330965	-2207037
5						-541329545

Table I-10

- This process is continued throughout the Planning Horizon.
- All of the aggregated returns are summed and the project costs subtracted, to give the project cash flow.
- After year 20, the remaining cash flow continues to increase as manageable lands continue to increase the amount of returns produced.

It should be noted that the analysis assumes that disbursements of the $10.2 million in project funds begin immediately in year 0 (effectively at the date of obligation) and occur in equal annual amounts, throughout the life of the project.

D3. Results of the Financial Analysis

At a discount rate of 10 percent, the net present value of the proposed project, under the assumptions used in this analysis, is positive, and thus the project is economically viable at that discount rate. The project would stop being viable at a discount rate of 20 percent, the rate at which the net present value of this project would fall to zero. Thus, 20 percent is the project's internal rate of return. If the cost of money is less than 20 percent, the project is viable; if the cost of money is greater than 20 percent, there should be an alternative investment that would give a higher return. Based on these results, it can be concluded that level of return is sufficient to indicate probable financial success of the project and should give sufficient timely returns to the participants to ensure their participation.

If all of the discounted costs and benefits are totaled, and the discounted benefits divided by the discounted costs, the result is the benefit-cost ratio. If this ratio is higher than one, the project is economically viable. The analysis of the Mali Forestry Sector Reform Program has not examined the benefit-cost ratio, as costs were netted out during the analysis and only incremental values remain. Since the net present value is positive, however, the benefit-cost ratio will be greater than one.

D4. Economic Analysis

D4a. Difference Between the Economic and Financial Analysis

As the economic and financial analyses both use the same modeling framework to determine the cash flow, the difference between the two is set by multipliers in the practices module. Prices used in the economic and financial analyses are 1992 producer prices. Farm gate prices are used for most of the economic and all of the financial analysis, as the market is freely functioning with little or no taxation or subsidies. The exchange rate is also determined in a free market. There are no imported inputs provided by the project. The project portion of the program consists primarily of technical assistance, training, and NGO grants. There is no project construction. Fuelwood was shadow-priced at twice the market price to reflect more closely the true cost of production. The opportunity cost of off-season labor is assumed to be zero.

D4b. Economic Analysis Results

The economic analysis returns a positive net present value and shows an internal rate of return of 24 percent. Mali will receive sufficient returns as a society to allocate resources to the Mali Forestry Sector Reform Program.

14

D5. Sensitivity Analyses

Sensitivity analyses address uncertainty. It is not known what will happen to prices or if the extension spread rates will be met, for example. These variables are thus systematically raised and lowered to determine the impact on the results for each unit of variance. Thus the variables tested were:

- Prices of all commodities
- Discount rate
- Spread rate
- Soil degradation rate
- Project budget and distribution
- Crop yields

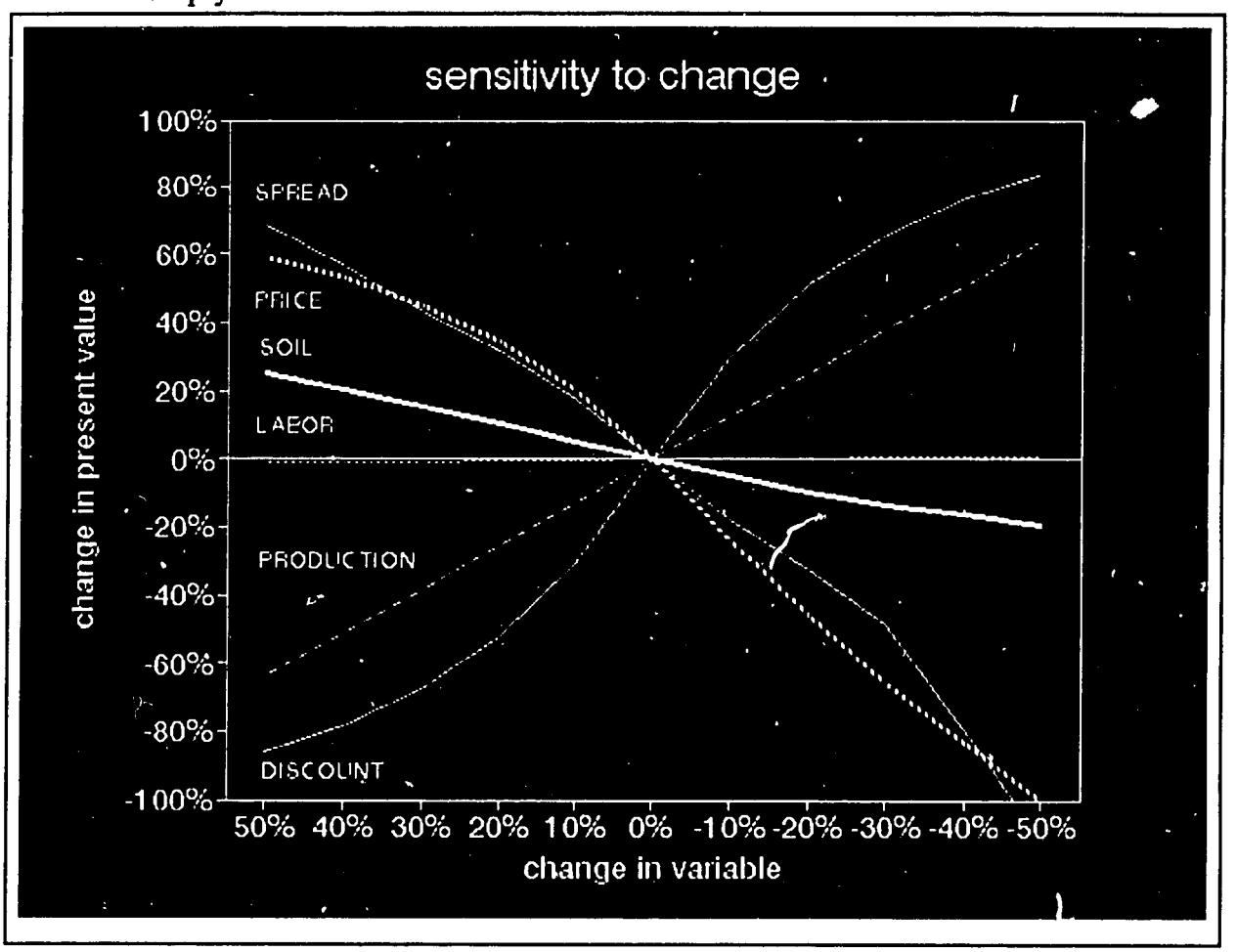

Figure I-1

The results of the sensitivity analysis can be seen in Figure I-1.

Changes up to plus or minus 50 percent, in 10 percent increments, were made to the variables, and resulting percent changes were observed in the net present value. All results

are linear with the exception of price, which varied less with increase than decrease, and discount rate, which is naturally curvilinear and has a direct relation to the net present value. This means as prices increase, they have less and less effect on net present value of the project.

Adding another $2 million to the project results in a reduction of the internal rate of return to 19 percent. Spreading this augmented budget over seven years instead of five years returned the internal rate of return to 20 percent.

Variance in the crop production is similar to the effect of a long-term climatic change. It was found that lowering or raising the crop production inversely varied the net present value. This results from significant diversification of the product mix within the farming system, thus spreading the risk by diversification of the product mix with the addition of cash income from sources other than crops. As crop production increases the net present value decreases because the return being measured is the incremental return, which increases slower than crop production.

Project management should be aware that project success is most sensitive to changes in spread rates and prices. Prices are not usually within the influence of project management, but spread rates can be influenced by emphasis on extension and on the ground activities.

E. Part 5: Limitations of Cost-Benefit Analysis for Natural Resources Investments

The above financial and economic analyses demonstrates that, given the assumptions made, the returns from the proposed Mali Forestry Sector Reform Program are sufficient to justify the project. It can be argued, however, that the economic returns calculated above actually understate the potential benefit of the program to Mali. This is because the standard tools for project economic analysis (e.g., cost-benefit analysis, net present value, internal rate of return) are biased against natural resources-type investments that involve significant inter-generational benefit flows.

The discount rate on which these analytic tools are based is a measure of the time value of money. By definition, the discount rate assumes that a given level of benefit in the future is worth less than the same level of benefit today. The fact that future generations have no voice, and that their willingness to pay is not factored into the analysis of whether to deplete a resource, produces a bias in favor of consumption by the present generation at the expense of the next. This inter-generational equity bias is particularly important for resources-poor countries such as Mali, where dependence on natural resources is likely to remain very high.[11]

---

[11] There is a growing body of literature on the problems of using orthodox economic analysis to evaluate natural resources investments. One reference is the London Environmental Economics Centre, *Environmental Economics in the Developing World*, report to USAID, May 1990 (served as the source of much of the argument presented here). Other references include: Anil Markandya and David Pearce, *Environmental Considerations and the Choice of the Discount Rate in Developing Countries*, World Bank working paper, 1988;

The requirement that projects meet high discount rates shifts cost burdens forward to later generations. It also means that projects with social benefits that occur in the distant future will be discriminated against. For exhaustible resources (e.g., minerals) the higher the discount rate the greater the value of present resources extraction relative to future extraction. This encourages early extraction and accelerates the speed at which the resource is exhausted. Similarly, with respect to renewable resources (e.g., forests) high discount rates on investments encourage exploitation in the present, and thus the depletion of renewable resources. Basing project investment decisions on discounted indicators also discriminates against projects with long gestation periods, such as afforestation with slow-growing native species rather than fast growing exotics.

Part of the problem is that orthodox economic analysis is dependent upon the accurate valuation of costs, benefits, and capital stock, including the stock of natural resources. The failure to correctly value natural resources in the decision making process will inevitably lead to the degradation of the resources base. Anything that is effectively sold at zero price will be overused.

Even extension of benefits into the far future does not account for this inter-generational bias. In the case of the Mali Forestry Sector Reform Program, there is an investment that should improve the resources base. One could quite easily have an investment that leads to a declining resources base. Both would have an environmental value that would have to be included in the analysis.

Depletion of the natural resources base is inadequately reflected in the market place (a market failure). Decreased supply due to a declining resources base may result in increased price. By the time the market reacts, however, it may be too late to restore a resource and production opportunities may no longer exist. For example, the improvement of soil that has washed into the river is not possible, and the formation of new soil is measured in geologic time. Similarly, the extinction of wildlife is irreversible. This is in contrast to man-made capital, which can be destroyed and rebuilt. Ideally, economic appraisal of projects would correct for market failure through shadow pricing. However, adequately valuing the natural resources base and the cost of the depreciation of that base is very complex.

The prices of natural resources should reflect their full value, which must be linked not only to the cost of extracting and transporting the resources, but also to environmental and user costs. Environmental costs are costs that resources extraction imposes on others, e.g., the loss of watershed protection benefits when forests are cleared. User costs involve the loss of benefits to future generations due to unsustainable management.

David Pearce, Anil Markandya, and Edward Barbier, *Sustainable Development, Resource Accounting and Project Appraisal: State of the Art Review*, London, 1989; J. Bojo, K.G. Maler, and L. Unemo, *Economic Analysis of Environmental Consequences of Development Projects*, Stockholm School of Economics, 1988; and Robert Solow, "On the Inter-generational Allocation of Natural Resources," *Scandinavia Journal of Economics*, vol. 88, no. 1, 1986.

Renewable resources should be consumed on a sustainable basis. Thus, the long-run rate of harvesting should equal the potential rate of regeneration. Given that, particularly in developing countries, the stocks of natural resources are declining (and below any reasonable estimate of what the long-term optimal natural capital stock should be), it is economically rational to make investments aimed directly at increasing natural stocks and preventing them from declining further. What is needed, and what orthodox cost-benefit analysis does not readily provide, is a method of optimization based on sustaining or improving the resources base, rather than maximization of immediate returns based on the depletion of the present base.

One might not need to hold the stock of environmental assets constant over time. However, to compensate for the environmental losses incurred in some projects, it would be necessary to ensure that the country's portfolio of investments included offsetting investments in the environment. These investments would not necessarily pass standard project appraisal tests. This rationale would probably justify the use, in appraising the Mali Forestry Sector Reform Program, of a discount rate equal to the estimated soil degradation rate. By this criterion, the Mali Forestry Sector Reform Program would make economic sense even at a discount rate of -3 percent.

Bibliography

Camara, Amadou, "Economic Analysis of Traditional and Improved Farming Systems and Optional Farm Plans for Peasants in the OHV Zone, Mali," master's thesis, Texas Tech University, Lubbock, 1988.

Christophersen, K. and G.E. Karch, "Financial and Economic Analysis of Reforestation, Soil Conservation, and Improved Woodstove Activities," Village Reforestation project, Energy Initiatives for Africa, USAID, 1988.

Dione, Josue, "Informing Food Security Policy in Mali: Interactions Between Technology, Institutions, and Market Reforms," CESA/MSU, Bamako, 1989.

République du Mali, "Les Ressources Terrestres au Mali," Volume III Annexes, USAID TAMS, Bamako, 1983.

République du Mali, "Détermination des Coûts Moyens de Production des Principaux Produits Agricoles," MinAg IER, Bamako, 1989.

République du Mali, "Etude des Filières d'Approvision des Cinq Principales Villes du Mali en Produits Forestiers," MinEnvEle DNEF/CTFT, Bamako, 1992.

Shaikh, Asif and G.E. Karch, G.E., "Will Wood Work? The Future of Wood Energy in the West African Sahel," Special document, IXth World Forestry Congress, Mexico City, 1985.

Shaikh, Asif. et al, "Opportunities for Sustained Development," Volume III Financial Analysis, USAID AFR/TR/SO, 1988.

Shaikh, Asif, "Forestry Development Options in the Fifth Region of Mali: The Economic Tradeoffs," 1985.

Shaikh, Asif and P. Larson, "The Economics of Village-Level Forestry: A Methodological Framework," USAID/Bureau for Africa, 1982.

SECTION II
THE NATURAL RESOURCES MANAGEMENT PROCESS

The first part of this section describes the natural resources management experience to date in Mali and attempts to describe lessons learned from these experiences. The next part describes in some detail the Mali Forest Sector Reform Program's approach to field-level natural resources management. The final portion discusses, for indicative purposes, the various types of technologies that might be used at the field level to improve natural resources management. It should be noted that at the local level, as at the national level, policy and organizational issues may be at least if not more important than technological issues.

A. Experience to Date: Models for Support to Local Communities

Working with local communities on natural resources management, whether on community or state lands, is not new; several organizations, including the Forestry Service, have worked with communities in more or less systematic ways for some time. The 1970s were a period during which the state generally felt responsible for environmental problems and took on the job of doing something about it, sometimes more or less ignoring the local populations or trying to "protect the rural population from themselves." The 1980s were a period of recognition of the necessity to either complement or move away from large-scale state-sponsored activities and planting schemes and to implement rural forestry activities at the village level. During the 1980s sets of effective technologies for rural use were identified and developed (see Shaikh, et al). However in some cases the technology adoption process was inhibited by a series of constraints unrelated to their technical appropriateness. In the 1990s, without returning to "integrated rural development," more integrated approaches are being developed that put the accent on decentralization; democratization; empowerment; transfer of knowledge, techniques, rights, and responsibilities; and creation of enabling conditions (policy reform). These approaches fall basically within the "aménagement du terroir villageois," or community-based natural resources management approaches. One basic premise of these approaches is that local users are in the best position to be local managers.

The purpose of this section is to summarize and evaluate relevant community-based natural resources management experience to date. This activity serves to verify, confirm, and refine the approach proposed under this project. However the analysis does not pretend to be more than a mostly superficial look at a handful of fairly arbitrarily selected activities.

The section is divided into two main parts that reflect the major missions of the Forest Service: support to local communities for natural resources management and improved management of public lands. To compare the different types of activities usefully, a series of hopefully common threads and phases have been selected including approach, diagnostic, analysis/synthesis, implementation, monitoring, and organizational structure.

A1. Support to Local Communities for Natural Resources Management

Several actors are involved in helping local communities manage their resources. These include NGOs, projects, government services, and various combinations of these entities, in addition to both traditional and modern village organizations or associations.

A1a. Near East Foundation Project: NGO, Douentza

Approach. NEF undertakes an integrated series of actions including functional literacy, rural radio, agriculture, organizational support, cereals banks, soil and water conservation (SWC), and natural forest management. It appears that some of SWC techniques were initiated directly by NEF, which raises the question of sustainability. However in terms of natural forest management, NEF's intervention has been demand driven (both by the Forest Service and the communities). NEF has followed the communities in an intercommunity approach and the organization of a *Kelka*, a semi-traditional intercommunity body to develop rules and controls for forest management. The approach also insists on the legal standing of the organization and on signed contracts or agreements with the administration.

Diagnostic. A classic forest inventory was performed by the forest service. The socioeconomic diagnostic seems to have been done by the communities. NEF has hired a lawyer to assist the legal and organizational aspects of local empowerment.

Analysis/synthesis. It is unclear how the analysis of information collected during the diagnostic phase is handled, where the analysis takes place, and if indeed a management plan exists for the forest in question (Bore).

Implementation. Implementation is done by the *Kelka* through an agreement (convention) with the administration. It is unclear how much of the management process, aside from the regulatory and control functions, is covered by plans or agreements.

Monitoring. It is unclear how monitoring will take place under the *Kelka* process. Local community members, however, have good idea of what environmental changes have taken place under which regulatory regimes, even though this information is mainly anecdotal. Under its SWC activities however, NEF has established an interesting approach of a series of sample plots that while probably not scientific enough to satisfy purists, will provide the villagers, NEF, and the administration with reasonably good data on the impacts of SWC over time.

Implementation structure. Although the relationship between NEF and the cantonnement have had their ups and downs, it should be recalled that, at least for the natural forest management component, it was the cantonnement that requested NEF's assistance. In some cases the forest service is capable of initiating collaborative arrangements with NGOs to address NRM problems.

At the local level NEF has played the role of facilitator, allowing communities the leeway to create their own kinds of organizations and their own types of rules and regulations. They have also gone beyond this to play the role of promoter and protector of community initiatives. This action can put them in conflictual situations vis-à-vis the administration.

A1b. CARE Mali Project: Koro

Approach. CARE, a well-known international NGO, is undertaking a variety of activities in Koro. This work started almost simultaneously with the VRP, and the USAID's VRP initiators helped facilitate the sometimes rocky negotiations between CARE and the Forest Service. CARE at that point was very much concerned about working directly with local communities and saw the Forest Service as an obstacle to this process.

After an initial phase as an extension service for technologies, CARE has recently put more emphasis on the identification and the revitalization of traditional community organizations more involved in the management process and involved in environmental control, regulation and enforcement. One such organization, the Ogakanas, performed a social and environmental enforcement and regulatory function. For the moment these entities are not legally recognized and do not integrate other communities and user groups from outside the community.

It should perhaps be noted here that at the technical level CARE and its village counterparts have moved away from K-forestry (e.g., windbreaks, nurseries, and woodlots) and are much more involved in more flexible and appropriate R-forestry activities such as direct seeding and management and care of natural regeneration. This last activity, management of natural regeneration of field trees, especially *Faidherbia albida*, seems to be a major success.

Diagnostic. It is unclear how the systematic diagnostic phase takes place. It is clear that CARE has more than a decade of experience in the area and has refined its approach as implementation has progressed. This is a sort of trial and error diagnostic approach that seems to have paid off at least in terms of technologies because CARE was willing to learn the lessons. The approach seems to have been less successful in identifying and strengthening structures.

Analysis/synthesis. It is unclear what kind of village-level analysis takes place. Emphasis seems to have been on the control or police function and the extension of technologies, and not on diagnosis or synthesis.

Implementation. Implementation is by the local Ogakanas under resources use agreements signed by Ogakana, the administration and CARE on a pilot basis. The agreements were developed by a highly respected jurist and ex-minister.

The Ogokanas, having evolved from a type of secret male "mask" society, did not traditionally include women. However, it appears that CARE has encouraged the integration

of women and women do now appear to assist Ogakana activities. This presence appears to be mainly for social functions and police activities between women. It does not appear that women have much of a decision making role.

Monitoring. It is unclear how this works.

Implementation structure. CARE works together with the local cantonnement and its staff. In spite of the experimental nature of the resources agreements and the fact that they were signed, changeovers in administrative staff have led to a reinterpretation of the accords. Moreover, even though the agreements were prepared by a jurist, the lack of legal standing for the Ogakanas and the conflict with the present Forestry Code (transferral of rights to inflict fines) has led to disagreements over legal interpretations with the new local administration. (There are probably lessons here for eventual local rulemakers.) However it does not appear that the disagreements have inhibited dialogue.

The use of income from police activities is unspecified. The current Ogokana operating mechanism does not permit us to state that villages are managing their resources for two reasons:

- Resources in these villages are mainly farm field trees that are more or less privately held. Their protection is necessary to maintain soil fertility on the farms but does not give any assurance about the organizational capacity of the village association to manage collectively owned resources.

- The apparent use of collected fines to fund social events instead of investments in the regeneration and protection of natural resources throws doubt on the commitment of the population to protect and manage the natural resources of their village lands. It appears that the major motivation for the agreement is not natural resources management as a process but the taking over of the regulatory and police functions from the Forest Service. In any case the present agreement puts more emphasis on police than on any other activity of management.

A1c. Bankass Environmental Protection Project: SOS Sahel

Approach. SOS Sahel, a recently installed british NGO, is involved in environmental protection and activities to increase rural revenues. SOS Sahel has applied a participatory approach aiming at playing a facilitating role between rural communities and the different technical services involved in natural resources management, mainly with the Forestry Service. The project, through the sponsorship of several workshops, is undertaking important sensibilization and extension activities toward Forestry Service agents, the rural population, and the administration.

SOS has identified a traditional organization, the Alamadiou, with which it is working toward environmental protection. The Alamadiou has several interesting characteristics including the fact that it covers numerous villages, is democratic, and has women members

and seems to have retained some of its vitality. The Malian lawyer from NEF has also given a hand to SOS.

Diagnostic. For a number of activities it appears that extension work moves forward with little systematic diagnosis. In other areas, and in particular plans for the participatory management of the Samory Forest, SOS has developed PRA capacity. The NGO has also used blowups of aerial photos and found that community members usually have no problem manipulating these tools.

Analysis/synthesis. It is unclear how this works, but given SOS Sahel's general approach it is likely that all actors are involved at various stages.

Implementation. In regard to integrated Natural Resources Management (as opposed to the extension of techniques and activities), SOS is just starting.

Monitoring. It is unclear how this works.

Implementation structure. The Alamadiou, as already noted, has a particularly interesting and important traditional structure. As a contre-pouvoir, SOS has to be very careful about the kinds of roles it might play in NRM. As a dynamic and effective control and social and environmental police group its role will be important. However the group cannot also be the overall manager of resources—it appears there will be conflict of interest if Almadiou is seen as the implementors.

A1d. CARE Mali Project: Djenné

Approach. This activity is an offshoot of the VRP, picking up after VRP had made some of the first investments in Djenné (e.g., nursery, etc.). It started around 1983. CARE/Djenné seems to have a typical project approach that emphasizes classical extension of NRM techniques and technologies in the main sectors: forestry, livestock, and agriculture. They seem less interested in the whole NRM process and the transfer of methodologies. CARE/Djenné does not seem to have an "aménagement de terroir" approach.

More recently CARE/Djenné has taken a more "go it alone" approach with even less integration of government services, although coordination is theoretically made through the CLD. It seems clear, that whatever the level of coordination, CARE/Djenné does not have a community-based NRM approach and does not seem to be heading toward support to local decentralized community organizations and natural resources agreements.

Diagnostic. Identification of problems does not appear to be the result of systematic, broad-based analysis. Problems may be identified as a function of technologies that are known to extension agents and with which they feel comfortable.

Analysis/synthesis. It is unclear how this works, especially at the village level. It does not seem to be a priority.

Implementation. CARE/Djenné has developed an approach that promotes village technical teams as the organizations that interface with the project and the administration. These teams, while perhaps having some advantages over the model farmer approach, seem to be very much a project creation and their sustainability should be questioned. Implementation is based on a fairly classical extension of techniques.

Farmers working with CARE/Djenné have done some very interesting work both with CARE and continuing on from where CARE extension left off. One particular case, demonstrated that when necessary, farmers are experimenters and researchers and that this capacity remains a largely untapped source of initiative, technology, and methodology. Mr. Fofana (a villager) succeeded in developing a simple technique for implementing erosion control grass contour strips in a degraded field after two years of unsuccessfully following CARE extension advice. His technique, soil scarification with millet stalk mulch, is more effective and less material-intensive than the CARE methods. In the same field Mr. Fofana has also experimented with traditional tied bunds and a new technique of converting and rehabilitating termite mounds on lateritic soils. Mr. Fofana certainly should be one of the stops for farmer-to-farmer study trips and should be tapped as a resource for better understanding, promotion, and use of traditional research techniques.

Monitoring. Unclear how this works.

Implementation structure. CARE/Djenné seems have opted for an isolationist approach with regard to other government structures. Over the years collaboration with other technical services have declined to the point where CARE/Djenné sometimes seems to be its own government. Sustainability is a major issue here.

A1e. Village Reforestation Project

Approach. This USAID-funded project ended in July 1993 after 13 years in the Mopti-Bandiagara zone. It was one of the first, if not the first, projects to emphasize rural forestry and community involvement. The VRP's early emphasis on K-forestry (woodlots and nurseries) was not particularly successful and the project subsequently moved more toward R-forestry.

Diagnostic. This was done mainly from the outside, based on available technologies. Some shift over the life of the project to more appropriation by local institutions did occur, however.

Analysis/synthesis. What analysis was done seems to have been done more at the Forest Service level than at the village level.

Implementation. A more or less classical extension of technologies approach was used. While classical for most agricultural services, it was new to the Forest Service and gave the agency valuable experience. Community development agents were recruited to support the extension approach.

One cannot describe the VRP without mentioning the success of one of the activities: planting of eucalyptus in the bas-fonds for pole production. A farmer, Mr. Togo, through contacts with the project, got some eucalyptus, learned how to produce them himself, and eventually became independent of the project and has a very lucrative enterprise that is spreading up and down the low-lying areas.

Monitoring. Some emphasis was placed on the development of a reporting and monitoring system during project conception. This system turned out to be onerous and inappropriate and did not help the project refine its activities. Subsequent monitoring activities were more useful to the Regional Direction but it is unclear how much the communities actually benefitted.

Implementation structure. The project was based upon implementation by local government structures (the Regional Direction of the Forest Service in Mopti), with little or no technical assistance and no NGO support.

It should be noted that the VRP provided the vehicle for several other activities that had a major (if not the major) impact on the forestry sector and forest policy in the last decade. Among these were the studies of the LTC on tree and land tenure and the forest code. Also, through VRP, USAID was able to support the consultative process for forest legislation revision.

The project seems to have had an important impact on the regeneration of vegetative cover and the increase in village partner revenues as the partners adopted and took over techniques and technologies extended by the project. One important aspect of the project was capitalization by Forest Service agents and the rural population of the training received from the project.

A1f. Direction Régionale des Eaux et Forêts de Sikasso (Swiss Institutional Support Project)

Approach. Part of a four-activity forestry program started in the early 1980s, the support to the Regional Direction in Sikasso aims at decentralized (regional) institution building. Important investments have been made (finance, infrastructure, and equipment). The project approach was partly based on an ambitious extension and sensibilization program (audio cassettes from local singers, audiovisual equipments, and other media) to encourage local tree planting, mainly in woodlots.

Despite heavy investments in extension since the early 1980s, the Sikasso region was one of the hardest hit by the events of March 1991 with many local foresters being threatened and having to retrench to major urban areas. This demonstrates that funding and technical assistance do not always lead to positive developments with local villagers. The approach appears to have been fairly top-down and technocratic. It seems that the approach was that of extension of technologies.

26

Diagnostic. Recent approaches to the diagnostic phase have included the use of PRA.

Analysis/synthesis. It is unclear how this is carried out.

Implementation. The initial emphasis was on woodlots, but more recently a diversification phase encouraged more rural forestry interventions such as windbreaks and living fences.

Monitoring. It is unclear how this is being handled.

Implementation structure. The Regional Direction of the Forest Service is directly responsible for project implementation. There seems to have been a lack of dialogue and coordination between the project and other actors in rural development.

A1g. CMDT Soil and Water Conservation Division

Approach. This CMDT Division started as a project called Projet de Lutte Anti-Erosive (PLAE) (Erosion Control project) that promoted erosion control techniques with CMDT farmers. The project and the extended techniques were so well received by farmers that CMDT decided to institutionalize the project and make sure that all CMDT field agents were involved. Both the project and the division are funded by the Netherlands and are also involved in village nurseries and woodlot plantations (without the collaboration of the Service des Eaux et Forêts).

The approach to soil conservation is basically a classical extension approach. One of the most interesting experiences in the area is that of the SIWAA. The experience in the SIWAA zone, based on co-management of communal natural resources by six villages, is a good example of inter-village administrative collaboration. Six villages have decided to manage the natural resources on their lands in collaboration with the technical services (CMDT and Eaux et Forêts). This experience is original because it is based on the collective will of the population to manage natural resources and protect their environment.

Diagnostic. While the details of this aspect of NRM are not clear, the area has a long history of collaboration with the CMDT and the PLAE. While global studies were perhaps not carried out, an informal system of trial and error has helped refine the most appropriate interventions. The first step in the PLAE process was the use of GRAAP techniques during general meetings to raise environmental awareness. This is something short of a village diagnostic. The next step is farmer-to-farmer visits that allow farmers to see firsthand the technologies in question and talk directly to other farmers about the technologies' benefits and disadvantages.

Analysis/synthesis. During general assemblies at the village a type of analysis takes place in which the community discusses the pros and cons of the interventions and the community agrees to undertake SWC activities. A community technical team is formed and trained and eventually forms the link between the village and the extension service.

Implementation. The division works through technical teams created for this occasion at the village level.

After several years of implementation under informal agreements, the SIWAA is ready to negotiate a resources use agreement amongst themselves and with the administration.

Monitoring. The SWC division encourages an annual réunion-bilan to discuss successes and failures and to reorient the process. In the case of SIWAA it is unclear how the monitoring aspects will be dealt with under the agreements.

Implementation structure. As noted the SWC division works through village technical teams that were initiated by the project or by the SWC division. In the case of SIWAA, the local Forest Service supported this effort by transferring forest resources management responsibility to local communities. In this context, a protocol is the process of elaboration and villagers are now deciding on how they will manage the resources.

With the reorganization and its new policies, the Direction of CMDT decided to collaborate with Eaux et Forêts in all forestry-related activities to perform better in its intervention zone. A collaboration protocol has been prepared to formalize this decision.

A1h. Koutiala Test Zone (PNLCD)

Approach. This is one of the six test zones of the National Program of Desertification Control. The goal is to control desertification through integrated rural development activities. The program has six activities among which is a natural resources management activity coordinated by the chef de cantonnement forestier.

Diagnostic: No information
Analysis/synthesis: No information
Implementation: No information
Monitoring: No information
Implementation structure: The program is implemented by the Rural Economy Subcommittee of the Local Development Committee (Sous-Commission Economie Rurale du Comité Local de Développement du Cercle).

A1i. Projet Aménagement du Terroir du Moyen Bani-Niger (ATD2): Ségou

Approach. This activity, with Canadian support for the past four years, has perhaps made the greatest strides in developing local community capacity to master all aspects of natural resources management. The emphasis was not solely on technologies but also on the transfer of the process and methodologies. The objective is to help local people develop management plans for better land use and assist them in the organizational and empowerment process. The natural resources dynamics that have been identified are not village-specific but cover larger zones, resulting in the call for intercommunity cooperation and collaboration.

The approach is broader than one single community and interesting attempts have been made to integrate all actors.

Diagnostic. This phase is done at two levels: a technical diagnosis that requires some skills not available at the village level, and a village diagnostic that emphasizes the socioeconomic aspects and is done by the villagers using PRA techniques.

Analysis/synthesis. This phase is also done at the village level and produces a management plan and a strategy of prioritized activities for implementation. Every community has its own management plan and the zone (covering several communities) has a schema directeur who ensures to a certain extent that the larger picture is taken into account.

Implementation. The management plan is implemented through agreements signed by the various communities and the administration.

Monitoring. Monitoring is interpreted by the project as part of the implementation process. It is unclear what types of systems and tools have been developed.

Implementation structure. The process is implemented by a project structure based in Segou and responsible to the director of the Forest Service in Bamako. Ironically, sustainability at the community level seems better secured than at the project level. Recently there have been attempts to integrate more with the CLD in the hope that at the end of the project, this structure can fulfill its mandate and use project-developed methodologies to help communities develop management plans.

A1j. Direction Régionale de l'Agriculture Ségou (Programme National de Vulgarisation Agricole)

Approach. This World Bank-funded activity is based on the training and visit (T&V) approach to agricultural extension—an approach that seems to have been particularly effective in Green Revolution countries. No long-term, on-the-ground expatriate technical assistance is involved in project implementation. All technical services (livestock and forestry) seem to be integrated into the process. The extension agent in direct contact with the local population is expected to be polyvalent, i.e., to cover all the sectors. As problems arise he/she refers back up the extension ladder for assistance and training.

Diagnostic. The program is established based on a village diagnosis to identify problems and available resources. Problems are identified as the activity moves forward, and these are brought to the attention of researchers and trainers.

Analysis/synthesis. A monthly workshop to review technologies is organized based on planned activities. Training is provided to researchers who have theoretically developed responses to programs. These workshops are organized especially for the specialized technical agents in charge of training village-based extension agents every two weeks. It is unclear whether community members attend these sessions.

Implementation. Extension agents work with villagers on farm to provide practical demonstrations of techniques. The message is spread by contact farmers or contact groups.

Monitoring. It is unclear how overall long-term monitoring works aside from the feedback from contact farmers and extension agents.

Implementation structure. The Regional Direction of Agriculture is in charge of executing the program. A great deal of responsibility and expertise is expected of the local extension agents.

A2. Support to Improved Management of Public Lands

Recently, attempts have been made to improve the management of public lands, particularly national forests, through approaches that are more multi-resource and multi-use, promote better planning for sustained yield, and encourage the participation of local communities and user groups. The previous policy of total protection with a strong regulatory emphasis meant that the understaffed and poorly equipped and trained forestry staff were the only constituents for the forest. One of the main objectives of these new approaches is the building of strong constituencies for the national forests, especially among local users but also through a whole range of possible partenarial relationships (school groups, recreators, tourists, naturalists, etc.).

It should be noted that presently no NGOs are involved in the improved management of public lands.

A2a. Projet d'Aménagement des Forêts Classées de Ségou

This project, with support from European Development Fund, works to test classified forests management systems with the effective participation of local people.

Approach. This is carried out through development of management plans, followed by activity-specific contracts with user groups.

Diagnosis. This is also fairly classical, with biophysical inventories and socioeconomic studies.

Analysis/synthesis. It is unclear how much of this is actually done by the communities and user groups.

Implementation. Execution performed through activity contracts with local groups. The project is pulling back from supporting forest personnel and attempting to turn these responsibilities over to local groups.

Monitoring. It is unclear how this is done and if local communities are involved.

Implementation structure. This activity is directly implemented by the Regional Direction of the Forest Service and does not include any technical assistance or NGO involvement. It represents an honest attempt by the Forest Service to open up national forest management and involve local communities. The approach seems for the moment to associate local populations in the traditional management approach.

A2b. FAO Forests and Food Security Project: Kaboila, Sikasso Region

Approach. This project is experimental and pilot in nature—the only way to justify the large investments in a very small forest and population. The project takes an integrated view of the forest (as being part of a larger production system) and thus has undertaken a number of activities (micro-realizations) on community lands.

Diagnostic. This activity uses the traditional inventories and studies done by a previous project. The project has also placed a great deal of emphasis on developing and using PRA techniques. It appears however that PRA techniques have been mainly used for diagnostic work on community lands.

Analysis/synthesis. It does not appear that much analysis was done at the village level prior to the introduction of PRA. The management plan that has been developed is in the traditional, classical mode.

Implementation. Implementation is done by local communities. The major product is wood and there is a system of remuneration under which revenues are divided among the woodcutter, a community fund, forest management fund that funds regeneration and protection activities in the forest, and the state (in the form of permits).

Monitoring. It is not clear how monitoring will work.

Implementation structure. The implementation structure for this activity follows the typical project model; there is technical assistance and a fairly top-heavy administration and support staff for only 400 ha. The articulation of the project with permanent administrative structures is not clear. Nonetheless, the approach hopes to develop methodologies whereby national forest management is sustainable at the local level with little or no outside input.

Another question that appears to remain unanswered is the project's approach to national-level interests such as biodiversity and watershed management.

A2c. Operation Aménagement et Productions Forestières

Approach. Upon its creation in 1972, OAPF's main objective was the execution of state-owned, large-scale semi-industrial plantations of fast-growing exotic species to provide Bamako with fuelwood and charcoal. Local communities were more or less excluded from benefits of the forest and were treated as a source of cheap labor rather than as participants and partners in forest management. This policy—even in the case of a national forest—is self-defeating. As such, with the implementation of the new forestry policy orientations,

31

OAPF developed and implemented a participative approach in classified forest management based on village territory management (including parts of the classified forest and adjacent zones), with the effective participation of local people living close to the forest.

Diagnostic. This new approach is just starting to be formalized. In the past, integration of user groups was based on mutual knowledge and negotiation. A type of systematic trial and error was encouraged. More recently two schools of thought developed: one classical with typical socioeconomic studies and inventories, and one that promotes and uses the capabilities of PRA.

Analysis/synthesis. Little of this is done at the village level. Recently, however, management plans have been discussed before finalization (this falls short of actual negotiation), and certain training and brainstorming sessions have allowed much greater user input.

Implementation. Implementation is project-style and somewhat separated from the normal Forest Service system. OAPF has been greatly scaled back from its plantation heyday.

Monitoring. What takes place is classical, with little user group participation. However some techniques have been developed or are under development to allow greater appropriation by local groups—phenological monitoring, pasture monitoring, etc.

Implementation structure. OAPF is a semi-autonomous state organization that reports to the director of the Forest Service. While it is a forest service organization, OAPF has relative independence, which may have been an asset in developing new approaches. In addition the emphasis on action research since 1988 has allowed many types of experiments and pilot activities to be undertaken, some of which have now been incorporated into the general management system.

A2d. Les Forêts Classées des Rails: Kita

Approach. Working directly with the local cantonnement, this ILO-supported activity aims at greater integration of local communities in the management of a series of national forests along the Bamako-Dakar railway. The approach is basically that of the FAO Kaboila activity. The ILO provides technical assistance.

Diagnostic. Several fairly classical studies have been carried out to develop management plans for these forests, including inventories, soil mapping, land use, and some socio-economic studies. It is unclear how much local communities participated in studies.

Analysis/synthesis. Plans have been developed but it is unclear to what extent they reflect community priorities.

Implementation. The implementation phase has begun and local communities are actively involved. These communities are taking charge of the planning, exploitation, control, and sale of firewood from the forests. Revenues generated are divided among the

exploiter, community, forest (regeneration and protection activities), and cantonnement (permits).

Monitoring. It is unclear what the approach to monitoring is under this project.

Implementation structure. The cantonnement implements this activity directly. Several problems have arisen with transporters, businessmen, and local politicians who feel threatened by the powers being transferred to the local communities. The activity has almost become a test of how far the Forest Service will go with the participatory approach. So far the Service has demonstrated sufficient will to defend the approach. It is often assumed that the Forest Service alone was the major stumbling block to greater participation. This activity and these conflicts demonstrate that there are other players and stakeholders who see their interests threatened by empowerment of local communities.

A3. Discussion and Conclusion

From the preceding discussion of different models, whether for the management of community or state resources, there are a variety of approaches and many degrees of success, integration, and sustainability. This characteristic of diversity is natural and appropriate because of the variety of ecological and socioeconomic conditions.

Another aspect of the participatory natural resources management problem has become clear: there is no panacea, no recipe (except that for disaster), no magic bullet for NRM. The following briefly discusses some major points from the experience to date.

- Simple technology extension services are not enough. The natural resources management process includes aspects of diagnosis of resources and the socioeconomic base; the planning, prioritizing, and analysis of information to make wise land-use decisions; and implementation of plans, negotiation of agreements, and monitoring of impacts. Rock bunds may be necessary and ways to extend rock bunds may be required, but they do not address the overall dynamic of empowerment of communities for the management of resources. Projects or activities that seem to have the greatest chances for long-term sustainability are those that have directly addressed organizational and rights recognition issues.

- The intercommunity or multi-community approach, although new, seems to hold more promise and be more effective than the single community approach. Very often resources problems and dynamics are shared across several communities. The activities that seem to be the most successful and useful are those that take a multi-community approach such as ATD2, NEF and SOS Sahel. Not only is there force in numbers, there is also efficiency. It also seems likely that the decentralization process, once definitive, will not reach all the way down to the village level, but rather the base unit will be a group of villages.

- Organizational legitimacy and effectiveness is a major concern. Projects that create artificial structures at the community level raise the sustainability issue. On

the other hand, projects that identify and promote traditional organizations must address two issues: first whether these organizations are responsive (or can be made so) to the new context of climate, demography and democratization, etc.; and second, whether they are the appropriate organization to take on management (e.g., compared with conflict resolution). Because of their legitimacy, traditional organizations should be used to the extent that appropriate and viable ones can be identified, that appropriate roles within the NRM process can be assigned to them, and that, through training and other techniques, they can account for changing conditions.

- The approach to management must be participatory. Although the term participatory management has been much abused, its essence holds true. Development and natural resources management cannot come or be imposed from the outside; they must be internal processes. All steps leading to natural resources management must involve the participation of the resources users.

- The approach should be process- rather than product-oriented. The mentalité d'assiste is often very strong at all levels of Malian society. People expect to be given gifts, things, activities. As seen with the ATD2 project, people sometimes lose patience with the development of capacities (the process) and want to be spoon-fed the product. One can find communities where people prefer to be given the fish instead of being helped to learn how to fish. Projects must fight against the tendency to give in to gift giving and fight the long-term struggle of capacity building. This is one of the costs of sustainable natural resources management efforts

- Basic strategies for diagnostic and analytic work, such as trial and error, should not be minimized. There seems to be a tendency to equate good with more complex. While satellite imagery and computer programs can in some cases be valuable tools for diagnosis and analysis, other simpler approaches such as trial and error might be more effective and less costly.

B. The Decentralized NRM Process and Possible Program Support

The process of successful local natural resources management takes many forms and depends on numerous local variables. This kind of diversity must be respected and integrated into the process. It is therefore impossible to present recipes for successful management systems.

There seem to be, however, several basic phases common to the NRM process. The following section attempts to outline these phases with the aim of giving a general idea of what the process is like. It should be emphasized that the aim of NRM is not kilometers of rock bunds but competent community-based organizations implementing and monitoring simple yet adequate natural resources plans.

For the purposes of this paper four simple phases are identified: diagnosis, analysis, implementation, and monitoring. These phases form a continuous loop. Monitoring can be viewed as rediagnosis, leading to improved analysis and synthesis and improved implementation, which is then monitored, etc. The loop can be entered at any point depending on the local circumstances and situations. For example, it is unlikely that any local community will be without some kind of natural resources management strategy in some stage of implementation. Thus at the community level some form of this loop exists already, and it may be a question of reinforcing and improving what is there.

B1. Diagnostic

Most successful NRM activities have a diagnostic phase. During this phase the local community is assisted to better understand its physical and socioeconomic resources base. Some approaches indicate that part of this process is technical, i.e., above the heads of the local users. This is a grave error—both the technical inventories and the socioeconomic investigations must be done by the users, with outside assistance where needed. The process may be long but there are no shortcuts to sustainable management. There are several good examples in Mali of community appropriation of the diagnostic phase.

There is another common error in this phase: anticipated analysis paralysis, i.e., the endless gathering of data because the complete picture is not clear. The complete picture is will never be clear. A good judgement stemming from experience is necessary to ascertain the point of good enough.

Several good techniques exist for participatory investigation of socioeconomic parameters, such as participatory rapid rural appraisal. Efforts must be focused on keeping this practical. Strangely, less seems to be available about participatory investigation of physical resources. Physical inventory techniques tend to be mystified by technicians, and vigilance must be used to make sure one arrives at something that is adequate enough, with the understanding that through monitoring one will get a second chance (and third and fourth, etc.).

Outside input during this phase is mainly limited to training and extension advice (technical assistance). Limited equipment and training materials may be needed.

B2. Analysis and Synthesis

This phase, which like all phases must take place in the community, is in essence the planning phase. Once the physical and socioeconomic resources are known, they must be put together into a prioritized plan. Plans may be community-wide or between the community and user groups. They must define resources to be managed (this may not be all the possible resources), the areas of intervention, timelines and schedules, management systems, participants and their responsibilities (e.g., relationship to the community at large), and anticipated inputs and outputs. Plans should also include a balance sheet.

Plans are the underpinning of contracts or conventions between the community and user groups, the administration, NGOs, CLDs, etc.

Plans should address all natural resources functions. Some plans and contracts put too much emphasis on the policing or control function to the detriment of planning, rational use, or other functions.

A problem of audience always arises. Plans must satisfy technicians and funders and at the same time be accessible to and mastered by the communities that have developed them and are responsible for implementation. The ATD2 approach to this problem is enlightening. In this case, two plans are developed. One plan satisfies the needs of technicians for a plan that is technically correct and adequate. The other plan is the community version (plan vulgarisé); it is simplified, in the local language, and physically and culturally accessible to the community. At the same time, this approach raises the issue of double standards and separate treatment of community members. Consequently, the long-term goal should be one common plan accessible to everyone.

Once again, outside input during this phase is mainly training and extension advice, with perhaps some training materials.

At the end of this phase the community should have a modest natural resources management plan, and a prioritized intervention strategy, and it should be in position to start negotiations on the plan.

B3. Implementation

During this phase the plan and resources agreement are negotiated and implementation is started.

It is hard to anticipate activities at this point as there are certainly a whole series that are possible. Some examples are: improved management of a village or multi-village forest, improved management and promotion of field trees, soil and water conservation techniques, etc.

In many instances non-NRM activities such as schools, clinics, roads, etc., will have a high priority for the community. These activities must be taken into account in the NRM plan and its implementation. However it should be clear to everyone that the community has the first responsibility for mobilizing resources for these activities and that the project will not fund them. It is essential that NRM plans generate enough resources over the long term to allow the community to invest in these activities.

Providing outside input during this phase can be tricky. One does not want to provide gifts (which promote underdevelopment) or to co-opt the process by negotiating on behalf of the villagers or by giving tied aid e.g., (only for soil conservation activities). Plans must be objective and generate benefits. If this is the case then a revolving natural resources management fund" can be put in place at the village level. The fund, as seen from the

outside would be a grant, but at the village level must be managed as a revolving and, if possible, interest-bearing fund.

B4. Monitoring

A section of this document is already dedicated to monitoring. However, it might be useful here to underline the fact that monitoring is in reality a form of updated diagnostic and uses many of the same techniques but at a lower intensity. Monitoring, obviously, should be done periodically—before disaster strikes. Outside input is once again mainly training and technical assistance.

The project's implementation approach at the local level has several key elements:

- The objective at all levels and for all functions is to put local people and users in charge of the natural resources management process. This requires a participatory approach.

- Local participation and development is not bought through a series of gifts. Development must come from within and be based on solid activities that pay for themselves. Financial support at the community level must be either credits (with or without interest) or revolving funds that stay at the village level and are kept at the same level or require a hefty dose of local-level resource mobilization.

- Emphasis should be placed on training and skill development to put the community in charge of the NRM process.

C. Examples of Natural Resources Management Technologies

It is difficult to give more than an illustrative list of technologies that might be used under the Mali Forestry Sector Reform Program. Conditions are varied and always changing, and local people are always experimenting. Some workable technologies are site-, situation- and person-specific. Two examples illustrate this point. CARE/Djenné suggested to Mr. Fofana that he implement grass contour strips in his degraded field to conserve water and soil. The first year he direct-seeded a grass species along the contour lines. It might have worked elsewhere but it didn't work for Mr. Fofana. Before the start of the next rainy season CARE suggested that Mr. Fofana direct-seed a leguminous creeper. This also failed. The third year Mr. Fofana, on his own initiative, plowed along the strips and piled millet stalks as mulch on the broken soil. This resulted in natural regeneration of local grasses along the strips and helped solve the erosion problem while providing fodder for Mr. Fofana's livestock. Mr. Fofana's solution did not come from a standard technical package (although it had elements of standard packages—the effects of mulches and the use of contours is not new), but from a process of reflection about the dynamics of his field.

The other example is that of Mr. Togo outside of Sevare in the Mopti region. His eucalyptus plantation for pole production is, arguably, one of the most successful forestry activities in the country. With help from VRP he found the right technology (eucalyptus in

low lying areas with favorable soil moisture) and the right market (poles in a pole scarce area). Many of Mr. Togo's neighbors, along the same valley have imitated him. However it is clear that this technology is not generally applicable to other areas and socioeconomic conditions.

No single technology will provide better natural resources management throughout the country. Each technology will be adapted to local conditions, and in many cases these adaptions will hardly resemble the original. They will often be hybrids of several different techniques.

Given this fact, the program's accent will not be a specific technology or sets of technologies, and targets will not be numbers of kilometers of contour dikes or numbers of trees planted. Instead, targets will be numbers of hectares under improved management. This objective obviously has a technology component but one that is difficult to predict beforehand.

It is nevertheless useful to discuss these technologies to demonstrate clearly that viable technologies do exist that are appropriate for conditions in Mali and, if used, could stem the rate of resources degradation and increase long-term productivity. A principle aim of the proposed project is to establish the enabling conditions (e.g., appropriate policies and empowerment of local communities) that will permit and encourage Malian farmers to adopt these technologies.

This section relies extensively on a review of resources-conserving agricultural practices that was done as part of the Sahel Sub-Regional Natural Resources Management Assessment (SSRA). The SSRA, which was sponsored by USAID's Africa Bureau (Office of Technical Resources and the Sahel Office), involved research in Mali, The Gambia, Niger, and Senegal. The results of the assessment were published in Shaikh, et al, *Opportunities for Sustained Development: Successful Natural Resources Management in the Sahel*, October 1988, four volumes. This section also draws heavily on a publication by the Office of Technology Assessment, entitled *Enhancing Agriculture in Africa*, 1988. Finally, it draws from the experiences of USAID and other donors in supporting natural resources management activities in Mali.

The SSRA study (Volume III, prepared by Kjell Christophersen) attempted to carry out an economic analysis of several of the technologies discussed below, including contour ridges, windbreaks, and organic fertilizers. The study concluded, however, that the difficulty in measuring benefits made rigorous financial analysis of these interventions extremely complicated. In the projects the SSRA team reviewed, members found few instances where efforts had been made to measure any increase in crop yields that might have resulted from the interventions. Part of the difficulty was that of assessing the short-term impact of long-term NRM technologies. Moreover, the study concluded, costs and benefits associated with these interventions are likely to be highly situation-specific.

Compared to most agricultural operations, agroforestry, soil conservation, and pasture improvement are long-term investments. Only some of the technical interventions available

produce immediate results (e.g., water retention dams that increase yields). The first benefits from fruit trees can be expected three to five years after planting. Fast-growing exotic tree species (gmelina, neem, eucalyptus) can be harvested in 5-10 years. Indigenous forest species such as *Faiderbia albida (Acacia albida)*, may require 10-15 years to produce a return. A live fence, if managed properly, can become effective in one or two years. Windbreaks may begin to produce results in three or four years. A great deal can happen in the interim to negate any investment made by a farmer or community.

In promoting natural resources-conserving technologies, it will be necessary to take into account the need to address the short-term basic needs of Malian farmers. For example, the Village Reforestation project found that acceptance by villages of the woodlot concept was directly related to the number of fruit trees provided. Similarly, the successful introduction of horticultural gardens has demonstrated the importance of interventions that provide direct benefits at the individual level. The use of interventions such as live fences could be closely linked with NGO programs to promote vegetable gardens.

C1. Agroforestry

There are three broad types of forestry interventions: agroforestry, in which forestry is combined with agriculture such that trees enhance, rather than displace, crop and livestock production; community forestry (also called social forestry) which mobilizes large numbers of people to plant and protect trees on commonly owned or private lands, with the aim of producing wood or other products, principally for village use; and plantation forestry, in which trees are grown commercially.

One area where the Forestry Sector Reform Program could work is in promoting agroforestry techniques. This might include: support for the introduction of multipurpose (fuel, fodder, fruit, poles, etc.) tree and shrub species into the cropping system; planting of fruit trees; and the promotion of windbreaks, boundary plantations, and live fences. Depending upon need, multipurpose trees and shrubs could be regenerated or planted at locations that do not compete with crops. This would include planting along field boundaries to demarcate fields; along waterways and slopes to control erosion; along roads, dikes, canals, lanes, etc., to protect them from wind and water erosion; at the top of ridges in fields (where productivity is likely to be low) to control wind erosion; and in a belt around the village or compound to increase shade and provide wind protection, as is done with single or small groups of trees and shrubs inside compounds or in the closer village fields.

Following up on the experience of the Near East Foundation, CARE/Koro, and the International Labor Office (Kita), the Forestry Sector Reform Program could also become involved in community forestry efforts. For the reasons discussed below, block plantations will not be a priority of the proposed program.

C2. Multi-purpose Tree and Shrub Species

Incorporating multi-purpose trees and shrubs into the farming system can improve crop and livestock production in several ways. Leaves from trees and shrubs increase soil

organic matter as they decompose. This organic matter improves soil structure, fertility, and water-retention capacity. The deeper root system of trees enables them to capture nutrients that have leached down from the topsoil and makes them available to annual crops. Trees can reduce evapo-transpiration due to wind, lower soil temperature (thus reducing the rate of decomposition of organic matter), reduce the impact of raindrops on the soil, control runoff, and improve water infiltration into the soil. Further, leguminous trees and shrubs can add nitrogen to the soils. Finally, the fruits and leaves of multi-purpose trees can serve as forage for livestock (ultimately producing manure) and wood for fuel, poles, food, and other uses.

C2a. Field Trees

Widely spaced interplanting or managed regeneration of trees, particularly multi-purpose leguminous trees, in fields can offer benefits to crops grown between the trees. One common species used as a field tree is *Faidherbia albida* (syn. *Acacia albida*, common Mali name, Balanzan). *F. albida* is a leguminous tree native to much of Africa, where it often plays a key role in traditional agroforestry systems. It has several characteristics that make it almost ideal for agroforestry interventions. *F. albida* sheds its pods and leaves at the onset of the rainy season. This mulch enriches the topsoil, benefiting crops. The pods are also a highly nutritious livestock feed. At the same time, the defoliated canopy decreases the shading of the understorey crops during the critical cropping season and decreases the competition for nutrients and water. However, the trees do provide enough shading to reduce evapo-transpiration (at a density of only 20 trees per ha, *F. albida* will reduce evapo-transpiration in the dry season by up to 50 percent).

Further, *F. albida*'s deep (20 meter) tap root enables it to draw nutrients from beyond the reach of other plants. Thus it contributes to better use of available resources and growing space than single crops. This trait, combined with its ability to fix nitrogen, significantly benefits crop growth. Each mature *F. albida* tree can provide approximately 2 kg of nitrogen to the crops around it. Research has indicated that intercropping with *F. albida* can increase millet and sorghum yields by up to 150 percent. *F. albida* can provide important sources of fuelwood and fencing material (up to a cubic meter of fuelwood per ha per year), and the pods and leaves are an important source of fodder during the dry season when annual grasses have disappeared. Finally, livestock congregate under the shade of the trees, and their manure further enriches the soil.

Several projects have had good success with the management of natural regeneration of balanzan in fields. This management consists first of identifying young trees to keep and weeding around the trees and protecting them until they are out of reach of goats. Proper pruning through the life of field trees may also increase foliage production. The benefits of field trees are long-term. It may take 10 years before trees are large enough to have a significant effect on crop yields, but the benefits continue for the remaining life of the tree. Malian farmers have long practiced agroforestry and recognized the value of field trees, particularly *F. albida*, and promote their growth in fields despite the fact that the protected species provisions of the Forest Code have regularly been used by agents to restrict the cropping of these trees and even limit pruning.

Although few other species have the magnitude of beneficial effects on crops as the balanzan, there are several other very important field trees depending on the ecological zone. These include *A. senegal* (gum arabic), *Vitellaria paradoxa* (Sheanut), and *Parkia biglobosa* (nere or locust bean). The management of these trees is much the same as that for the balanzan.

In a financial analysis of alternative agroforestry practices in Senegal, Karch (1991) derived a benefit-cost ratio of 4.32 and an internal rate of return of more than 50 percent for field trees.[1]

C2b. Alley Cropping

Alley cropping generally refers to crop production between rows of nitrogen fixing trees. Under alley cropping, lines of trees or shrubs are grown in hedge rows and managed in such a way as to minimize competition with the associated crop. They provide a mechanism for nutrient recycling, as the branches of the nitrogen-fixing tree or bush are periodically heavily pruned to provide a source of mulch or green manure and to reduce light competition with crops. Depending upon the species used, the hedge row can serve as a source of poles, fuelwood, and fodder.

Alley cropping has been the subject of research in Mali for several years, particularly focusing on *Gliricidia sepium*, *Leucaena leucocephala*, and *Cassia siamea*. *Gliricidia* and *Leucaena* are nitrogen fixers that produce high quality fodder. *Cassia siamea*, though not a nitrogen fixer, has a deep rooting system that exploits the soil at a different depth than the annual crop.

Research in Zinguinchor, Senegal, has demonstrated a positive response by millet and maize crops to twice-yearly mulching with foliage from *Gliricidia* and *Leucaena*. Research near Bambey, Senegal, where rainfall is much lower, showed positive responses from lines or very wide alleys using *Acacia senegal* (the same species as in the famous gum gardens of

---

[1] Karch, G. Edward, "Comparison of Agroforestry Practices in Senegal Using Financial Analysis," 1991. Karch compared a number of agroforestry practices using varying assumptions. The figures used here are from Table 5, p. 18. These calculations assume: (1) no project subsidy to the farmer for tree planting; (2) an opportunity cost of labor at zero; and (3) a discount rate of 25 percent. The calculations made were:

- Net Present Value—the sum of the costs discounted and the returns discounted. A positive number indicates that the farmer makes money if the assumptions are true.
- Benefit Cost Ratio (BCR)—the discounted benefits divided by the discounted costs. If the BCR is greater than 1, the farmer will make money if the assumptions are true.
- Internal Rate of Return (IRR)—the discount rate at which discounted costs equal discounted returns. It is also the discount rate that, if used, would provide a net present value of 0 or a benefit cost ratio of 1 (again, if the assumptions are true).

Only the BCR and the IRR are cited in this text.

the Sudan). Alley cropping research has also been going on at a research station in Kaolack, Senegal.

However, alley cropping is more labor-intensive than traditional cropping methods and requires considerable change in farming practices. Farmers are often reluctant to try alley cropping because the space needed by the trees clearly reduces the amount of cropland available, and the benefits in terms of improved fertility (which should compensate for the area sacrificed) are not intuitively obvious. Finally, alley cropping is also more applicable in less arid regions. More research is needed to identify suitable species for alley cropping in non-irrigated semi-arid conditions, where water competition between trees and plants would be a severe constraint.

C3. Block Plantations

As noted above, the Forestry Sector Reform Program will not promote plantation forestry at any scale. USAID's experience with the Mali Village Reforestation project identified several social and institutional constraints to the woodlot approach to community forestry. Although cases of privately owned woodlots have been very successful, the VRP found that woodlots sometimes suffered from the perception that those created were government woodlots. This was particularly true in the case of community projects, where the distribution of eventual benefits was not clear, and as a result villagers did not invest in woodlot management. Conflicts with other farming activities also limited the availability of labor to weed the newly planted trees in a timely fashion. The VRP found that costs of publicly managed woodlots, especially on the marginal sites likely to be chosen, exceed the benefits. Wood products harvested from natural stands are by and large less expensive to produce than those from plantations.

An additional problem with woodlots is that they were conceived to produce only a low-priority, low value product: fuelwood. In cases where woodlots did succeed, other products were produced.

The economic justification for block plantations is very sensitive to both the discount rate and the survival and growth rates. One problem experienced with the VRP was that the requirement that trees be planted at the beginning of the rainy season corresponded to the period of greatest labor scarcity, since farmers were planting their crops at the same time. The failure of farmers to plant the trees in a timely manner greatly increased tree mortality rates, and the subsequent need for replanting greatly increased the costs of the intervention. In addition growth rates were typically very low.

The project must, however, be aware of the targets of opportunities, such as Mr. Togo's very successful woodlots of eucalyptus.

In his financial analysis of agroforestry practices, Karch (1991) derived a benefit-cost ratio of 1.63 and an internal rate of return of 32 percent for block plantations. This is relatively low compared to other practices analyzed and was attributed by Karch to the long delay before benefits began accruing.

C4. Fruit and Nut Trees

While fruit trees usually provide little fodder benefits, fields can be grazed after the trees are above the reach of goats. Some non-leguminous fruit trees are also more likely to compete with field crops than certain field trees. In his financial analysis, Karch calculated a benefit-cost ratio of 7.39 and an internal rate of return of more than 50 percent for fruit orchards, and a benefit-cost ratio of 3.52 and an internal rate of return of more than 50 percent for nut orchards. These rates were high due to the high value of the products. However, the high return is also dependent on a high market price for a single product.

Protecting the regeneration of certain indigenous fruit and nut trees is fairly common and is much less expensive and requires less management than establishing and maintaining orchards of mangoes (*Mangifera indica*) or cashew (*Anacardium occidentale*). Among the most important species kept in fields in Mali are baobabs (*Adansonia digitata*), Karite, néré, and tamarin (*Tamarindus indica*). The last two species are also legumes. The fruit and pods of these trees are important sources of food for the community and may be sources of revenue for women, who often hold rights in the harvest from such trees. Harvesting and initial transformation of the sheanut is an important industry in Mali, and predominately the domain of women.

C5. Windbreaks, Live Fences, Hedges, and Border Plantings

C5a. Windbreaks

Windbreaks improve agricultural productivity by: reducing physical damage to crops; improving stand establishment and decreasing the time and energy devoted to replanting; increasing humidity and decreasing wind speed and temperature (reducing evapotranspiration), thus reducing crop demand on stored water and allowing crops to withstand longer drought periods; and protecting crops from storm winds and minimizing lodging.

The best data on the benefits from windbreaks are from a CARE-funded Maggia Valley Windbreak project in Niger. That project has since 1975 established more than 350 kilometers of windbreaks to protect some 3,000 ha of rainfed millet and sorghum. Subsequent evaluations have indicated that crop yields increased by 15-23 percent as a result of the windbreaks. On-farm research in the Maggia Valley indicates that a single line of neem, *Azadirachta indica*, can increase millet yields by up to 30 percent while providing additional farm income through the sale of poles and firewood.

Windbreaks have limitations, however. They must be properly sited (oriented perpendicular to the prevailing winds) and require the cooperation of groups of farmers. They require high labor inputs for planting and some continued protection from livestock in the early years. In the Maggia project, for example, villagers had to agree to forego grazing on the land for three years, to permit the branches to grow out of the reach of livestock. This was enforced by guardians paid for with project funds. Another problem is the ownership of the trees. In the absence of clear tree tenure, conflicts can arise over the

distribution of wood products harvested from them. Trees also provide shelter and nesting sites for grain-eating birds. Further, some tree and shrub species require groundwater at levels that exceed the windbreak's water-conserving benefits. Finally, the benefits of windbreaks are longer-term; the impact increases as the trees grow. Karch, in his comparative analysis of agroforestry practices, calculated a benefit-cost ratio of 32.65 for windbreaks, by far the highest of the options he examined.

As with all of these technologies siting is extremely important. CARE, for example, was unable to replicate the success of the Maggia valley in the Koro area. One reason was that there was no corresponding valley with its favorable effect on groundwater and funnelling effect on the wind. In addition the Koro farming area already has large numbers of field trees, these trees already have an effect on the wind, thereby diminishing the returns on further investments in windbreaks.

C5b. Live Fences and Hedges

Living fences are single rows of trees or shrubs used to provide fence posts or a barrier. They may be cut above fence height for fuelwood, poles and fodder or they may provide fruits, pods, medicines, or other secondary forest products. Hedges are defined as plants in one or more rows that form a continuous barrier and are regularly cut back to form a dense interwoven mass of branches and foliage. A common species used for live fences is *Prosopis juliflora*, which provides fuelwood and poles. This can be mixed with *Guiera senegalensis*. Once well established, the thorny branches of *P. juliflora* provide an effective barrier against livestock. Other species and their secondary products that can be used include *Jatropha curcas* (soap, oil, and medicines), *Zizyphus mauritiania* (fruits), *Moringa oliefera* (water purification, food, bee forage), various citrus species, etc.

Live fences and hedges can also reduce wind erosion and evapo-transpiration. They also have the additional potential of adding organic matter and nutrients to the soil and providing fuelwood and fodder. However, they may also compete somewhat with neighboring crops. Living fences and hedges can be used to demarcate fields, particularly intensively cultivated vegetable gardens. The principal benefit of fences and hedges is, of course, as a barrier to protect crops from livestock. Karch calculated a benefit-cost ratio of 2.54 for fences and hedges and an intended rate of return of more than 50 percent.

Popularly initiated living hedges or sisal and euphorbs persist throughout Mali's Third and Fifth regions. While declining rainfall has decreased the northern range of sisal, and while traditional hedges are not always well maintained, farmers have planted vast numbers of new hedges around gardens and orchards in these regions. Under the PVO co-financing grant to Save the Children, approximately 16 kilometres of live fencing was constructed. Similarly, more than 19 kilometres of live fence were constructed through the VRP in the Fifth region. The use of live hedges has also been promoted by the CARE project in Koro.

To the extent that barriers need to be created for demarcation or crop protection, live fences are preferable to metal fences (which are generally beyond the means of most

farmers) or dead wood or cut thorn bush fences (which consume significant quantities of wood periodically, must be maintained, and are becoming increasingly scarce).

C5c. Border and Roadside Planting

This is perhaps one of the easiest social forestry practices to carry out. The plantings can be used to demarcate fields. Roadside plantings provide shade, improved community ambience, and reduced road maintenance costs. In Mali, the central obstacle to adopting this technology successfully has been the lack of community interest, in large part due to unclear tenure concerning the eventual products of the trees.

C6. Soil and Water Conservation Technologies

The various types of soil and water conservation structures are described below.

C6a. Waterways and Water Diversions

Waterways are either natural or constructed channels that carry excess water. Natural waterways are usually lined with grasses that prevent them from becoming gullies and reduce erosion. Diversions are constructed in fields to reduce water damage and flooding and to channel runoff to other fields or to areas where it can be used for other purposes. Both of these water management tools are used to control water on fields and to reduce soil erosion and water damage to crops.

During the rainy season many villages are flooded regularly by runoff from croplands. This problem is exacerbated by tracks or paths leading to villages that serve to collect and channel runoff. This problem can be addressed by the construction of graded swales or grassed waterways that prevent erosion and decrease flooding by intercepting the water and conveying it around villages.

C6b. Check Dams

Gullies are formed when high velocity rainwater runoff cuts deep fissures in the land profile. Rock check dams have been successfully introduced by several NGOs and projects in Mali, including the VRP Bandiagara station. Less well-known in Mali are grassed waterways, which can also be used to correct and prevent gully erosion. A grass lining reduces erosion by lowering water velocity over the soil surface and binding soil particles with roots. In The Gambia, a species of vetiver grass has been used successfully to control gully erosion and waterway diversions. This grass is unpalatable to animals during the dry season (when grazing pressure would be greatest). Further, it does not spread easily and thus poses little danger of becoming a weed. It is possible that a similar use of grassed waterways could be extended to Mali's rural producers.

Check dams in the Operation Haute Vallée zone have reduced the risk from inadequate rainfall, allowing farmers to use land more intensively and to save time and human energy. Farmers are eager to experiment with this technique since little capital is

required, and increased moisture availability improves potential returns when coupled with fertilizers.

In many cases, a series of channel protection dams might need to be constructed along a watershed. Such an effort may surpass the abilities of a single village and may therefore require broader community efforts.

C6c. Contour Dikes and Ridges

During heavy rains, sheet erosion removes topsoil and nutrients from upland fields. Adequate infiltration of water for crops and forage is not possible with rapid runoff. The construction of contour dikes and ridges will protect soil on such slopes. Small dikes or ridges (also called berms or bunds) are built along existing contours. The spacing between the dikes depends on the steepness of the slope—the steeper the slope, the narrower the distance between the dikes. The dikes slow runoff, retain topsoil, and increase infiltration of water. Generally, the areas immediately above and below the barrier store more than normal amounts of moisture.

When rainfall is intense, contour dikes can convey excess water at a non-erosive rate into a wooded area or an uncropped drainage way that has been stabilized with permanent vegetation. The contour dikes can also serve as guides for farmers practicing contour plowing. Finally, as soil builds up behind the dike due to erosion, a terrace effect is created and the slope gradient is reduced.

The immediate increase in yields is only a temporary benefit, since soil nutrients then become the limiting factor rather than water. Contour ridges themselves do not enhance soil fertility. Their benefits come from increased soil accumulation and water retention in the soil. Thus contour ridging and other physical interventions must be combined with interventions that improve soil fertility and nutrient availability, micro-climates, and soil physical properties over the long term. VRP and CARE/Djenné have had particular success combining contour dikes with traditional micro-catchments called *zai*, discussed below.

The primary benefit of water harvesting and erosion control through contour dikes is to maintain the long-term productivity of the land base, although field studies increasingly indicate that significant short-term yield gains are also possible. In three agroclimatic zones in Burkina Faso, a three-year evaluation of impermeable earthen bund anti-erosion systems built during the previous five years showed an average grain yield increase of 30 percent (170 kg per ha) on sorghum fields and 43 percent (90 kg/ha) on millet fields (Peter J. Matlon, "Prospects for Improving Productivity in Sorghum and Millet in West Africa," ICRISAT 1989). Permeable rock bund water harvesting systems show even higher short-term productivity results. A four-year evaluation of such systems constructed by farmers in the highly degraded Yatenga region of Burkina Faso demonstrated yield gains of nearly 55 percent.

Because contour dike systems require little or no cash outlay and the construction is done during the dry season when the opportunity cost of labor is low, these techniques are

well suited to small farmers' resources. Economic analyses of the package tested by ICRISAT have shown that a break-even annual sorghum yield increment of only 155 kg would assure a return of 15 percent on the labor and cash investment. In the Sahelo-Sudanian zone, this increment was be exceeded by two-thirds of the farmer participants. (World Bank Appraisal, Natural Resources Management project, pp. 11-12)

The VRP and numerous other projects have obtained good results through the installation of dikes and contour farming. The village of Baima in Mopti station is a particularly successful example, where the technologies introduced by the project have been adopted by farmers in surrounding villages.

D. Improved Agronomic Practices

On slopes with a slight gradient, agronomic practices alone are often sufficient to stabilize soil. Practices include contour planting, water harvesting micro-catchments, and tied ridges. In most years these practices will provide only slight yield increases. However during drought years, their impact on yields is much more pronounced. For example, crop yields from a water harvesting scheme in Burkina Faso were similar to those from traditional farming in a year when rainfall was adequate. The following drought year, however, the yields on fields using the technology were 48 percent greater than those on neighboring fields.

D1. Contour Planting

One common agronomic practice is tillage and seeding along the contour, rather than with the slope. Contour tillage creates a series of small barriers to water flow, reducing velocity and promoting infiltration (and thereby increasing the water available for plant growth). Contour planting has been introduced by numerous NGOs and projects in Mali, generally with good results.

D2. Micro-catchments and Tied Ridges

Micro-catchments can be constructed, often in the form of a "V" or half moon, to harvest water. Tied ridges are a variation of the micro-catchment principle. Tied ridges are a method of field plowing using a ridging plow with a tie attachment to make cross-ties (small barriers) to keep water from running down the rows. The tied ridges create closed micro-basins of a few meters in length. The cross ties are lower than the ridges, enabling them to act as spillways.

Water catchments have transformed wasteland into productive fields, yielding in excess of 600 kg/ha of cereals with only 250-300 millimeters of rainfall. Micro-catchment applications on abandoned, degraded land have shown cereals yields of 0.5 kg per square meter (500 kg/ha) on 320 millimeters of rainfall. Construction of micro-catchments requires considerable input of labor that is often a scarce resource for farm households. However, opening degraded land to agriculture through more intensive forms of management provides land to the land-poor, reduces tenure disputes, and reduces pressure on a fragile resource.

Zai, sometimes called poche d'eau or water pockets, is an improvement on traditional planting pits used to rehabilitate degraded land. Traditional pits are improved by increasing their size, putting the excavated earth down slope to allow runoff water to concentrate in the pits, and applying manure. These improvements to the traditional planting pit in Niger, the *tassa*, have resulted in a spectacular rate of adoption. (*Indigenous Knowledge and Development Monitor*, Vol. 1, no. 1).

This technology is most applicable in more arid environments, as excessive water runoff can damage the ridges and cross ties. Tied ridges can have particular benefits in complementing the use of fertilizer, which in the absence of sufficient moisture can damage crops.

E. Improving Soil Fertility through Manuring, Fertilizer Use, and Increased Fallow

In recent years researchers have pursued several themes to improve management of soil fertility inputs. Work on regenerating soils through natural means has concentrated on improving the forage component of fallow and incorporating trees into the cropping system. Research has also been carried out on soil amendments. Not all of the technologies examined have been promising. For example, while results indicate that rock phosphate and single super phosphate provide significant yield increases for up to three years after application, their application is uneconomical at current rock phosphate prices.

E1. Manure

Manuring involves the recycling of organic material so that nutrients in animal and plant wastes are used to improve soil fertility. Manuring is an important means of transferring nutrients from pasture land to crop land and of recapturing some of the nutrients taken by animals from the field. The presence of organic matter has numerous benefits for the soil, including increasing its water holding ability, preventing soil hardening, increasing the supply of nutrients, and providing a favorable environment for microbial activity. Research has concluded that manure represents a major portion of available soil fertility nutrients in Mali. It has been estimated that the total organic waste per animal is equal to two bags of N-P-K fertilizer per year. Nevertheless, the use of manure in Mali is constrained by several factors.

Geographic location. The tethering of livestock is generally restricted to fields near the compound to guard animals from predators and theft. At the same time, lack of water sources restricts the distribution of livestock.

Concentration of manure distribution. The purchase of cattle does not guarantee benefit from their manure. Herds in Mali are often composed of cattle belonging to several owners, but only the herd manager decides which fields to manure and how long. Generally, this person would ensure that the needs of his or her land are met fully before those of others. Developing a system for the more optimal distribution of manure is turning to important for maximizing the overall economic benefits of manure.

High rates of nutrient loss in application. One cause of nutrient loss is that manure is frequently left on the field throughout the dry season and is often burned before being incorporated into the soil.

Labor intensive management and transportation of manure. The nutrient requirements of crops can be high (from 5-20 tons of fresh manure per ha). For this reason manuring is more economically viable for vegetable plots and home gardens.

E2. Chemical Fertilizers

Chemical fertilizers can clearly have a strong positive impact on soil fertility. However, their use is limited by cost and by the risk it entails. When rainfall is insufficient during the time of application, there is a high risk of crop damage or even total crop failure when chemical fertilizers are used. Because of the variability of rainfall in low rainfall zones, chemical fertilizer carries an unacceptable level of risk in dry zones, despite an apparently high rate of return.

E3. Mulching

The use of mulch (twigs and small branches left over from the cutting of poles or agricultural residues or from other sources) has several benefits. Mulch accumulates soil, organic matter, and seeds; lowers soil temperature; protects against the impact of raindrops; attracts termites, which aerate the soil; and increases the absorption of water into the soil. In a research experiment in Guesseboli, Niger, under the USAID-funded Forestry and Land-use Planning project, twig-mulched plots yielded five times as much as non-mulched plots.

F. Controlled Burning and Firebreaks

Burning off vegetation during the dry season has been an accepted cultural practice for centuries. Bush fires are started by hunters, farmers who do not have the resources to plow thick vegetation, and herders who wish to generate the green shoots that grow after burning (burning draws water from lower soil layers to the soil surface, promoting new grass growth). Anecdotal evidence suggests that the area burned annually and the intensity of the burning have increased in recent decades.

While burning produces short-term benefits, in the long term it is detrimental to range and forest resources. Bush fires not only destroy annual and perennial grasses, but also eventually the soil humus upon which the regeneration of grasses depends. Extensive burning reduces the biomass needed for livestock during the dry season. It also contributes to the destruction of the forest cover and hampers forest regeneration.

Experiments have shown that the control of burning allows a significant increase in range carrying capacity during the dry season. However, since the ownership of range and forest and hence the benefits from the protection of the resources—are not clearly demarcated, individuals have little incentive to control fires. The institutional mechanisms to prevent and control fires exist, as evidenced by the fact that planted crop lands suffer

relatively little from fires. In areas where farmers have responsibility for the land, bush fires are greatly reduced. In Mali, since the National Conference on the Bush Fire Code, the Forest Service has recorded fewer fires as a result of the preventive action of early burning.

Clearly prevention is the best solution to the fire situation. However since fires cannot always be prevented, one technique of limiting fire damage has been the clearing of firebreaks, often 30-50 meter wide belts along forest or range boundaries. Firebreaks can serve multiple uses, such as agricultural production, growing of fruit trees, managed grazing, forage, and thatch cutting. It should be noted however that the strong winds usually associated with late fires limit the effectiveness of firebreaks. They are in fact usually used as places to start backfires.

G. Integrated Forage Crop Production and Pasture Management Schemes

The recent experience of a UNDP project in Dankunku, The Gambia, (which in turn built on the experience of the USAID-funded Mixed Farming and Resource Development project) demonstrates the benefits of these practices to improving livestock production and conserving range resources. Under this project, the Gambian Department of Livestock supported the creation of livestock owners associations that developed, with government assistance, livestock and rangeland management plans.

The Dankunku project charges a small annual grazing fee per head per year. These fees are used to improve water supplies, fence pastures, improve pastures with forage and tree species, market dairy products, and improve animal health. The project also emphasizes the development of small, practical industries associated with livestock production, including the use of milk products and animal by-products. For example, the project has filled the demand for yogurt in the immediate area. During the rainy season, excess production is sold in the capital, Banjul.

Controlling grazing on pastures, rangelands, and in forests is important to ensure long-term sustainability. With controls on grazing, it is possible to improve land resources by transplanting and reseeding drought-resistant grasses and legumes that are highly nutritious. A significant constraint on controlling grazing is the commons nature of range and woodlands. Under the proposed program, and where Eaux et Forêts has responsibility for rangelands or grazed woodlands, grants could be provided to support efforts by Eaux et Forêts to contract with local livestock associations for the multi-purpose use of these lands.

H. Summary

The above technologies are illustrative. At the beginning of the Mali Forestry Sector Reform Program, a comprehensive review of existing technology will be undertaken. The objective of this review will be to identify a toolbox of high-potential technologies that address common constraints and can be put at the disposition of communities for their analysis, adaptation, and possible use. Where it appears that additional research will be required, discussions will be held with the local communities (and appropriate GRM

agencies) to get their support for trials and research. The Forestry Sector Reform Program will not directly support long-term government technical research.

This section has hopefully demonstrated that a promising diversified and effective toolbox of technologies already exists. Given the right enabling conditions these technologies and others can have a positive impact on local natural resources management in Mali.

I. Proposal: Conditionality on a Process of Policy Analysis and Reformulation

One of the major weaknesses of previous forestry legislation in Mali was that no continuing process existed for policy analysis and formulation. The code, partly under donor pressure, was replaced by another in 1986. This new code appeared to be even more inappropriate than what it replaced, partly because the Forest Service lacked a process of policy analysis and formulation. This should not happen again.

The following statement, referring to policy implementation, applies equally well to policy analysis and formulation:

> "Policy implementation is profoundly dynamic. As actions are taken over time to carry out policy directives, the policy itself evolves. As outcomes are achieved, target groups and other actors are affected; thus the policy environment changes." ("Forestry Policy Reform in Mali: An Analysis of Implementation Issues," 9/93, p.31)

It is essential that the Forest Service develop the capacity to monitor this dynamic and integrate it into more appropriate policies. The substitution of one code or set of legislation for another does nothing to establish this capability. Nothing institutionally guarantees that the new loi d'orientation will have the desired impacts. A policy review process is all the more important given the fact that a wide range of policies (decentralization, land tenure, etc.) that are beyond the control of the Forest Service are in progress and will directly affect the appropriateness and effectiveness of emerging forest policy.

It is therefore necessary that the Forest Service create a type of Forest Policy Review Board. This board should represent a cross-section of society including foresters, jurists, politicians, deputies, administrators, farmers, herders, and others. The board, chaired by the director of the Forest Service, should meet twice a year to assess the impacts of policy reforms, progress in application and implementation of legislation, and interactions of policies with other government actions affecting rural areas and natural resources management. The board should also recommend actions that would promote better integration, more appropriate policy implementation, and policy revision and reformulation.

In addition a policy feedback mechanism needs to be developed that assesses policy impacts at the local level and feeds that information back to the review board. The Rural Economy Subcommittee of the Local Development Committees is perhaps the appropriate institutional home at the local level. The Forestry Sector Reform Program will provide guidelines on this mechanism during the first year of implementation.

J. Restructuring the Forest Service

Reorganization and personnel shake-ups of the Forest Service are already underway. The director and deputy and all division chiefs (with one exception) have been replaced. The former staff had been around for 10 years or more and was widely associated with the business as usual of the 1980s. The new team represents a clean break with the past, with new, younger faces (including a woman as division chief). The new team seems to be more committed to a participatory approach and certainly seems to have this as their marching orders. It should be noted that the reasons behind these changes also include party politics. The new staff is largely composed of active members of the ADEMA party, presently in power.

It is expected that several regional directors will be replaced soon (the change has already taken place in Mopti). In addition there is a proposal to make sure that all chefs de cantonnement have project experience and hence many existing chefs will have to be replaced. This proposal stems from a desire that staff at the execution level have the experience and skills to collaborate with other structures (e.g., NGOs) and technical and extension experience, and are not solely interested in control activities.

The personnel shakeup poses administrative problems for the Service. Many former division and regional chiefs were highly graded and will now find themselves supervised by less-advanced employees. The large numbers of experienced older, but demoralized, agents presents a certain risk to reforms in progress. One proposed solution, in application elsewhere, is to use non-project funds to finance "golden handshakes" for this staff. It has been estimated that many of these agents would opt for early retirement for 6,000,000 f cfa. Funding 30 such buy-outs would not only help revitalize the Service but would also pare it down and relieve some of the long term financial burden that will be exacerbated by the change in roles. The program, in support of the new approaches, might then promote the recruitment of a smaller number of recent graduates (including geographers, social scientists, economists, community development agents, animators, facilitators, and foresters) with a major emphasis on recruiting women.

Progress on structural reorganization is slightly less well-advanced. Current proposals include the separation of fisheries as a service national and the creation of a Commissariat à l'Environnement. The rationale behind these proposals is to give fisheries a higher profile given its importance to the national economy and to separate out the control functions from extension functions. However the main technical divisions (Soil and Water Conservation, Parks and Hunting, Management and Reforestation, and Projects and Programs) at the Forest Service would remain as they are.

Both the proposed and implemented changes clearly demonstrate the will to reorient the Service. However the structural changes proposed, though a step in the right direction, fall short of creating an agency that reflects and can carry out a new mission, particularly in regards to extension and communications functions. The present and proposed divisional mix persists in presenting a technocratic and technical view of the future. Extension and communications will take on greater significance in the years to come as policy reforms are

implemented, and yet they remain hidden in a technical division (Soil and Water Conservation).

It is an open question how much influence the project can have on the restructuring in progress. However at minimum, the following functions should be clearly reflected in the structure with the appropriate profiles:

- planning
- extension for local communities and individuals
- technical support
- public lands management
- monitoring and evaluation
- policy and legislation
- training
- communication, information, and facilitation

At the risk of dilution, some of these functions might be combined into one administrative unit, for example extension and training. The present technical divisions could be regrouped in the technical support unit.

K. Research and Study Component

K1. Ideas on a Research Approach and Topics

The impacts on local communities of the national research paradigm—centralized, technical, on-station research—have been disappointing, to say the least, for a variety of reasons, including but not limited to irrelevant and inappropriate research topic selection (not asking the right question or not knowing what question to ask), poor research design, lack of participation by beneficiaries, lack of understanding of the total farming system and its constraints, a strongly authoritarian and centralized system that stymies initiative, lack of trained personnel, lack of links between extension and research, research programs that are not result-oriented, research monopolies that eliminate competitive effectiveness, etc.

Some progress has been made, for instance under the USAID-sponsored Farming Systems Research project. However structural and methodological weaknesses remain, especially within forestry research. The only major advances in forestry research over the past six years have come not from IER research programs but from two rural development organizations: OAPF and OARS. It is highly recommended at this stage to avoid the formal IER structure for forestry research.

The approach of the project will be more participatory, more informal, more flexible, and will use more partners (including NGOs, recent graduates, students doing theses, local farmers and extension agents). At the same time, it will be more accountable because contracts of specific time frames and objectives will be let on topics of immediate concern. The approach will be to fund multi-disciplinary studies of limited duration and cost. An emphasis will be placed on using research targets of opportunity for training and institution

building at the local and national levels. At the end of the project it is anticipated there will be a group of organizations and individuals capable of responding to and carrying out forest research activities and promoting a free market for research. Topics will be less technical (hard) and more oriented toward the integration of the social sciences into forestry research (soft): e.g., management systems, methodologies, transfer techniques, negotiation and conflict resolution, and indigenous knowledge systems. These topics have long been neglected by the foresters and researchers in part because they tend to be messy, not because they lack relevance.

Where topics and questions are obvious the project will contract with the best local institutions to carry out studies. If needed, short-term consultants can be brought in to support local teams. As topics are identified during project implementation, short requests for proposals will be developed and published and submissions analyzed by a committee at the Forest Service.

K2. Suggested Topics

K2a. Land and Tree Tenure

This study would be a follow-on to the successful LTC studies in the Fifth region. It will be necessary to coordinate closely with the CFD initiative "observatoires sur le foncier." Also, the project might consider taking up the forestry observatory. The observatory is designed to monitor land and tree tenure changes as policy and decentralization initiatives move ahead.

K2b. Traditional Natural Resources Classification Systems

The OAPF experience has shown that technicians and local NRM users have different classification systems leading to different types of management. It is necessary to continue these studies on both methodological levels and wider field experience (content) levels. This might cover the following types of resources:

- soils
- vegetation
- water
- animals

K2c. Local NRM Organizational Structures

There is obviously a major interest in Mali in identifying viable traditional or modern organizational structures to which many NRM tasks could be delegated. Much more work needs to be done in identifying criteria for the selection and development of these organizations. For example some NGOs seem to be putting the emphasis on traditional conflict resolution and contre pouvoir organizations. Outstanding questions on this subject include the following: Can these organizations be assigned management responsibilities without compromising their traditional roles and without losing efficiency? How well do

these organizations adapt to the new contexts of demographic pressure and a less authoritarian and more democratic society? How does one address traditional inequalities and injustices such as the role of women? For modern or project sponsored organizations, how does one assure legitimacy and sustainability?

These questions are crucial in the long term and merit attention early in project implementation.

K2d. Local Conflict Resolution Techniques

NRM cannot be carried out without conflicts. These are a natural part of the process and must be accepted and managed. To a large extent the proof of the Forestry Sector Reform Program's pudding is in the extent that NRM conflicts are well managed and lead to acceptable negotiated results. Local techniques have a large role to play and should be inventoried and studied. Methodological advances from other areas, including the United States, should be analyzed and integrated where appropriate. Conflict resolution cases are interesting also in their ability to suggest or become a process for developing rules and regulations. As exceptions sometimes prove the rule, the study of breakdowns may be especially enlightening. At the time of this writing, two fulani communities in the Niger delta came into a conflict that resulted in more than 20 deaths and hundreds of wounded. Obviously an acceptable conflict resolution forum did not exist.

K2e. Methodologies and Support for Local Plans and Contracts

Several projects and NGOs are working on the problem of how to develop management plans and contracts (agreements) in forms that are consistent with local understanding and local appropriation and ownership. A study of the different techniques and methodologies employed would aid the development of manuals and guidelines for NRM and would make Activity 3 of the program more efficient.

K2f. Contracting Techniques

Much emphasis is being placed on contracts between local user groups and communities and the administration. Yet very little is known about local perceptions of contracts or the means to make contracts more accessible to local folks. Some local experience seems to indicate that the written word carries less weight than the spoken word and that papers are seen as permits or authorizations and not as mutual engagements with mutual rights and responsibilities. Much more work needs to be done before the country is littered with broken and misunderstood contracts and natural resources agreements.

K2g. Local Communication Systems

Communication is the key to extension, participation, negotiation, and good relations. To the extent that extension and other efforts can integrate local communications systems and be appropriated by communities, program activities will be more effective and sustainable. Strangely, knowledge of local communications systems is often take as a given. Recent

studies in Sikasso and at OAPF have shown that much of the richness and the multi-dimensional aspects of the communications systems are being missed and are underexploited.

K2h. Appropriate Monitoring Techniques

The section on monitoring raises some of the issues that might be addressed through a study early in project implementation. The main issue seems to be how to make the verbal and anecdotal nature of local monitoring more systematic and useful.

L. Ideas for a Section about Rule Making

The timing of the decentralization process, and particularly the creation of decentralized structures, organizations, and entities that will ultimately be responsible for local rule making (under the forestry loi d'orientation), is difficult to predict at this stage. Although this uncertainty could be conceived of as a major constraint to project implementation, it is also a major opportunity and should not prevent support to local communities and other project activities from moving forward. Local rule making to a large extent should be based on local experience. As communities struggle to address individual, concrete natural resources management cases, the need for certain types of rules and regulations will arise. Particularly in the case of resolution of NRM conflicts, the need for certain rules are apparent. One of the roles of rule makers is to analyze and codify the informal rules that have developed from these concrete situations and cases on the ground.

At present, because there is something of an NRM policy void, there are many concrete activities being tried in the field that are enlightening the rule making and policy process. The situation of the Ogakanas is an example. The disagreements over their legal status and whether some of their activities run against the old code provide a wealth of information about what kind of local rules might be useful to encourage certain processes and institutions. Another possible example is from Douentza and concerns the reappropriation of land from women who have invested in its rehabilitation. What kind of local rules might be necessary to protect investors in land reclamation or rehabilitation? Another example are the several cases of communities taking policing activities into their own hands.

It is only through analysis of these activities that rules can be developed that respect the positive aspects of the techniques and practices of local organizations while circumventing their weaknesses. The actual situation of a policy and legislative void may have some disadvantages but it has certainly allowed for a great deal of local-level policy and rule making experience that will greatly enrich the new regulatory process. While this is perhaps a situation that makes many bureaucrats feel uneasy, it definitely has tremendous benefit.

Without concrete activities taking place in the field (i.e., without people trying different kinds of management), the development of appropriate local rules is nearly impossible. Rule making can take place in a experiential void, but what it will likely produce is something like the Forestry Code of 1986, which is still inappropriate for the local situations. In reality the point of decentralized rule making is to take into account local experience. Although natural resources management activities should not get too far out in

front of the rule making process to avoid eventually being in major conflict with the rules, the most logical place for them is on the cutting edge, providing input into the process itself.

M. Local-level Monitoring

The devolution of authority to local communities for the management of their natural resources requires that all the elements of effective management are adequately transferred or developed and appropriated by these communities. One of the essential elements in the management process is monitoring and the development of local mastery of the feedback loop used to refine and redirect activities as a function of their socioeconomic and environmental impacts. Without this feedback local communities will in essence be flying blind.

The tendency to centralize and "technocratize" monitoring functions must be balanced, as with all other management functions, with local control of (and decentralized) monitoring. Devolution of authority is not complete without the ability to locally monitor and refine the process. The real challenge is for centralized monitoring to adapt to the types and kinds of information that are meaningful at the local level.

Many efforts at monitoring either ignore the beneficiaries entirely or propose techniques that are inappropriate (culturally or technically) at the local level. The Village Reforestation project, for example, recognized the need for an information system, but the proposed system was onerous and mainly irrelevant to local needs and uses.

One of the jobs of the project team will be to develop, together with local communities, appropriate monitoring techniques and to develop manuals and guidelines for decentralized monitoring. There are many possibilities, and although often neglected, some experience has been gained at the field level by such organizations as the Forest Service, the ATD2 project, and NEF Douentza. What follows below are some general guidelines.

Whereas centralized monitoring is mainly statistical and expressed in written or numerical form, local monitoring for the foreseeable future will be largely verbal and anecdotal. (This is not to say that local rural inhabitants are not capable of understanding and using more sophisticated tools; they certainly are. It means that general community participation in monitoring will depend on using techniques that are generally understood, i.e., with which local community members feel comfortable, can manipulate, and for which they feel some ownership.) It will be a question not of rejecting this system but rendering it more systematic and useful.

Many of the tools of periodic, oriented participatory rapid rural appraisal can and should be used. Some of these tools include group transects, group interviews, timelines and calendars, and perhaps Venn diagrams. Recording and documentary techniques should allow information gathered to stay at the community level and be analyzed there. These techniques might including audio cassettes (the audiotheque rural approach is instructive), drawings (maps, etc.), and perhaps instant photos.

Key indicators noted below must be based on community perceptions of what is important. However it seems reasonable to expect that on the technical side, agricultural yields, forest and pasture regeneration and availability, surface areas recuperated or rehabilitated, animal health, forest product supply, water quantity and quality, and other factors will be of major interest.

In terms of socioeconomic indicators, emphasis might be placed on levels of involvement and participation; impacts on social groups such as women, youth, the elderly, castes, etc.; prices of local agricultural produce; impacts on relations with other groups and communities including the administration and other projects; development of spin-off activities; and levels and adequacies of financial, human, and material resources management.

Local-level monitoring of natural resources management can only be developed through a process of dialogue with local communities. This process, which is indispensable, will require a certain amount of apprenticeship for both the government and local communities. However the devolution of authority over local resources to communities will undoubtedly provide a strong local incentive to be more active in and develop tools and techniques for monitoring of resources use.

N. Development of an Effective Management System for Public Lands

The reorientation under this project will lead to a Forest Service with two main functions. The first function is that of providing extension advice to local communities and individuals. Field activities for this function are supported under Activity 3 of the Forestry Sector Reform Program. The other major role is to manage the nation's public lands (classified forests, wildlife reserves ,and national parks).

Historically this second role has received relatively little attention; public lands have existed in theory but the reality of the field was quite different. Major areas of public lands have disappeared under the axe, the plow, and the hoof. Perhaps more than 50 percent of Mali's total public land area still exists in some form. Even the Baoule National Park, a UNESCO Biosphere Reserve, is under very heavy pressure and is losing ground every day.

In addition to the inevitable lack of human and technical resources, the largest single contributor to this state of affairs has been an outdated and poorly adapted management approach. As with the domaine protégé areas, public land management has stressed police-style protection in lieu of good management and sensible use benefitting local communities. In fact local use, management, and participation were frowned upon. Hence forests were rarely perceived of as being useful to communities, rarely valued by local populations, and seen as more of a nuisance and production constraint than a benefit or potential advantage.

Management has been uni-dimensional to the detriment of populations and resources. Forests were often classified as wood reserves for the steam-powered vessels that plied the river or used the train tracks. Other resources have been ignored in planning and implementation and therefore the full range of benefits have not been exploited. Multi-

purpose management requires brainstorming about all possible uses even before resources inventories are undertaken. Particularly neglected have been non-consumptive uses such as education, research, recreation, ecotourism, and cultural resources management.

Forests and other classified areas were not conceived of as part of larger rural production systems until very recently (OAPF). In addition when it was done, forest management was performed by technicians to benefit the resources and not the people. Not until about 1990 did management plans start to include the development of local communities as a management objective and to consult with local users about objectives and techniques. Poorly adapted management approaches were top-down and technocratic. Many plans were drafted for a small technical audience. Very few have been developed with and for potential users: rural user groups. Additionally, substantial funds continue to be wasted on technically correct resource inventories that do not involve local people and are for the most part useless for management planning.

Public lands, having as their only constituency understaffed and underequipped forest agents, slowly degraded and sometimes even disappeared. The public was not consulted let alone integrated into decisions about the management of public lands.

Luckily over the past five years a variety of new, more open and appropriate management systems have been tried and put into practice. Examples include the work of Operation Aménagement et Productions Forestières around Bamako (with World Bank, CFD, and Norwegian help), the work of the Regional Direction in Segou (with FED support), the work of the Kita Cantonnement (with ILO support), the Forestry and Food Security initiative in Sikasso (supported by the FAO), and others. These groundbreaking activities have provided a wealth of experience that should be capitalized on by the Forest Service in developing an effective management system for public lands.

Below we present another plan based on the components under Activity 4 of the proposed Forestry Sector Reform Program in Mali.

Output 4.1: Guidelines and procedures developed for participatory, multiple-use sustained yield management of public lands.

One of the first steps to improved management of public lands is the development of simple guidelines and manuals that promote or require participation, multiple use, and sustain yield management. (It should be noted here that there are several proposed manuals in existence, none of which are totally satisfactory.) It is essential that these guidelines insist on simple, practical, and flexible plans. The objective is not to satisfy a few technicians but to transfer a large part of the planning process and management to actual users. These guidelines should be developed with the participation of user groups early in project implementation and widely vetted—particularly with local user groups—before being put into final form. They should be subject to regional and local workshops of at least several days' duration.

Output 4.2: Multiple-use management plans developed and implemented for selected classified areas permitting controlled use of these forests by local communities.

After the guidelines are developed several participatory plans will be developed and implemented. Criteria for selecting the public lands will include ecological and biodiversity importance and potential, the presence of active user groups, the proximity to activities relating to the support of local communities (activity 3), representation of a range of types of public lands, etc.

Output 4.3: Elaboration of a program for classification and declassification of public lands.

The system for classification and declassification of public lands is in disarray and the process is in a logjam. Hundreds of applications for classification are pending, some of these because of protests by local populations. At the same time, thousands of acres of classified lands are being actively farmed or otherwise used and should be declassified.

This activity should be closely coordinated with the government organizations involved in cultural resources management. It appears that the full potential and range of classification is not being used. Many major historical and archeological sites lack any kind of national status or protection. In addition the national forest system includes many interesting sites from a cultural perspective.

O. Ideas for Training

Training approach. The approach to training will emphasize workshops, short-term training at the local level, joint training (villagers and foresters, other technicians and foresters, NGOs and foresters, foresters and politicians and local leaders, etc.), and developing soft skills participation, promotion, negotiation, organization, facilitation, conflict resolution, management, prioritization, collaboration, and others. Sorely missing from the foresters' repertory, technical skills are a minor problem compared with the lack of approach and extension skills.

Long-term training. Because of the difficulty in capitalizing on this type of training in Mali it should be kept to a minimum: perhaps one student per year for the five years. If this is accepted a possible approach would be to go for bids on the long-term training component with the requirement that the winning institution would invest in building up Sahelian forestry expertise (including using Malian students as a resource and trainers) and would be involved in the preparation and execution of decentralized workshops and séminaires in Mali. Hence the investments the organization might make would be compensated by a guaranteed level of effort in local training. Workshops might cover such topics as: public involvement in forest management, natural resources conflict resolution techniques and systems, land-use planning, forestry policy analysis and development, policy monitoring, participatory techniques, geographic information systems, biodiversity management, participatory research, team building, resources planning and monitoring, and

land and tree tenure. Of lesser importance are the strict technologies, which are problematic because of differing cultural, ecological, and economic conditions.

Organization of training and communication skills. At the national level, the DNEF does not presently have the capacity to undertake the necessary retraining and communication and information functions that a reoriented service requires, although the Training Center at Tabacoro (under reorganization) will undoubtedly be a major asset. As part of the restructured and reoriented missions of the Forest Service (Program Activity 2), a unit that coordinates and promotes training, information, communication, and extension methodologies is needed. It is also necessary that the structure of the Forest Service encourage a partnerial approach and a forum for collaboration. It must further clearly and widely inform the public of policies, rules, and approaches. To provide institutional building in this area it is suggested that a specialized NGO be attached to the "Direction Nationale des Eaux et Forêts" with an illustrative mandate to:

- develop the information and communications systems
- develop training plans and partners
- carry out selected training of trainers at the national level
- develop extension and monitoring methodologies
- encourage and promote the use of an array of partners including NGOs

With regard to the third and fourth program activities—support to local communities and improved management of public lands—significant levels of effort in training are needed. Since the Forest Service for the moment can neither provide this training nor the expertise, NGO or private sector involvement will be necessary at the local level. It appears that the best way to achieve the goals of the project will be to assign the job of organizing short-term, practical training workshops to a competent local entity. Training will touch the topics noted above with an emphasis on team building (building partnerships among actors), ensuring wide consensus on the goals and objectives of the project, and building local-level Forest Service training capacity.

P. USAID Experience: Village Reforestation Project

The VRP, started in 1980, was the first of a new generation of forestry projects that targeted decentralized, small scale community forestry activities.

Approach. The VRP approach contained many elements that have since worked their way into the conventional wisdom of Sahelian forestry. Some major elements of this approach are:

- working directly through the Forest Service
- little or no technical assistance
- working directly with local communities
- emphasis on extension functions (appui-conseil) instead of police functions
- recognition that forestry is more than tree planting (management of natural forests, soil and water conservation, etc.)

- emphasis on positive management actions (plant production, reforestation and soil conservation) instead of passive control and protection actions
- use of staff trained in extension (community development agents) to complement forestry staff
- recognition of the role of action and research in project implementation
- coordination with other partners including NGOs and the Peace Corps

Understanding of the issues. The VRP spawned a wealth of state-of-the-art multi-disciplinary studies that defined a generation of projects and influenced some of the major contributors to this field. A partial list of people involved is a "who's who" of Sahelian forestry in the 1980s.

Understanding of the techniques. VRP was one of the first projects to demonstrate clearly the flaws of the woodlot approach, although many projects in Mali subsequently failed to take this lesson into account.

Policy dialogue. VRP's influence on policy dialogue has been significant since the beginning. Several issues that some people think came out of the events of March 1991 were addressed in the project. The conditions precedent to first disbursement for VRP noted in the Grant Agreement of September 1980 included a guarantee from the GRM that agents would not participate in any repressive activities and community development agents would be recruited for the project. This policy dialogue continued in the late 1980s and the early 1990s with the work of the Land Tenure Center. VRP, in spite of its very modest size, has had the most constructive effect on the reform of the forest legislation of any forestry activity in Mali.

SECTION III
NOTES ON THE LOI D'ORIENTATION

The following is based on the review of proposals from the Forest Service, the Forest Service's advisors, and design team input.

It is generally agreed that the loi d'orientation should be general, laying out principles that will guide local lawmakers and users. It should also be flexible and easily understood. This section presents ideas that could serve as critiera for judging whether a loi d'orientation is acceptable. It should be noted that the most recent proposal from the Forest Service is head and shoulders above other versions. The Service seems to be on the right track.

The law should develop the following principles:

- Forests and forest resources will be managed on a sustained yield basis[1] for the benefit of future generations.

- In the interest of future generations it is necessary for the state, communities, and individuals to protect and manage forest resources.

- Management of forests, given the variety of resources they contain, will be based on multiple uses.

- Forest resources will be defined (though not exclusively) as:

  - wood and wood by-products
  - non-wood products
  - grazing land
  - recreational resources
  - ecotourism resources
  - cultural and historical resources
  - water resources
  - wildlife
  - biodiversity

- For forest management to be effective and efficent, direct resources users will be associated with all management functions.

[1] Sustained yield management is under fire in the U.S. The latest fashion is ecosystem management. In any case, the message of sustained yield in this context is twofold: these resources must produce and they must be used on a capital-conserving basis to avoid degradation and eventual compromise of the resources base.

- Forest management will be decentralized and power devoluted to local groups through contracts and resources agreements between the administration and recognized local entities, where feasible.

- All Malians (users of forest resources) have the right to and should participate in forest management decisions made at the local level.

- Because of their role in forest resources use, special attention must be made to integrating women's rights and obligations.

- Local rules and regulations for forest management must be developped under guidance from the Forest Service.

- Local rules and regulations must contain provisions for conflict resolution.

- Local rules and regulations can be proposed by anyone, but may become binding only upon approval by an officially recognized democratic assembly.

- Local rules and regulations must contain safeguards against forest resources abuse, means of enforcing these safeguards, and penalties for violators.

- All Malians have the right to dispute or appeal actions taken against them by the administration in the exercise of its control function. The appeal process must be fair and objective, timely, accessible, inexpensive, and easy.

- On all lands in the public domain the Forest Service responsible for forests is the responsible manager. As manager the Service ensures that national needs are taken into consideration in the management of these lands. Management will be participatory, multi-use, and based on sustained yield.

- On all lands that belong to private individuals or decentralized communities, the individual or community is the responsible manager subject to the payment of relevant taxes and permits. The role of the Forest Service for these lands will be to provide extension advice and guidance and any other appropriate role that the communities wish to convey on the agency.

- Management of local forest resources by communities will be based on plans and contracts that spell out the rights and responsibilities of all parties.