Measuring the Impacts of Natural Resource Management Activities in Mali's Upper Niger Valley

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Acknowledgments

So many people contributed to this report that it is not possible to name them all individually. Mike McGahuey (USAID/AFR/SD) must be singled out, however, because without his keen interest in NRM and strong desire to better understand how NRM activities fit into the overall scheme of agricultural transformation in Africa, I would not have had the opportunity to visit the OHVN and prepare this report. Mamadou Lamine Sylla also made a major contribution to this report by organizing the field trips, providing me access to a wide variety of OHVN documents, and participating in many open, frank discussions about the strengths and weaknesses of the NRM program that he is managing.

Those who contributed the most to this effort—the farmers who interrupted their daily routines to spend the day with us during our field visits—are too numerous to mention individually. These farmers contributed to this report not only by chatting with us and allowing us to visit their farms, but also by working hard during the last 10–20 years to improve their farming techniques, literacy skills and management abilities.

Others who helped, either in the design of the rapid appraisal or by commenting on the various presentations I have made concerning this work, are Gaoussou Traoré and Mamadou A. Dembele of USAID/Bamako and Bob Winterbottom of IRG.

Executive Summary

A visit to seven villages in the Office de la Haute Vallée du Niger (Office of the Upper Niger Valley, or OHVN) and discussions with about 100 farmers using natural resource management (NRM) practices confirmed that something good is happening in the zone (see Section 4):

- Yields of all crops are increasing for farmers adopting NRM intensification methods.
- Farmers are unanimous that life is better now than 10 years ago.
- Farmers are optimistic and enthusiastic about the future.

These results come from a complex process that has been going on for more than 15 years (Sections 2 and 3). Ingredients contributing to the current success appear to be:

- Identification of technologies capable of increasing declining yields
- Potential for increased cash income from improved cotton production
- Community approach to implementation
- Focus on youth
- Focus on villages/farmers most likely to benefit from NRM actions
- Use of demonstration effect through model farmers and model villages
- Incremental training (literacy, technical skills, community organization, management)

Support services offered have included:

- Roads
- Credit guarantees for limited period following management training
- Input/output transport assistance
- Regular supervision and support to trainees
- Some free equipment for implementing NRM activities
- Market research by OHVN to help with crop diversification

Looking toward the future, two questions need to be addressed:

1. Is it possible to extend these results by . . .
    - further increasing yields/incomes of current NRM farmers?
    - reaching a broader group of OHVN farmers?
    - reaching farmers outside the OHVN area?
2. Is it possible to quantify the impacts of NRM intensification activities in terms of . . .
    - benefits realized by farmers?
    - benefits realized by Malians in general?
    - benefits realized by the rest of the world?

The answer to both questions is yes. Suggestions for accomplishing these tasks are contained in this report (Sections 5 and 6).

Glossary of Acronyms and Abbreviations

AVB	agents vulgarisateurs de base
APCAM	Assemblée Permanente des Chambres d'Agriculture du Mali
BNDA	Banque Nationale de Développement Rural
CLUSA	Cooperative League of the USA
CMDT	Compagnie Malienne pour le Développement des Textiles
FCFA	CFA franc
IPM	Integrated pest management
NGOs	non-governmental organizations
NRM	natural resource management
OHVN	Office de la Haute Vallée du Niger
PASIDMA	Projet d'Appui au Système d'Information Décentralisé du Marché Agricole
USAID/W	U.S. Agency for International Development, Washington, D.C.

Foreword

The Office of Sustainable Development in USAID's Africa Bureau (USAID/AFR/SD) has long used formal assessments of natural resource management (NRM) programs it has assisted to evaluate impacts and take stock of lessons from its investments. The experience of USAID/Mali's Upper Niger River Valley program was—and continues to be—particularly fruitful. In addition to providing lessons for other programs, it offers a real foundation for hope that the degradation of farmland can be halted and even reversed using a multiyear, multifaceted approach.

Beginning in the late 1980s, this program has brought together agriculture, NRM, microenterprise and governance elements in promoting improved NRM practices for farmers. Over the 12 years before the study discussed in this publication, personnel from the mission, AFR/SD, and various research institutes had already conducted several informal assessments in the program area, which is in the zone covered by the Office de la Haute Vallée du Niger (OHVN). These experts noted that, at least in some communities, there appeared to be positive trends in terms of improved livelihoods, decreased degradation, and strengthened governance.

In order to improve its information on the lessons produced in the OHVN, AFR/SD invited Dr. Valerie Kelly of Michigan State University to assess people's perceptions in some of the communities involved. In early 2000, Dr. Kelly visited seven communities in the OHVN and interviewed about 100 farmers. While this was a small sample of the total OHVN population, Dr. Kelly conducted the assessment from a perspective honed by over 20 years of experience of assessing rural development in West Africa and elsewhere. In addition, Dr. Kelly conducted extensive interviews with OHVN personnel and reviewed critical reports.

Based on her interviews, Dr. Kelly noted the following preliminary conclusions about the farmers she spoke with: (a) yields for all crops increased for farmers adopting intensified NRM practices; (b) farmers were unanimous that life had improved over the last 10 years; and (c) farmers were optimistic and enthusiastic about the future. She went a step further and noted that across the interviews, two things stood out: first, as farmers moved from near-subsistence to commercial agriculture, they started treating farming as a business. Second, they used NRM practices as a way to increase the efficiencies of fertilizers, improved seeds and other investments necessitated by a transition to commercial farming operations.

Dr. Kelly was particularly emphatic about the impacts that the management/literacy training provided by the Cooperative League of the USA (CLUSA) had on farmers, both in developing entrepreneurial skills and in helping people develop and manage cooperatives. As members of competent coops, farmers could do a number of things that they could not do as individuals. She noted the importance of this new feeling of empowerment on people's attitudes. Overthrowing feelings of helplessness has been paving the way for people to take effective action to move out of poverty.

Dr. Kelly was clear that she thought that she visited some of the better OHVN communities, and she had hard questions about the extent of the impacts that she saw. She noted, for example, that while the information from participating farmers showed positive yield trends over the last 10 years, yield changes for the zone as a whole over the same period were stagnant. Moreover, marketing missteps caused problems for a number of farmers, leaving them with unsold stocks of some grains and vegetables. More training in marketing for farmers may be indicated, along with more and better information on demand volume, transportation problems, and special requirements affecting the national, regional and European/U.S. markets.

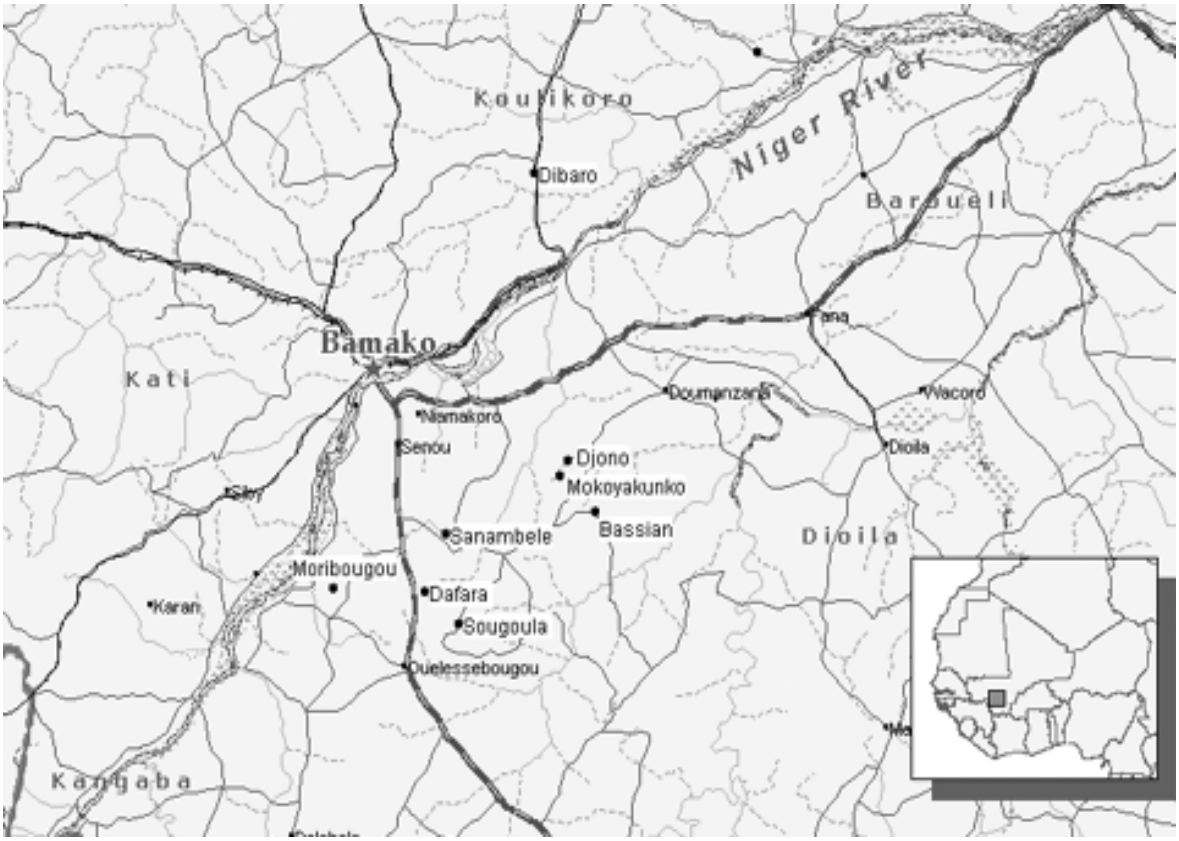
However, Dr. Kelly was also clear that there appeared to be no particular constraint to scaling up the impacts seen in the communities that she visited. Additional work will be necessary to more clearly identify the activities that would best contribute to such an expansion, and she provided several options for taking the next steps.

From AFR/SD's perspective, Dr. Kelly's work showed that the lessons that were produced in the OHVN are not crop- or site-specific. Most would apply to a broad range of sustainable development problems. We recommend that you read this thoughtful study, glean the lessons, and add your own.

Carl M. Gallegos, Ph.D.
Acting Chief
Division of Economic Growth, Environment and Agriculture
USAID/AFR/SD

Note: a previous version of this study, *Measuring the Impacts of Natural Resource Management Activities in the OHVN,* was made available on the web by IRG, Ltd., the firm which arranged for Dr. Kelly's visit to Mali in 2000. The document may be found at http://www.dec.org/pdf_docs/PNACP456.pdf.

MAP OF THE UPPER NIGER VALLEY REGION OF MALI, SHOWING SEVERAL VILLAGES IN THE OHVN STUDY



Map courtesy of Peter Freeman, Development Ecology Information Service
www.devecol.org

Background

Over time, the development community has talked about the fact that different models of sustainable development should include one in which entrepreneurial farmers invest in systems that generate more secure and prosperous livelihoods and decrease degradation rates. By several measures, growing numbers of producers in the OHVN (Office de la Haute Vallée du Niger) zone of Mali appear to be on the road to this type of sustainable development. Information available from informal appraisals and the OHVN database suggests that a significant number of producers are moving from subsistence systems to diversified, revenue-generating systems where yields are increasing and degradation rates are falling. The system is built on production practices that integrate natural resource management (NRM) with investments in inputs (fertilizers, improved seeds). In principle, this integrated system uses inputs more efficiently and allows producers to practice intensified agriculture on less land. Commercial credit is the source of capital for many of these investments, and, judging by the repayment rates, the producers have achieved a high level of competency in enterprise management. There also appears to be progress toward community-financed extension systems and community-financed support to improve the delivery of health and education services. The OHVN experience appears to merit closer study to (1) better quantify the results and (2) draw lessons that can be applied to other situations.[1]

[1] This introductory paragraph is adapted from my scope of work, which was drafted by Mike McGahuey.

Objectives and Methods

Given general perceptions of what has been happening in the OHVN during the recent past, it seems worthwhile for USAID and OHVN to measure and document the OHVN program's impacts better. This report is a first step in that direction. Specific objectives are to (1) confirm the general perceptions described above; (2) recommend low-cost, easy-to-implement methods for better quantifying the impacts of NRM/intensification practices; and (3) recommend actions that can be taken to increase adoption of promising NRM/intensification practices.

To accomplish these objectives, I (1) reviewed a wide range of documents describing activities in the OHVN zone during the last 20 years (see References); (2) identified existing databases concerning the OHVN that could contribute to current objectives; (3) developed a format for conducting group discussions with farmers and OHVN agents concerning their experiences with NRM techniques (techniques adopted, factors influencing adoption, impact on production, impact on incomes and standard of living, etc.—see Appendix 1); (4) conducted the group discussions during four days of field visits organized by OHVN; (5) discussed preliminary findings and recommendations with USAID/Bamako and OHVN staff; (6) made two presentations of preliminary findings in Washington, D.C., to USAID/Washington personnel and representatives of organizations collaborating with USAID/W on NRM activities; and (7) drafted the current report describing key findings and recommendations.

In my work I have focused on describing—and, whenever possible, quantifying—changes in agricultural productivity and incomes that have taken place among farmers who adopted NRM practices during the last decade. It is important to note from the start that these changes cannot be attributed with certainty to any particular USAID investments or OHVN activities, since the preconditions for doing an analysis of causality over time are absent. The most important precondition lacking is the ability to isolate USAID contributions from other historical events. USAID is only one of many actors in the OHVN, and during the last decade many things have happened in Mali (e.g., structural adjustment, market liberalization, restructuring of OHVN, devaluation of the CFA franc, a military regime replaced with a democratically elected government, etc.) that have contributed to the higher level of agricultural productivity and income that we find in the OHVN today.

Another problem is the nature of the USAID contribution—it was a very diverse contribution covering a wide range of interventions that varied across time and space depending on initial conditions and the expressed needs of different communities and farmers. Some activities were specific to the OHVN project (e.g., support for extension services, road building, literacy training, OHVN restructuring, credit guarantees), while others were activities supported by the USAID country program that had an impact in a number of places besides the OHVN area (support for input/output market liberalization, governance and democracy activities, youth training/employment activities, etc.). When appropriate, I call attention to some of the USAID-funded activities that seem to have been particularly important components of the overall environment that stimulated productivity and income growth in the OHVN, but it must be stressed that these observations are based on qualitative rather than quantitative assessments.

Conceptual Framework

In any effort to evaluate the impacts of a program, it is important to begin with a theoretical picture of how the program activities are likely to affect selected indicators and produce desired outcomes. Figure 1 is adapted from the results framework used by USAID/ Mali to monitor activities contributing to their sustainable economic growth strategic objective. The major change I have made is to add a row between the intermediate result of "increasing sustainable dryland agricultural and NRM practices" and the strategic objective of "increasing value added to national income." This intermediate row represents the positive impacts on agricultural productivity and farm incomes that must occur if the strategic objective is to be achieved. In the longer-term process of quantifying contributions of NRM activities to national income, I believe the first step is collecting farm-level evidence that productivity and incomes are increasing in areas where NRM practices are being adopted.

Figure 1:
Sustainable Economic Growth Strategic Objective Results Framework

USAID Strategic Objective

Increased Value Added to National Income in Agricultural Sector

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Intermediate Impacts

Increased Agricultural Productivity

Increased Farm Incomes

Intermediate Result

Increased Sustainable Dryland Agricultural and NRM Practices

Activity Results

Cropping Tenure Prolonged

Degraded Lands Rehabilitated

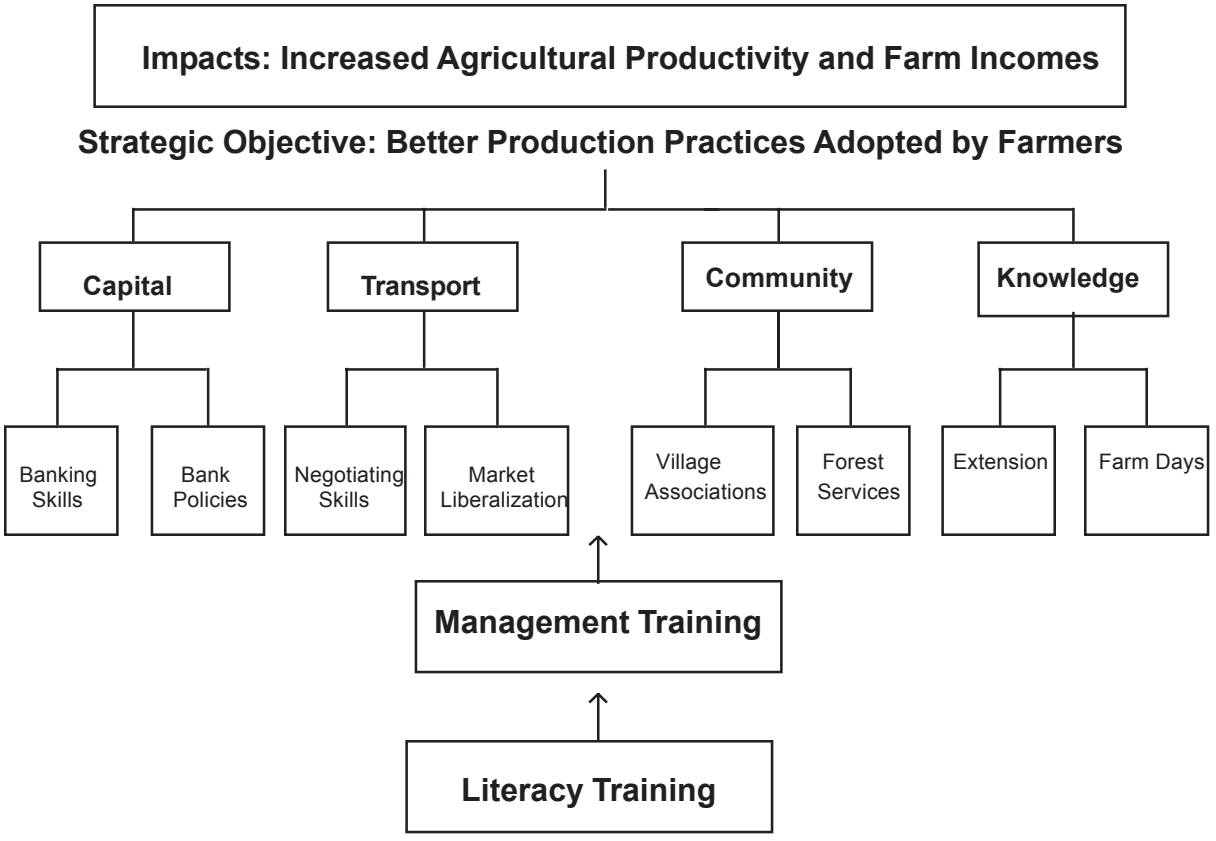
Afforested Area Increased

Integrated Pest Management (IPM) Technologies Increased

Figure 2 is adapted from the USAID results framework designed specifically for USAID's OHVN activities. The strategic objective of the results framework is "better production practices adopted by farmers in the OHVN." Figure 2 shows that adoption of improved production practices is thought to be fostered by working on the "facilitating variables"—that is, by improving farmer access to commercial capital, decreasing transport costs, increasing community control over local resources and improving farmer knowledge of alternative production practices. For a decade now, OHVN and USAID have been monitoring changes in the facilitating variables as well as increases in the adoption of improved production practices. These are all variables that can be monitored by counting numbers of loans issued, kilometers of roads built, number of villages managing their own forests, etc. These indicators, however, do not provide us with much information on how much (if at all) the adoption of these improved technologies is improving agricultural productivity and incomes. As these are the types of impacts we now want to evaluate, I have added a line of "impacts" above the strategic objective line.

In summary, what I am attempting in this report is to go beyond the OHVN project's strategic objective of increasing adoption of NRM practices, to an evaluation of the broader impacts that adoption of these practices is having on agricultural productivity and incomes. I doubt, however, we are at a point where we can begin quantifying how much OHVN's NRM activities contribute to the value added at the national level. Although this remains the ultimate objective, I do not believe it can be done in a credible way until we are able to quantify key productivity and income impacts at the farm level.

Figure 2: Conceptual Framework of OHVN Impacts, Objectives and Activities



Rapid Appraisal Results

My rapid appraisal was based on four days in the field, seven village meetings that included group discussions with an estimated 100 farmers, and a review of OHVN documents. It leads me to confirm the impressions of Mike McGahuey and others who have been working in the OHVN zone for a number of years—*something good is happening in the zone.* Evidence of progress includes these trends:

- Crop yields are increasing for farmers adopting NRM intensification methods.

  We don't know how widespread this increase is, as there is not yet strong evidence of it in the aggregate data, but all villages visited provided numerous illustrations based on individual farmer records (see Appendix 2).

- Village youth are staying at home to farm rather than migrate.

  This was very evident in all villages visited; youth were present at all meetings, they played important roles in managing farmer associations, and they were very active participants in rapid appraisal discussions.

- Farmers are investing heavily in agricultural equipment, traction animals and livestock.

  When asked what they were doing with their increased incomes, the most common response was investment in equipment and/or livestock.

- Farmers are diversifying, with many new forays into dry-season crops and tree crops.

  Increased production of horticultural products during the dry season (green beans for Europe, onions/tomatoes and bananas for Bamako, possible increases in sorrel production for export to the United States) is one of the reasons for the reduction in out-migration. Marketing remains a problem here, but the farmers' associations appear to have a level of management skills permitting them to deal with the setbacks and move ahead (vs. the old days when they expected the government to bail them out).

  Tree crop production (particularly teak for production of construction poles) through development of village and private woodlots is expanding slowly, but most examples seen during the rapid appraisal had not yet begun to generate income.

- Farmers are unanimous that life is better now than 10 years ago.

  - They eat better (more food and better variety)
  - They dress better
  - They travel more easily (motorbikes have replaced bicycles in many cases)
  - Schools and health services are more accessible
  - They are better educated (literacy programs and management training by CLUSA)

- Farmers are optimistic/enthusiastic about the future.

There is always the possibility that the villages visited were exceptional ones and not typical of the zone. There is no way to know this for sure without doing a survey with a large, randomly selected, representative sample—a potentially costly endeavor. The only source of representative information available for the zone is longitudinal data on aggregate crop production statistics. At present, these data suggest that the progress noted in the rapid appraisal is not widespread enough to have made a major impact on the aggregate picture. Summary statistics (Table 1) on production, yields and area cultivated in the zone present a picture of impressive growth in production for most crops but little growth in yields—i.e., most of the productivity increases have been realized through area expansion rather than through intensification and better resource management.

Nevertheless, we have a growing base of rapid appraisal results for approximately 20 villages (including the results of two previous trips by Mike McGahuey to different villages) that all point in the same direction. We also have the OHVN database showing continued expansion in cotton production (to which farmers attribute their recent increases in income) and increased adoption of intensification techniques (to which participant farmers attribute their yield increases). Even if the rapid appraisal results are not fully representative of the entire zone, it is clear that important progress is being made in many villages and that important lessons can be learned about (1) what has been driving the changes, (2) the magnitude of the increased household income being generated by program participants, and (3) the expected impact that these changes in income could have on national income if the types of situations we saw in the rapid appraisals became widespread.

Table 1: Area, Production and Yield Data for the OHVN: 1991/1992–1998/1999

		1991	1992	1993	1994	1995	1996	1997	1998	Trend
Cotton	area (ha)	10506	12201	8624	11692	14605	23158	30750	35816	+
	prod (tons)	11842	12494	10684	13097	16167	21990	28927	33740	+
	yield (kg/ha)	1127	1024	1239	1120	1107	950	941	942	–
Tobacco	area (ha)	209	285	331	237	100	83	77	87	–
	prod (tons)	411	525	549	330	160	133	105	112	–
	yield (kg/ha)	1971	1842	1661	1392	1600	1579	1853	1874	–
Millet	area (ha)	30906	31516	31892	34188	36660	35732	38149	37422	+
	prod (tons)	30226	23900	26700	31800	32441	36095	38714	35595	+
	yield (kg/ha)	978	758	837	930	885	1010	1015	951	stagnant
Sorghum	area (ha)	46603	48334	48140	51213	56009	59431	66390	72572	+
	prod (tons)	50508	43911	44622	47904	50292	64638	73047	75901	+
	yield (kg/ha)	1084	908	927	935	898	1088	1100	1046	stagnant
Maize	area (ha)	11099	11485	11648	12157	12834	13072	14411	15457	+
	prod (tons)	13845	13110	13938	11214	12929	14594	16814	20033	+
	yield (kg/ha)	1247	1141	1197	922	1007	1116	1167	1296	stagnant
Rice	area (ha)	4431	4656	4640	5243	5774	6333	7165	8596	+
	prod (tons)	4679	4553	4420	5194	5033	7188	8184	9941	+
	yield (kg/ha)	1056	978	953	990	872	1135	1142	1157	stagnant
Groundnuts	area (ha)	12297	12823	13331	13993	16210	16878	20286	23420	+
	prod (tons)	10889	9415	11807	12473	13896	14488	17962	21773	+
	yield (kg/ha)	886	734	886	891	857	858	885	930	stagnant
Fonio	area (ha)		749	1153	1084	1115	1344	1391	1271	+
	prod (tons)		287	476	526	507	652	684	796	+
	yield (kg/ha)		383	413	485	455	486	492	626	+
Cowpeas	area (ha)						255	312	521	+
	prod (tons)						216	165	290	+
	yield (kg/ha)						842	529	557	–

Source: OHVN, Septième Session du Conseil d'Administration, Plan de Campagne 1999–2000, pg. 16.

This brings us to the question of what is driving the progress noted by the rapid appraisals. This progress is the result of a complex 15- to 20-year process involving multiple efforts by many actors. Nevertheless, USAID has been a dominant actor, providing OHVN with an important source of external financing since the 1980s.[2]

Important contributions have also come from the Germans, who are supporting non-governmental organization (NGO) activities in the Ouélessebougou sector. Their anti-erosion program (PAE) focuses on developing a *gestion de terroir* approach giving high priority to improving village-level management of a community's natural resources. In addition, there are an estimated 20–30 NGOs operating in various capacities in the OHVN (not all in the agriculture or NRM sector). In other words, the progress is a result of major investments in the zone over a long period of time. Based on information gathered during the rapid appraisals, discussions with USAID and OHVN personnel, and documents reviewed, the key ingredients contributing to current progress appear to be:

- Good identification of *technologies* capable of reversing declines in yields
- Potential for increased cash income from expansion of *cotton* production
- *Community* approach to implementation
- Focus on *youth*
- Focus on villages/farmers most *likely to benefit* from NRM actions
- Use of *demonstration effect* through model farmers and model villages
- *Incremental training* (literacy, technical skills, community organization, management skills using the CLUSA model)
- *Support services* offered, including:
  - Roads
  - Credit guarantees for limited periods following management training
  - Input/output transport assistance
  - Regular supervision and support to trainees
  - Some free equipment for implementing NRM activities
  - Market research by OHVN to help with crop diversification

[2] A review of the *Procès-verbal* (OHVN August 1998) showed USAID annual contributions to the OHVN budget ranging from $200,000 to $500,000 between 1995/6 and 1998/99, with a planned increase to $1.3 million for support of the agribusiness unit of OHVN in 1999/2000.

Expanding the Progress

WHAT TO DO

It is my opinion that the progress seen during the various rapid appraisal trips results from the synergy of the various programs that have been undertaken, rather than from any single or limited number of activities or investments. Nevertheless, certain components are more essential than others if farmers are to make the transition from the semi-subsistence production practices that characterized the zone in the 1970s and 1980s to the level of commercial agriculture needed to stimulate agricultural transformation and generalized economic growth:

• There must be a profitable cash crop with reliable markets and stable prices.

• There must be improved, affordable technologies that benefit both cash and food crops.

• There must be training programs to equip young farmers with the literacy and management skills they need to function as effective commercial farmers, both independently and in associations.

Without these basic ingredients, agricultural transformation will not take place. The OHVN program—at least in the villages covered by rapid appraisals—exhibits each one of these key ingredients.

Although the NRM program covers the entire OHVN zone, it has recognized that farmers are unlikely to adopt NRM practices if there is not a strong income incentive. Hence, OHVN's NRM program began by targeting sectors where cotton production was already underway, then expanding into zones where cotton production was being introduced. This policy has worked thus far, but both farmers and the OHVN administration recognize the need to identify alternative cash crops for lower rainfall zones where cotton is not feasible, and to reduce the risks of over-reliance on a single cash crop in zones where cotton is currently king.

The NRM program staff are to be commended for their efforts to identify and promote (in collaboration with Malian researchers) (1) truly effective anti-erosion practices that have proven capable of recovering highly degraded land and (2) improved methods of collecting, composting and applying organic fertilizers. Although there is a long list of different techniques promoted by the NRM department of OHVN, the data show that it is the anti-erosion techniques (rock lines and plugs, fascines (gulley plugs), and vegetative bands in particular) and the improved management of organic matter (compost and manure pits and use of crop residues) that are the most popular components of the program. These techniques, combined with the use of chemical fertilizers applied to cotton that is rotated with (largely unfertilized) cereal crops every 2-3 years, has resulted in substantial yield increases over time for participant farmers (see illustrations in Appendix 1).

One of the most impressive components of the OHVN program is the farmer training introduced by CLUSA in the early 1990s. The CLUSA approach has a number of characteristics that make it stand out from other farmer training programs—the most important being that the ultimate goal is to empower farmers so they can handle their own affairs as they make the transition from semi-subsistence to commercial agriculture. Given this goal, CLUSA does not set up a training program until farmers exhibit some initiative in (1) becoming literate in local languages and (2) creating an association with a well-defined set of goals. At this point, CLUSA offers training designed to help the group meet its goals. In the villages visited, the most common goal for newly formed associations was to obtain bank credit for agricultural equipment and inputs. Our discussions with the many young farmers

who were managing the association finances and credit left us with the impression that CLUSA has done an outstanding job in this respect. Associations are helping individual members prepare loan requests (including proof of capacity to repay loans), making decisions about the creditworthiness of association members, submitting consolidated loan portfolios for all association members (written in Bambara) directly to local bank representatives, dealing with several banks at once (depending on the type of credit sought), negotiating and contracting with input suppliers, and managing the loan repayments which have been in the 95–98% range during the last several years. Once the initial training program is completed, CLUSA tends to move into the background—remaining available for consultations when needed (perhaps to undertake new activities), but encouraging the associations they have trained to manage their own affairs.

If these three key ingredients are in place, I believe the adoption of NRM practices, and the productivity increases associated with them, can expand to villages and zones not yet reached. The presence of support services will, however, influence the speed of the expansion. For example, assistance with equipment to transport rocks for anti-erosion structures appears to be needed by some farmers and associations, but not by others (depending on proximity of rock supplies and number of carts already available in the village). It will be important to carefully evaluate each situation to avoid unnecessarily raising program costs and stifling local initiative, while taking into account situations where a bit of help with rock transport could stimulate an entire series of more productive activities. Another important support service is improving rural infrastructure. Poor roads are a major obstacle to farmers trying to diversify into production and marketing of horticultural products and to the acquisition of inputs (both problems mentioned in several of our village discussions). In addition to farmers, credit is important for farmers, input suppliers and traders purchasing farm production as well. USAID's provision of funds to guarantee credit to farmers' associations during their first four agricultural seasons may be one of the reasons that bank representatives are now traveling from village to village to deal directly with farmers (I have no evidence to support this, but it is difficult to believe that the guarantees did not provide some incentive). There are still many villages (particularly in the newly established cotton areas) where associations have not yet been created and in these places input credit is being managed by OHVN and distributed to individuals (rather than to associations), with much less favorable repayment performance (see the OHVN report: *Procès-verbal de la 6ème session ordinaire du Conseil d'Administration de l'OHVN*, August 1998). Given the poor performance to date for the individual loans, providing guarantees for them does not appear to be the best option. Rather, it appears more appropriate to move as quickly as possible (without violating the basic CLUSA principles) through the stages of literacy training, association creation, and management training so these villages can catch up with those in the zones where cotton production is already better established. This requires coordination of the training efforts (now often carried out by Malian NGOs that were trained by CLUSA) and OHVN/CMDT cotton promotion/expansion efforts.

PROBLEMS TO RESOLVE

During the course of the rapid appraisal mission and discussions with OHVN staff, a number of real or potential problems surfaced that could hinder the desired transition to commercial farming. They are described briefly below.

Backsliding on development of private sector input markets. Although progress was made in the mid-1990s with the privatization of input markets, at present farmer associations appear to be relying entirely on OHVN for their cotton inputs. Both farmers and OHVN reports (e.g., OHVN August 1998) explain that the apparent backsliding came about because the prices charged by the private sector distributors were substantially higher than those prevailing in the nearby zones managed by the Compagnie Malienne pour le Développement des Textiles (CMDT), where inputs were still being provided through CMDT channels.

This led OHVN farmers to protest the higher prices in their zone vis-à-vis the CMDT zone. The OHVN response was to rebuild their input supply network, relying on CMDT connections to keep costs and prices at the same level as those prevailing in the CMDT zone. This is an issue that needs to be addressed at the level of national policies: Mali needs to develop a national fertilizer plan based on a thorough analysis of the pros and cons of the continuing CMDT monopoly on cotton inputs. This is not a simple issue, as there tend to be important economies of size and scale associated with fertilizer imports. The small private sector operators who attempted to market inputs in the OHVN area were probably dealing in such small quantities that they were unable to realize the economies accruing to the CMDT—hence the inability to charge competitive prices.

Continued OHVN financing of credit and high rates of default for new cotton producers. For the 1998/99 campaign, OHVN financed 62.5% of input credit (down slightly from 65% in 1997/98), with the Banque Nationale de Developpement Agricole (BNDA) financing the rest. I found this information (from the OHVN August 1998 *Procès-verbal*) surprising, as the villages we visited were all getting their credit through the BNDA. Understanding that the type of credit situations we saw represent only about one-third of the total input credit portfolio for the OHVN suggests, perhaps, that the villages we visited are representative of about one-third of the OHVN farm population—i.e., those that have succeeded in creating viable farmer associations (not a very scientific way of getting at representivity, but an interpretation that helps us get closer to understanding how widespread the situations we observed might be). This same OHVN report (*Partie Recommandations*, pg.17) indicated that defaults are a problem in zones where farmer's associations are not well-established and OHVN is obliged to provide credit to individual farmers:

> *Le crédit individuel a représenté 33.15% du crédit total accordé par l'ÓHVN. Ce type de crédit est en nette progression depuis 3 campagnes. Cet état de faits est lié d'une part à l'inexistence d'organisations paysannes capables de gérer le crédit collectif dans le secteur de Faladié et d'autre part à l'extension de la culture du coton dans la zone de Kolokani et de Kangaba.*

These results are in sharp contrast to the high repayment rates reported by the farmers' associations we visited (95–100% were the typical rates cited) and the higher repayment rates reported by OHVN for association credit.[3] The lower rates for repayment of individual credit and the need for OHVN, rather than private banks, to provide the credit raises the question of whether OHVN/CMDT is moving ahead too fast with their plans to expand cotton areas. Is it a good decision for OHVN to be offering credit directly to individual farmers who are just beginning to produce cotton? How rapidly can these credit responsibilities be transferred to the banking sector? Is there a role for USAID credit guarantees in these zones where cotton is now being introduced?

Decisions about financial or in-kind support for rock hauling. As noted above, the issue of whether to provide equipment (carts, tools) for building anti-erosion barriers appears to be one that needs to be evaluated on a case-by-case basis. Too much assistance (when it is not really needed) can pose problems for sustainability if farmers become reliant on external sources of help not only for building but also for maintaining the anti-erosion structures and for extending their benefits to more farmers. On the other hand, when carts are not available and rocks are far away, building anti-erosion barriers can be an impossible task. Some intermediate options might be providing credit or actually providing the equipment as a gift to associations on the condition that they develop a financial plan for replacing the equipment once fully depreciated.

[3] For the 1996/97 campaign, association credit due to OHVN was reimbursed at 94% while only 88% of individual credit was reimbursed; taking all outstanding credit into account associations are at 93% reimbursement while individual borrowers are at 68%—a substantial difference. Improvements were noted for the 1997/98 campaign when individual borrowers repaid 97% of current debts and 92% of total debts while the associations reimbursed 99% of the current campaign's and 98% overall (pg. 11, Proces Verbal, OHVN August 1998).

Decisions about which markets to develop for horticultural crops. USAID is putting a substantial amount of new funding into the OHVN's agribusiness unit, which is charged with the task of developing new markets for OHVN products. There have been some signs of progress in developing export markets. Following the CFA devaluation, Mali was able to break into the European green bean market, with most of the exported production coming from the OHVN zone. And there are plans underway to increase sorrel (hibiscus) production for export to the United States.

Efforts to diversify into cash crops that are either complements to, or substitutes for, cotton are to be commended, but the extent to which Mali should be targeting European and U.S. markets versus other markets in the West African sub-region needs to be better evaluated, in view of the serious problems encountered in the green bean subsector this past season. In the bean-producing village that we visited we were shown very large stocks of produce that had not been picked up by the exporter as specified in the production contract. Apparently, the exporter had not made adequate provision for the type of packaging required by his buyers in Europe, so he was unable to collect the produce from the villages and ship it on time to France. Although I would not recommend that the OHVN agribusiness unit ignore Europe and U.S. markets, I would suggest that it divide its attention between those markets (which are characterized by extremely high quality standards and complicated transport arrangements) and the markets that are opening up in Mali and nearby countries such as Ghana, Ivory Coast and Nigeria. (See INSAH, November 1998, which discusses the issue of European versus regional export markets for both horticultural and livestock products).

Inadequate attention to cereals market development. As farmers improve productivity, they are increasingly capable of marketing cereals that were previously produced exclusively for home consumption. Yet traditional views of cereals as a 'social' rather than a 'market' crop, and limited knowledge about managing cereal stocks for profit, continue to hamper cereal market development. OHVN may need to improve farmers' marketing skills as well as the database on cereal production and stocks in the zone. Given recent efforts of the USAID-funded PASIDMA program to better estimate regional cereal availability and encourage trade within Mali as well as the W. African region, it is recommended that OHVN and APCAM (which has local associations throughout the OHVN zone) work together in an effort to improve cereal marketing efficiency. In the villages visited, many farmers and associations appear to be holding excess cereal stocks because they (1) feel prices are too low and (2) prefer building village cereal banks to hedge against poor harvests. One association visited had received a 9-month line of bank credit based on an 80 F/kg valuation of the associations' cereal stocks. Using the line of credit, the association purchased cereals from members at 80 f/kg. To make good on the loan, they need to sell their stocks at more than 80 f/kg or members will need to buy back their own cereals. At the time of our visit they were quite concerned about their ability to repay the loan, as current prices were in the 60 F/kg range.

Rapid expansion of livestock herds. Most of the model farmers visited were enthusiastic adopters of the NRM themes involving increased use of manure (improved stables, composting, etc.). With this enthusiasm comes increased herd size—one farmer had increased his herd from about 60 to approximately 120 head in about 5 years! As noted elsewhere, our impression is that we were visiting the better-off farmers, and we do not have to worry about most farmers owning 120 head of cattle in the near future. Nevertheless, some thought needs to be given to the long-term implications (e.g., overgrazing) of the growth in herd size linked to the intensive use of animal manures.

Need to improve integration and complementarity of organic and inorganic fertilizers. At some point (sooner rather than later) farmers will need to start increasing the use of inorganic fertilizers. At present, inorganic fertilizers are used almost exclusively on cotton. If

cereal and cotton yields are to increase beyond their current—relatively mediocre—levels, use of inorganic fertilizers on cereals will no doubt need to be part of the picture (in addition to improved seed varieties and continued improvements in management practices). Finding the optimal combination of organic and inorganic fertilizers for different crops and rotations may require more research to identify the combinations that are most efficient from both a private (profit) and a social (environmental) perspective. During our rapid appraisal visits, Mike McGahuey asked several different farmers to describe how they saw organic and inorganic fertilizers fitting into their production schemes. The replies always indicated that farmers viewed the two as complements rather than substitutes, suggesting that farmers could be encouraged to use more inorganic fertilizers if they could be convinced that it would be a profitable investment.

Assuming there is good research evidence that inorganic fertilizer use can be profitable for cereals grown on fields where erosion has been controlled, OHVN might want to consider an extension approach that resembles that of Sasakawa Global (SG) 2000. SG 2000 encourages farmers to cultivate a half-hectare control plot (current practices) and a half-hectare test plot (recommended doses of inorganic fertilizers). This permits farmers to easily make comparisons of yields for the two technologies and, given the literacy skills of the OHVN village animateurs—local farmers trained by extension agents to help other farmers in the area—it should not be too difficult to make comparisons of financial returns as well. For this approach to work well, the farmers need to be closely supervised to make sure the fertilizers are applied using optimal dates and techniques. SG 2000 has been working in the millet/sorghum areas of the Segou and Mopti regions for several years, trying to introduce yield-enhancing technologies such as inorganic fertilizers (including rock phosphates). Thus far, the evidence suggests that the inorganic fertilizer is generally not profitable (see Nubukpo et al. 1999 for a discussion of SG 2000 programs in the Segou Region). One hypothesis concerning the lack of profitability is that SG 2000—in sharp contrast to the OHVN program—did not begin with a focus on improved NRM practices (anti-erosion investments and improved quality of organic amendments). Thus, it seems important to invest some resources in analyzing the potential to profitably use inorganic fertilizers on cereals in the OHVN zone which are grown on land that has been protected against erosion and that benefits from increased levels of soil organic matter.

Better Quantifying Progress Made to Date

Although OHVN has made important progress in documenting adoption trends for a wide range of recommended NRM practices, and there is a mounting body of anecdotal information concerning the positive farm-level impacts of this adoption, we are still unable to quantify the income impacts of NRM practices. Data collection and analysis techniques need to be refined and expanded if we want to better quantify both the farm-level and the national-level income impacts of NRM adoption.

Trying to quantify the impacts of NRM adoption over a period of almost 20 years—years which were characterized by major changes in the general economic and political environment— raises numerous questions concerning the real causes of any impacts measured: NRM adoption? Economic reform? Political reform? As noted above, it is impossible to scientifically determine the relative importance of the multiple factors that have affected rural incomes in the OHVN zone during the last 20 years. Nevertheless, a better analysis of what has happened to farm incomes in the OHVN during the last two decades will help us evaluate the impact of NRM promotion in combination with all the other political and economic reforms that have taken place.

The proposal which follows is designed for incremental implementation. It starts with recommendations for small improvements in data collection and analysis that can be made using existing OHVN resources and moves on to more costly but scientifically sound methods of gauging changes in rural incomes.

Six options are described for improving the measurement of income impacts:

1. Improvements in counting and reporting adoption of better NRM practices.
2. Improvements in reporting OHVN production and yield statistics.
3. A case study approach to collecting and analyzing NRM farm-level income impacts (e.g., impacts on crop-based, livestock, and nonfarm incomes).
4. Rough extrapolations from case studies to the sector level.
5. Survey of OHVN farmers using a representative sample.
6. Development of an ongoing program of monitoring key income and food security indicators.

In addition to measuring changes in income, there are a number of general environmental indicators that should also be monitored in order to evaluate the overall impact of current crop and livestock production on soil erosion and forest cover. We may be able to show substantial increases in income at the farm level, but if this is accompanied by increased clearing of woodlands and forests to accommodate larger numbers of farmers and cotton fields (Table 1), the income gains are unlikely to be sustainable over time. Hence, it will be important to combine the income data with other sources of information (e.g., aerial or satellite photos) that show overall trends in land use and the extent to which conservation efforts are outpacing or being outpaced by growing enthusiasm for crop and livestock production.

IMPROVEMENTS IN COUNTING AND REPORTING ADOPTION

Over the years the OHVN NRM program has collected statistics on the adoption of various practices or ‘themes’. Table 2 is a summary of what OHVN calls the ‘physical’ results of their program, updated in December 1999. It shows the growth (1996–1999) in physical measures (e.g., meters, hectares, number) of 22 practices promoted by the NRM program.

Table 2: Illustrative OHVN Adoption Report: Physical Indicators of NRM Adoption

NRM Themes	Level of Adoption (units)				
	Prior to 1997	1997–1998	1998–1999	1999–2000	Sum
Rock lines (m)	79400	6485	10076	5329	101291
Branch barriers (m)	18500	780	2011	1574	22865
Small dikes (m)	38900	1492	775	457	41624
Vegetative bands (m^2)	8998	1341	4000	3240	17579
Living fences (m)	127022	12000	11831	9309	160162
Permanent field markers (ha)	1098	599	846	544	3087
Protected areas (ha)	450	450	615	750	2265
Diversionary gullies (n)	1417	625	1171	50	3263
Firebreaks (m)	5250	1406	615	500	7771
Controlled land clearing (ha)	140	300	—	—	440
Village-managed forests (n)	1620	35	—	—	1655
Wells (n)	120	13	13	9	155
Deeping of ponds (n)	68	2	1	2	73
Improved bottom land (ha)	20	—	—	—	29
Village tree nurseries (n)	57	15	5	28	105
Plants from tree nurseries (n)	178800	13318	14640	45576	252334
Village woodlots	447	23	19	18	507
Improved cooking stoves (n)	2340	745	312	323	3720
Manure pits (n)	2268	265	338	—	2871
Stables for collecting manure (n)	13608	140	135	—	13883
Improved animal pens (n)	146	8	—	—	154
Compost pit (n)	1303	399	490	—	2192

Source: OHVN December 1999 and other OHVN data. Notes: ha= hectares, m = meters, n = number.

Although the table tells us nothing about how many farmers are involved or the income impacts of adoption, it does provide some insights about the relative popularity of different themes and the extent to which adoption is growing. Theoretically, this type of information could be used to estimate income impacts for the zone if we were able to estimate an average income impact per unit of physical measure.

Table 3 sheds some light on what the physical adoption statistics mean in terms of participating villages

and farms. It also attempts to evaluate impacts in terms of hectares of previously degraded land recovered and number of farms that have moved from shifting cultivation to working on fixed plots of land. Four improvements that could be made to these statistics are described below.

Report the Percentage of Villages and Farms Adopting

At present OHVN is counting and reporting the number of villages and farmers adopting specific practices. These absolute numbers would be much more useful if presented along with numbers showing the relative prevalence of the adoption that has occurred. If 50 of 5,000 farmers in a sector have adopted a theme (1%), that is much less impressive than knowing that 50 of 100 (50%) have adopted it.

To accomplish this, OHVN needs to standardize how they count villages and hamlets in their statistics—some reports reviewed appear to be counting hamlets as individual villages, while others count the mother village and all hamlets as a single village. Without standardization and consistent reporting across time and in different types of reports, it is difficult to know if real progress is being made.

The issue of the changing boundaries of the OHVN also poses problems for interpretation of the growth in adoption counts and percentages. During the recent past, two sectors (Banamba and Boro) have been dropped from the OHVN and one (Faladié) has been added. There is no ideal solution for dealing with such changes when preparing statistical reports on changes over time. Adding new zones where adoption is just starting or dropping former zones where adoption was high can give the impression that NRM is taking a big step backwards if one looks only at the aggregate statistics for the entire OHVN area. When a time series of statistics covers a period during which boundary changes have occurred, there must be clear documentation of when the changes took place and the number of villages/households that were added or dropped from the statistics for each year concerned. Without clear documentation of these changes, comparing aggregate OHVN data from year to year is clearly inappropriate. Ideally, statistics should be disaggregated and reported at the level of the units (sectors, circles, or *arrondissements*, for example) that are likely to move in or out of OHVN coverage.

Table 3: Illustrative OHVN Adoption Report: Villages, Farmers and Recovered Area

Sector	Villages	Farms	Recovered Area (ha)
Kangaba	53	1529	3027
Bancoumana	57	2335	3221
Ouélessébougou	97	3628	7604
Dangassa	33	534	434
Fouani	110	3295	7264
Kati	70	1787	1303
Faladié	35	951	2274
Koulikoro	73	1358	2075
Sirakorola	79	2220	7656
Total OHVN	607	17637	34858

Source: OHVN 1999 data provided by M. Sylla.

Present More Detail to Show the Degree of Adoption by Villages and Farms

At present, a village is counted as participating if only one farmer adopts just one theme. This is a pretty weak level of participation, and it is not very informative to group this village with another village where 90% of farmers are participating and most have adopted three or more themes. Similarly, a farm is counted as participating if it has adopted only one theme. For example, a farm that is using a wood-conserving stove but has adopted no other NRM theme is not differentiated in these summary statistics from a farmer who

has made substantial investments in anti-erosion or composting themes. Such a high degree of aggregation makes it harder to evaluate the potential impact of the NRM program. Appendix 2 presents a more disaggregated format for reporting village and farm level adoption that would help OHVN better communicate what is happening in the zone.

Clarify the Definition of 'Recovered Land' and Disaggregate it into Different Categories

A total of almost 35,000 hectares 'recovered' (17% of OHVN cultivated area in 1999) is impressive, but what does it really mean? Is OHVN reporting the entire area of a field if a rock line brought back into production a small corner of the field that was unproductive due to erosion? Or only the area of the small corner that was affected? In my opinion, the latter is the preferred method. What qualifies a field for being classified as unproductive? No yield at all? The farmers' qualitative appraisal that the land was getting an unusually low yield for the crop in question? The extension agent's appraisal that yield was below a specified level for a given crop?

For these numbers to have real meaning, there needs to be some standardization in classifying 'recovered' land. Perhaps OHVN is already using adequate criteria. If so, the definitions need to be better explained in reports so that the end users of the information grasp the distinctions. Deciding on the criteria to be used is more appropriately done by a soil scientist or agronomist than by an economist. Nevertheless, there are certain elements of information that could facilitate economic analysis if they could be taken into account. For example, making the determination on the basis of before/after yields for specified levels of technology (e.g., seed variety, fertilizer and manure applications, etc.) would contribute to improved economic analysis of the impacts of NRM activities.

Make Some Effort to Measure 'Disadoption'

Adoption data are collected annually by OHVN extension personnel and based on the activities of new adopters that they supervise and/or observe during each season. Each year the new adopters are added to the previous ones to obtain a cumulative level of adoption by theme, village, and farm. A major exception to this was a survey conducted in 1999 that attempted to do an exhaustive inventory of currently practiced NRM themes (see OHVN December 1999).

Because the focus is on increasing adoption, there is no year-to-year effort made to take into account cases of disadoption. For example, if a household purchased an improved stove but decided not to use it, the household would remain in the cumulative statistics as an adopter. Similarly, if a farmer planted some living fences but they all died and he made no effort to replace them, the farmer would still be counted in the cumulative statistics for adoption. Given limited resources for monitoring, the issue of 'disadoption' should not be turned into a major drain on OHVN resources. Nevertheless, OHVN field personnel should give the issue some consideration and try to develop low-cost methods of monitoring 'disadoption' for those themes where it is most likely to occur. This monitoring should include some effort to identify the causes of the 'disadoption' so that corrective actions can be taken.

Improvements in Reporting OHVN Production and Yield Statistics

The OHVN statistical service conducts surveys every year to measure area cultivated, estimate the probable harvest, and report final results for the entire agricultural campaign. These surveys are designed to accurately estimate aggregate production for the zone. More effort is put into estimating cotton production (much larger sample of fields per enumeration unit) than for cereals and other crops because of the need to organize logistics for collecting and processing cotton.

It is recommended that the NRM service and the OHVN statistical service examine the possibility of adding a few additional variables to the annual production survey in an effort to better grasp the extent to which fields covered by the production survey have benefited from NRM practices. Given the very limited number of fields evaluated for non-cotton crops, it would be best to limit this additional data collection to

the cotton fields. Since land is rotated from cotton to cereals and back, collecting the following type of information on cotton fields only should provide information on a representative sample of fields if the data are collected consistently over at least 3–5 years. The types of information that would be useful are:

1. Meters of anti-erosion structures (rock lines, branch barriers, small dikes, vegetative bands) on the field and dates established.
2. Use of *parcellement* or *mise en défens* on the field.
3. Carts of organic matter applied to the field in current year.
4. Carts of organic matter applied to the field in previous year and crop cultivated that year.
5. Number of years since field was left in fallow.
6. Estimate of percent of each field currently suffering from erosion (particularly important for fields where no NRM practices are being used).

Because the statistical service's sample is randomly selected and representative of the OHVN zone, adding this type of information to the annual survey should help the NRM service to get a better idea of how widespread the use of these techniques is. It would also permit them to do some analysis on whether yields for fields having benefited from different NRM practices are better, worse, or about the same as those of fields not benefiting from NRM practices. Note that such analyses will *not* permit OHVN to determine the yield impact of the practices, because there is no way of controlling for the initial condition of the field prior to use of NRM practices. For example, it is reasonable to assume that most of the fields benefiting from anti-erosion themes were in a state of relatively low productivity prior to adoption of the themes. If this is true, we may find that yields on NRM fields are not any better than on untreated fields, or even lower. Hence, while this information cannot be used to evaluate the contribution of NRM practices to yields, it can help us better understand the general dynamics of NRM adoption (location, percent of fields, length of use, most common combinations of practices) and give us some idea of current yields for a broad, randomly selected sample.

The NRM program has made a point of focusing on sectors and villages where certain preconditions favoring NRM adoption exist. Among the criteria used are the degree of socioeconomic disequilibrium, the receptivity of the milieu to NRM techniques, and the demonstrated willingness of local populations to actively participate in identifying and implementing solutions to their problems (OHVN December 1999). As a result, NRM adoption is much higher in some sectors of the OHVN (Ouélessébougou and Gouani, for example) than others (Dangassa or Kati, for example). This raises the question of the level of disaggregation permitted by the OHVN sample design. For the purposes of monitoring and evaluating the NRM program, it would be helpful to be able to get statistically significant results at the OHVN sector level. Even this level of disaggregation remains problematic in some cases, because, as noted earlier, the boundaries of OHVN have changed, with some sectors (or parts of sectors?) being added (e.g., Faladié) or removed (e.g., Banamba and Boron) from OHVN responsibility.

CASE STUDY APPROACH TO COLLECTING AND ANALYZING NRM FARM-LEVEL INCOME IMPACTS

During our field visits in the OHVN zone we were presented with several case studies illustrating the adoption of NRM practices and the corresponding changes in land use, cropping patterns, yields, livestock holdings, and investments in animal traction equipment (see Appendix 1 for one example). Although the data presented differed from case to case, there were some common aspects:

- a time perspective starting with the first year of adopting an NRM theme and continuing to present.
- a list of NRM practices adopted (usually quantified in terms of meters or hectares per year).

- annual yield and production figures for either (1) selected NRM fields or (2) an aggregate picture of all fields for the farm.
- an inventory of animal traction equipment owned.
- some information on inputs used each year (carts of manure, sacks of fertilizer, pesticides and insecticides used).

These case studies were presented to us by village *animateurs* in the presence of the case-study farmer. The *animateurs* represent the final link in the extension chain. They are members of village associations who have been selected by association members to receive special training in NRM practices from OHVN *agents vulgarisateurs de base,* or AVB (extension agents). To become an *animateur*, one must have successfully completed a literacy program. Most village associations have several *animateurs* (2–5). Once trained, the village *animateurs* help organize work/training groups to assist individual farmers or groups wanting to learn about or implement particular themes. The animateurs' own fields often serve as the initial trial sites in the village. *Animateurs* are encouraged by OHVN to keep records on participating farmers so that they can track their progress. To date, there is no standardized format for this record keeping and no absolute requirement that it be done for all participants. Nevertheless, one gets the impression that the *animateurs* are in possession of a substantial amount of information that could be used as a starting point for calculating the income impacts of NRM practices if it could be transferred from personal notebooks to a standardized reporting format. OHVN has already used a couple of case studies in reports and a conference paper to illustrate the impacts that NRM adoption has had on selected farmers.

My recommendation is that the OHVN begin their efforts to better quantify the income impacts of NRM adoption by seeing how many case studies they can put together from information currently recorded in the notebooks of *animateurs* and/or AVBs. Although we raised the issue of data availability with OHVN personnel at all levels, no one seemed sure how much information was currently recorded and how difficult it would be to get it transferred to some type of standardized format. Appendix 3 contains some draft 'questionnaires' designed to collect information that is currently recorded in AVB's and *animateurs'* notebooks. The questionnaires were drafted while I was in the field and discussed with OHVN personnel (M. Sylla). My recommendation is that OHVN do a trial run, filling in about 10 copies before continuing with a larger number of cases, because the quality of the data in the first 10 copies needs to be evaluated to see if it is adequate for calculating income impacts. Appendix 4 contains an example of the type of calculations one could do if the data were adequate. OHVN and USAID also need to evaluate the cost (primarily AVB and *animateur* time) of transferring the data to these questionnaires and decide if doing another 50 to 100 questionnaires would be desirable and feasible given their current resources.

Rough Extrapolations From Case Studies to the Sector Level

Getting another 50 to 100 examples of changes in cropping patterns and yields over time would not permit us to come up with statistically valid estimates of the contribution of NRM to income because we would have no way of knowing how representative these cases were, but it would help us to get beyond the 'anecdote' stage (5–10 case studies) in which we currently find ourselves. With 50 to 100 examples, we may be able to say something about typical yield impacts over time for the most popular themes and then develop hypotheses about the aggregate impact that these yield changes would have if more degraded land benefited from the adoption of these techniques. This would probably require a small amount of additional consulting time (5–10 days) from me or another agricultural economist to develop a set of indicative yield change/income scenarios based on the data collected and train OHVN staff so they could do similar analyses in the future.

Survey of OHVN Farmers Using a Representative Sample

I am not presently recommending the development of a stand-alone survey to evaluate income impacts of

NRM adoption. This decision is based on the following factors:

1. My impression that neither OHVN nor USAID want to commit the level of resources required.
2. OHVN dissatisfaction with the last major survey effort in the zone (done in collaboration with the Institut du Sahel [INSAH]).
3. My belief that it is more important to build OHVN capacity for regular monitoring.

There is one area, however, that might warrant some type of survey—the quantifying of income from NRM themes that are not directly related to crop production. My terms of reference included the task of identifying and quantifying NRM-related income-generating activities that are not normally captured in aggregate income statistics. My impression is that the current NRM program in OHVN is not promoting many themes that would be generate these types of income, so I have not made any concrete recommendations for trying to quantify these impacts in the short run. Some background on why I came to this conclusion follows.

Activities are underway in many villages to transfer management of local forests from the forest service to village associations. In all cases encountered during our field visits, the objective was to manage the forests for conservation purposes—permitting harvesting only for personal use of village members. Although one could place a value on the personal consumption, this is not likely to represent a major contribution to local or national income at the present time. In some villages visited, karité (shea butter) harvesting and processing was a major income-generating activity for women. The NRM program does not have any themes that relate directly to karité production per se, so valuing this production to measure the contribution of the NRM program to household and national income does not appear justified at the present time. The value of the karité harvested and processed should be considered in national accounts; I have not been able to confirm whether it is (I suspect that karité exports may already be taken into account).

Perhaps the most likely NRM activity to be included in this category is the establishment of woodlots by both villages and individuals. During our fieldwork, we saw a number of woodlots planted in teak for production of construction poles. Most had been recently planted and were not yet generating income. As the currently planted woodlots mature and the total number of woodlots increases, OHVN should develop some method for monitoring consumption and sales so that the contribution of these woodlots to household, village and national income can be taken into account. At present—based on what was observed in villages visited—it seems premature to put much effort into quantifying woodlot incomes.

There are undoubtedly a number of other forest products that are gathered, processed, and sold (condiments, herbal teas, medicines) by rural households in the OHVN zone. It was difficult, however, to get a feel for the importance of these incomes relative to income from cropping and livestock activities. The focus of the OHVN/NRM program has clearly been the promotion of anti-erosion and soil fertility techniques. The groups of farmers we met with spoke enthusiastically about how NRM adoption had affected crop and livestock production practices and incomes but never mentioned any impact on other types of income. This could be an omission on their part (and mine, for I did not raise the issue). Had we been speaking with women, we might have had more discussion of such incomes, as they are more likely than men to gather and sell forest products. Given the general lack of NRM themes related to generating income from forestry products, however, I suspect that the OHVN/NRM program has not had much of an impact on the level of incomes generated from these activities. If this is true, expending OHVN/NRM resources in an effort to quantify these incomes is probably not warranted at present. As more and more villages assume the responsibility for managing their forests and OHVN assists with the development of management plans, it may be important to evaluate the extent to which villages or individuals are able to increase the income generated from the forest's renewable resources.

DEVELOPMENT OF AN ONGOING PROGRAM OF MONITORING KEY INCOME AND FOOD SECURITY INDICATORS

Household income growth is an important indicator of program success for most of USAID/Bamako's projects. Unfortunately, the task of monitoring income growth is so daunting that USAID staff and project personnel usually opt for monitoring less informative but easier-to-collect indicators. This has clearly been the case with the OHVN project.

I am recommending that USAID/Bamako look into the possibility of using some promising new methods for income monitoring that were developed by MSU as part of a USAID-funded project in Mozambique. At present, the methods are also being tested in Kenya (again, with USAID funding). There is an initial cost in using these methods (see below) that is easier to justify if it is applied to monitoring a large number of diverse projects rather than to a single project such as the NRM component of the OHVN program. Hence I recommend that this type of monitoring be considered by USAID rather than by the OHVN.

A comprehensive document describing the methods used in Mozambique is available (Tschirley, Rose and Marrule, 2000). An excerpt of a few pages from the report is attached in Appendix 5 to give readers a better idea of what this type of monitoring can do and the level of survey work required. This income-proxy method provides the possibility of obtaining regular (for example, yearly) information on household income without performing cumbersome quantitative surveys each time.

In brief, the method requires conducting an initial survey to collect detailed information on a wide range of both income and potential proxy variables (this is the most costly part). These detailed data can then be used to create econometric models that estimate total household income and permit analysts to identify appropriate proxy variables. Data for the smaller set of proxy variables are then collected in subsequent surveys and used to monitor changes in income over time. Two models were developed for Mozambique. The more detailed model uses 40 variables to estimate both total income and the amount of income earned in 10 separate income categories; the less detailed model uses 16 variables to estimate total household income. In the Mozambique case, this initial survey was funded by USAID and conducted collaboratively by MSU and a number of NGOs working on USAID projects, many of which required some type of income monitoring to satisfy USAID reporting requirements. In Mali, it might be possible to use the upcoming budget/consumption study or some other major survey now in the planning stages as a base to which the proxy work can be added rather than fund an entire survey.

If USAID decided to move in this direction, the issue of monitoring income from forest products (see above) could probably be incorporated into the initial surveys and proxy variables—as could other project-specific interests.

Closing Remarks

In summing up, I would like to reiterate that I was very impressed with what I saw during the four days I visited OHVN farmers and farmers' associations currently working with NRM themes. The farmers were among the most knowledgeable, motivated, and enthusiastic farmers that I have met during the many years that I have been working in the Sahel and elsewhere in Africa. In a qualitative sense, I am very comfortable stating that the farmers visited have clearly improved their food security and incomes because they adopted NRM practices at a time when a wide range of policy changes and sectoral investments made it particularly profitable to do so.

The limitation of this type of rapid appraisal is that I cannot say anything concrete about how representative the farmers with whom we met are. Nor can I say anything quantitative about the size of the income impacts stimulated by the NRM program at either the farm or the national level. These are two very important types of information that both USAID and OHVN need to gather in order to evaluate where they are and what they need to be doing to further expand the benefits of NRM practices. Implementation of the recommendations in "Better Quantifying Progress" section of this paper should bring us all much closer to understanding what is really happening with respect to NRM in the zone.

Given that there appear to be a number of very useful lessons to be learned from the OHVN experience, it seems important to me that both USAID and OHVN invest some resources in (1) improving their ability to quantify the size and extent of the income impacts stimulated by the NRM program and (2) documenting and publicizing the OHVN story so that others in Mali as well as elsewhere may benefit from the experience.

References Consulted

Bingen, R.J. and B. Simpson. 1995. "Technology Transfer and Agricultural Development in West Africa." In *Technology Transfer and Public Policy,* edited by Y.S. Lee. Westport, CN: Quorum Books.

Crawford, E., and V. Kelly. November 2001. *Evaluating Measures to Improve Agricultural Input Use*, Department of Agriculture Economics Staff Paper No. 01-55. E. Lansing, MI: Michigan State University.

Crosson, P. and J.R. Anderson. March 1995. *Achieving a Sustainable Agricultural System in Sub-Saharan Africa.* Building Blocks for Africa 2025, paper no. 2. Washington, D.C.: The World Bank.

Hagen, R. 1993. *NRM Timeline and Issues for West Africa*. Unpublished draft document.

Hijkoop, J., P. van der Poel, and B. Kaya. 1991. *Une lutte de longue haleine: Aménagements antiérosifs et gestion de terroir.* Bamako and Amsterdam: Institut d'Economie Rurale and Institut Royal des Tropiques.

Institut du Sahel (INSAH). November 1998. *Food Security and Agricultural Subsectors in West Africa: Future prospects and key issues four years after the devaluation of the CFA franc.* A set of policy briefs on livestock, cotton, horticulture, and food consumption prepared for a CILSS Policy Conference, November 30–December 2, 1998. Bamako: Institut du Sahel.

Maiga, A.S., B. Teme, B.S. Coulibaly, L. Diarra, A.O. Kergna, and K. Tigana. September 1994. *Etude: Ajustement structurel et développement durable—Cas du Mali.* Bamako and London: Institut d'Economie Rurale and Overseas Development Institute.

McGahuey, M. December 1998. *Developing a Methodology and Baseline Data for Monitoring and Evaluation of Natural Resources Management and Environmental Impact of USAID Interventions in Mali.* Washington, D.C.: USAID (AFR/SD/ANRE/NRM) trip report.

Nubukpo, K., V. Kelly, M. Yade, and M. Galiba. August 2000. *Accelerating Agricultural Intensification in the Riskier Environments of Sub-Saharan Africa: A Case Study of the Sasakawa Global 2000 Program in Mali.* Select Paper presented at the International Association of Agricultural Economists meetings in Berlin.

OHVN. May 1992. *Contribution de L'O.H.V.N. à la Gestion des Ressources naturelles dans sa Zone d'Intervention*. Report of an annual seminar held 12–14 May 1992.

OHVN. September 1995. *Evaluation du Programme de Gestion des Ressources Naturelles en Zone OHVN*. Bamako: OHVN.

OHVN. August 1998. *Procès-verbal de la 6ème Session Ordinaire du Conseil d'Administration de l'Office de la Haute Vallée du Niger* and other documentation discussed at the Septième Session du Conseil d'Administration de L'OHVN. (This appears to be a set of documents given to participants at the 7th meeting of the OHVN Administrative Council that met in 1999. I have used August 1998 as the date because that is what appears on the first document in the set—the minutes of the 6th Session.) Bamako: OHVN.

OHVN. December 1999. *Communication de l'Office de la Haute Vallée du Niger à l'Atelier Régional sur les Expériences de la Gestion des Ressources Naturelles: Evolution et Perspective*. Koudougou, Burkina Faso.

Rose, D. and D. Tschirley. January 2000. *A Simplified Method for Assessing Dietary Adequacy in Mozambique*. Research Report No. 36. Maputo: Ministry of Agriculture and Fisheries. Full document is available on the Michigan State Web Site (www.aec.msu.edu/agecon/fs2).

Ruben, R. and D.R. Lee. March 2000. *Combining Internal and External Inputs for Sustainable Intensification.* IFPRI 2020 Brief 65. Washington, D.C.: International Food Policy Research Institute.

Sanders, J., D. Southgate, and J.G. Lee. December 1995.*The Economics of Soil Degradation: Technological Change and Policy Alternatives*. Soil Management Support Services Technical Monograph No. 22. W. Lafayette, IN: Purdue University.

Sanogo, A., B.S. Coulibaly, M.K. Ndiaye, M.Sidibe, B. Teme, M. Togola. April 1993. *Etude des phénomènes de dégradation des terres au Mali: Esquisse d'un programme national de conservation et de restauration.* Bamako: Consulting report done for FAO.

Scherr, S. and S. Yadav. May 1996. *Land Degradation in the Developing World: Implications for Food, Agriculture, and the Environment to 2020.* Food, Agriculture, and the Environment Discussion Paper 14. Washington, D.C.: International Food Policy Research Institute.

Shaikh, A., E. Arnould, K. Christophersen, R. Hagen, J. Tabor, P. Warshall. 1988. *Opportunities for Sustained Development: Successful Natural Resources Management in the Sahel,* Volumes 1–3. Washington, D.C.: e/di (a member of International Resources Group).

Speirs, M. and O. Olsen.1992. *Indigenous Integrated Farming Systems in the Sahel.* World Bank Technical Paper Number 179, Africa Technical Department Series. Washington, D.C.: The World Bank.

Tefft, J. 2000. "Cotton in Mali: The 'White Revolution'and Development," in *Democracy and Development in Mali.* Edited by R.J. Bingen, J. Staatz and D. Robinson. E. Lansing, MI: Michigan State University Press.

Tschirley, D., D. Rose, and H. Marrule. February 2000. *A Methodology for Estimating Household Income in Rural Mozambique Using Easy-to-Collect Proxy Variables.* Research Report No. 38. Maputo: Ministry of Agriculture and Fisheries. Full document is available on the Michigan State University Web site (www.aec.msu.edu/agecon/fs2).

USAID/Bamako. various dates. Several documents, reports, proposals, etc. concerning the OHVN projects that were provided by Mike McGahuey.

Weight, D. and V. Kelly. 1999. *Fertilizer Impacts on Soils and Crops of Sub-Saharan Africa.* MSU International Development Paper No. 21. E. Lansing, MI: Michigan State University. Full document is available on the Michigan State University Web site (www.aec.msu.edu/agecon/fs2).

Yanggen, D. December 1995. *Understanding Small Farmer Adoption of Natural Resource Conservation Techniques in the Sahel: A Conceptual Framework with an Application to the Cotton Growing Zone of Koutiala, Mali.* Unpublished mimeo.

Yates, R.A. and A. Kiss. January 1992. *Using and Sustaining Africa's Soil.* Summary of the proceedings of a World Bank Seminar held in Washington, D.C. in January 1992.Agriculture and Rural Development Series N. 6, Technical Department, Africa Region, World Bank. Washington, D.C.:World Bank.

Appendix 1

OHVN Case Study of Production and Income Changes for A Farmer Having Used NRM Practices During Nine Years

CASE STUDY TABLES FROM OHVN DECEMBER 1999

Introduction. The following pages contain an example of an OHVN case study taken from an OHVN conference paper (OHVN December 1999). Although it tells the story of only one farmer, it shows a good understanding of the types of data that must be collected for a large number of farmers if OHVN is to do a more thorough job of reporting on zone-level impacts of NRM adoption.

A number of improvements could be made in the economic analysis. Among the more important would be (1) accounting for differences between the "with adoption" and "without adoption" scenarios; (2) accounting for year-to-year changes in production and prices for the economic analysis (rather than a simple comparison of first and most recent years); and (3) using real prices (nominal prices deflated by an index such as the consumer price index) that reflect seasonal and interannual price risk (the current analysis uses a single price across all years to value output). Note that Appendix 4 uses data for the same farmer, but with some changes in the method of calculating benefits introduced.

Farmer: Masiamé COULIBALY, Bini village, Gouani Rural Development Sector (SDR)

Themes used by farmer:

- bandes enherbées (vegetative bands)
- végétalisation
- labour perpen-diculaire à la pente (contour plowing)
- grattage à sec (light hoeing before rains)
- utilisation fumure organique (manure use)
- parcellement et piquets verts (marking long-term field borders)
- labour de fin cycle (end-of-season plowing)
- contour rock lines

Table A.1.1
Evolution of area, yields and production for Masimé Coulibaly
1990/91–1998/99

Crops		Agricultural season									
		1990/ 1991	1991/ 1992	1992/ 1993	1993/ 1994	1994/ 1995	1995/ 1996	1996/ 1997	1997/ 1998	1998/ 1999	Average Area
	Area (ha)	2	3	2	2	3	—	4	2	4	2.7
Millet	Yield (tons/ha)	0.8	0.95	1	1	1.2	—	1.28	1.3	1.3	
	Production (T)	1.6	2.85	2	2	3.6	—	5.1	2.6	5.2	
	Area (ha)	4	3	5	6	3	5	3	4	4	4.1
Sorghum	Yield (tons/ha)	0.95	1.2	1.43	1.63	1.7	1.8	1.8	1.8	1.85	
	Production (T)	3.8	3.6	7.25	9.78	5.1	9	5.4	7.2	7.4	
	Area (ha)	3	4	3	4.5	4	4	4	3.5	4.5	3.8
Maize	Yield (tons/ha)	1.25	1.3	1.8	1.95	2	2.15	2.4	3.05	3.2	
	Production (T)	3.75	5.2	5.4	8.78	8	8.6	9.6	10.7	4.4	
	Area (ha)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.75	0.75	
Rice	Yield (tons/ha)	0.85	0.9	0.9	0.95	0.95	1	1	1.02	1.2	
	Production (T)	0.6	0.63	0.63	0.66	0.66	0.7	0.7	0.77	0.9	
	Area (ha)	0.5	0.7	0.7	0.7	0.5	0.5	0.5	0.5	0.75	0.6
Peanut	Yield (tons/ha)	0.6	0.7	0.75	0.75	0.8	0.8	0.85	0.7	0.58	
	Production (T)	0.3	0.49	0.53	0.53	0.4	0.4	0.42	0.35	1	
	Area (ha)	10	10	10	6	10	11	9	9	11	9.5
Cotton	Yield (tons/ha)	1.41	1.55	0.93	2.59	1.52	1.52	2.11	2.11	1.41	
	Production (T)	14.1	15.5	9.93	15.56	15.2	16.7	19	19	14.1	
	Area (ha)	0.5	0.75	1	0.5	0.5	0.5	0.5	1.25	1	0.7
Cowpea	Yield (tons/ha)	0.3	0.4	0.5	0.5	0.5	0.55	0.6	0.6	0.5	
	Production (T)	0.15	0.3	0.5	0.25	0.25	0.28	0.3	0.75	0.5	
Total area		20.7	22.2	22.4	23.4	24.7	24.7	24.7	23	28	

Table A.1.2:
Analysis of Changes in Masimé Coulibaly's Yields Between 1991 and 1999

	Years		Yield differences		Observations
Crops	**1990–91 kg/ha**	**1998–99 kg/ha**	**Yield kg/ha**	**Percentage change**	
Millet	800	1,300	500	62.5	For cotton: low yield in 1999, but if 1990–91 is compared to 1997–98, the yield difference was 703 kg.
Sorghum	950	1,850	900	94.7	
Maize	1,250	3,200	1,950	156	
Rice	850	120	350	41	
Cowpeas	300	500	200	66.6	
Peanuts	600	780	180	30	
Cotton	1,410	1,414	4	0.003	
				49.8 (1997–1998)	

Table A.1.3:
Economic Analysis of Masimé Coulibaly's Farm

Crops	**Mean area (ha)**	**1990 yield kg/ha**	**1998 yield kg/ha**	**1990 Prod (T)**	**1998 Prod (T)**	**Value (FCFA)**		**Yield increase (kg)**	**Income increase (FCFA)**
Millet	2.7	800	1,300	1,600	5,200	112,000	364,000	325	252,000
Sorghum	4.1	950	1,850	3,800	7,400	266,000	518,000	195	252,000
Maize	3.8	1,250	3,200	3,750	4,400	262,500	308,000	117	45,500
Cotton	9.5	1,410	1,410	14,101	14,101	1,198,585	1,198,585	0	0
Peanut	0.7	850	1,200	600	900	72,000	108,000	150	36,000
Rice	0.6	600	780	300	1,000	45,000	150,000	333	105,000

Note: Constant prices used: Cereals 70 F/kg
Cotton 85 F/kg
Peanuts 120 F/kg
Rice 150 F/kg

Appendix 2

Suggested Format for Periodic Reporting of NRM Village and Farm Adoption in the OHVN

Suggested format for periodic reporting of NRM adoption by villages and farms in the OHVN

Date:

Degree of village-level participation in NRM program *** need to specify if hamlets are counted as villages or not**

	Total Number of:		Number and % of Villages Adopting Different Soil Fertility Themes			Number and % of Villages Adopting Different Anti-erosion Themes			Number and % of Villages Adopting Different Forestry Themes		
Sector	Villages*	Population	1–3	4–5	>5	1–3	4–5	>5	1–3	4–5	>5
Kangaba	55		53 (96%)								
Bancoumana											
Ouélessébougou											
Dangassa											
Gouani											
Kati											
Faladiè											
Koulikoro											
Sirakorola											

Degree of farm-level participation in NRM program

	Total Number of Farms in the Sector	Number and % of Farms Adopting Different Soil Fertility Themes			Number and % of Farms Adopting Different Anti-erosion Themes			Number and % of Farms Adopting Different Forestry Themes		
		1–3	4–5	>5	1–3	4–5	>5	1–3	4–5	>5
Kangaba										
Bancoumana										
Ouélessébougou										
Dangassa										
Gouani										
Kati										
Faladiè										
Koulikoro										
Sirakorola										

Appendix 3

Draft Questionnaires for Collecting Data From AVB/ANIMATEUR Notebooks

EVOLUTION DES RESOURCES DE L'EXPLOITATION:

POPULATION, CHEPTEL, ET SUPERFICIES

SECTEUR:	**VILLAGE:**	**AVB:**	**AV:**	**CHEF DE L'EXPLOITATION:**	**NO. EXP.**

	POPULATION TOTAL DE L'EXPLOITATION		MAIN D'OEUVRE AGRICOLE ACTIF HIVERNAGE		MAIN D'OEUVRE AGRICOLE ACTIF CONTRA-SAISON		MIGRATION CONTRA-SAISON		CHEPTEL					SUPERFICIES (HECTARES)	
ANNÉE	HOMMES	FEMMES	HOMMES	FEMMES	HOMMES	FEMMES	HOMMES	FEMMES	BOEUFS LABOUR	BOVINS	ANES	OVINS	CAPRINS	CULTIVABLES	CULTIVÉES
1999/2000															
1998/1999															
1997/1998															
1996/1997															
1995/1996															
1994/1995															
1993/1994															
1992/1993															
1991/1992															

COMMENTAIRES SUPPLÉMENTAIRES:

EVOLUTION DES RESOURCES DE L'EXPLOITATION:

EQUIPMENTS

SECTEUR:	VILLAGE:	AVB:	AV:	CHEF DE L'EXPLOITATION:	NO. EXP.

NOMBRE DE CHAQUE TYPE D'EQUIPEMENT **FONCTIONNEL** APPARTENANT A L'EXPLOITATION

ANNÉE	TM CHARRUE	MULTI-CULTURE	SEMOIR	TRACTEUR	CHARRETTE	HANDY	APPAREIL TRAITEMENT	AUTRES:	AUTRES:												
1999/2000																					
1998/1999																					
1997/1998																					
1996/1997																					
1995/1996																					
1994/1995																					
1993/1994																					
1992/1993																					
1991/1992																					
1990/1991																					

COMMENTAIRES SUPPLÉMENTAIRES:

THÈMES PRATIQUÉES

SECTEUR:	VILLAGE:	AVB:	AV:	CHEF DE L'EXPLOITATION:	NO. EXP.

ANNÉE	LIGNES EN CAILLOUX (METRES)	BARRIERE EN CAILLOUX (METRES)	BANDES ENHERBÉS (METRES)	PARCELLE-MENT (HECTARES)	PRATIQUES CULTURALES (HECTARES)	JACHERE (HECTARES)	FASCINES (METRES)	HAIES VIVES (METRES)	DIGUETTES (METRES)	PARES FEU (METRES)	AUTRES:	AUTRES:	FUMURE ORGANIQUE					ENGRAIS MINERALE (KILOGRAMMES)			CUMULE DES HECTARES RECUPERÉS
													NOMBRE DE FOSSE		NOMBRE DE CHARRETTE UTILISÉ						
													COMPOSTE	FUMIER	COMPOSTE	FUMIER AVEC PAILLE	FUMIER SANS PAILLE	NPK	URÉE	AUTRE	
1999/2000																					
1998/1999																					
1997/1998																					
1996/1997																					
1995/1996																					
1994/1995																					
1993/1994																					
1992/1993																					
1991/1992																					
1990/1991																					

COMMENTAIRES SUPPLÉMENTAIRES:

EVOLUTION DE LA PRODUCTION
HIVERNAGE

SECTEUR:	VILLAGE:	AVB:	AV:	CHEF DE L'EXPLOITATION:	NO. EXP.

ANNÉE	TRAITEMENT	MIL			SORGHO			COTON			ARACHIDE			NIEBE			MAIS			AUTRE		
		SUPER (HA)	PROD MT	REND (KG)	SUPER (HA)	PROD MT	REND (KG)	SUPER (HA)	PROD MT	REND (KG)	SUPER (HA)	PROD MT	REND (KG)	SUPER (HA)	PROD MT	REND (KG)	SUPER (HA)	PROD MT	REND (KG)	SUPER (HA)	PROD MT	REND (KG)
99/00	OUI																					
	NON																					
98/99	OUI																					
	NON																					
97/98	OUI																					
	NON																					
96/97	OUI																					
	NON																					
95/96	OUI																					
	NON																					
94/95	OUI																					
	NON																					
93/94	OUI																					
	NON																					
92/93	OUI																					
	NON																					
91/92	OUI																					
	NON																					
90/91	OUI																					
	NON																					

* LES CHAMPS SANS TRAITEMENT SONT CEUX QUI N'ONT PAS BENEFICIÉ DE PRATIQUES ANTI-EROSIVES ET AUXQUELS ON N'A APPLIQUÉ NI FUMURE NI ENGRAIS POUR AU MOINS TROIS CAMPAGNES.

COMMENTAIRES SUPPLÉMENTAIRES:

EVOLUTION DE LA PRODUCTION

CONTRE-SAISON

SECTEUR:	VILLAGE:	AVB:	AV:	CHEF DE L'EXPLOITATION:	NO. EXP.

REMPLIR LES NOMS DES CULTURES DANS LES CASES CI-DESSOUS

ANNÉE	TRAITEMENT	CULTURE 1:			CULTURE 2:			CULTURE 3:			CULTURE 4:			CULTURE 5:			CULTURE 6:			CULTURE 7:		
		SUPER (HA)	PROD (MT)	REND (KG)	SUPER (HA)	PROD (MT)	REND (KG)	SUPER (HA)	PROD (MT)	REND (KG)	SUPER (HA)	PROD (MT)	REND (KG)	SUPER (HA)	PROD (MT)	REND (KG)	SUPER (HA)	PROD (MT)	REND (KG)	SUPER (HA)	PROD (MT)	REND (KG)
99/00	OUI																					
	NON																					
98/99	OUI																					
	NON																					
97/98	OUI																					
	NON																					
96/97	OUI																					
	NON																					
95/96	OUI																					
	NON																					
94/95	OUI																					
	NON																					
93/94	OUI																					
	NON																					
92/93	OUI																					
	NON																					
91/92	OUI																					
	NON																					
90/91	OUI																					
	NON																					

Appendix 4

Illustration of Budget Analysis Possible Using the Types of Data in Appendix 3

The production data used in this appendix are taken from the case-study farmer presented in Appendix 2. The point of this appendix is not to do a full-blown analysis of the net increases in income realized by farmers adopting NRM practices, but to illustrate a number of things that could be done to improve the analyses currently done by OHVN. The tables below illustrate three changes that OHVN could easily make in the way they do their financial assessments of adoption.

(1) The first table quantifies the yields for a "without project" scenario rather than simply comparing yields in the initial starting year with current yields. A comparison of a with and without scenario does a better job of showing the full extent of yield differences that can be attributed to adoption of NRM practices. In the example that follows I assume a rate of decline in yields over time due to erosion and nutrient depletion that approximates that shown in aggregate national yield statistics for Mali.

(2) The second and third tables use both the with/without scenario and two different price scenario to capture the potential impact of price instability on income. The illustration values the nine-year cumulated differences in yields between the case-study farmer and the without project scenario using both a favorable and unfavorable producer price (prices for the illustration were arbitrarily selected but reflect recent reality).

A more appropriate method would be to value the yield difference for each year using the average price during the harvest season (unfavorable scenario) at a major OHVN market and the average price during the hungry season (favorable price scenario), converted to real terms using a price index. By using actual prices, corrected for inflation, we get a better picture of how price instability (which is generally high in Africa) affects the value of agricultural production. I did not have adequate time to get the price data needed for this type of analysis during my visit to Mali, but the market data available in Mali is adequate for this type of valuation.

(3) The fourth table adds an additional consideration—the time value of income. The table uses the favorable price scenario of the preceding table, but discounts the stream of income using a 10% discount rate to obtain a present value (PV) of the stream of annual increments to income obtained by the farmer adopting NRM practices. This type of analysis takes into account the likelihood that farmers place a greater value on present than on future income. Doing this type of analysis tends to reduce the benefits a farmer might realize from investing in NRM because the yield/income differences tend to be larger toward the end of the nine years than at the beginning of the period.

A major shortcoming of the analyses presented in these four tables is that they do not account for differences in farm-level costs between the with and the without project scenario. If we are able to get more complete information on levels of inputs used each year by participant and nonparticipant farmers and the costs of constructing some of the anti-erosion structures (see Appendix 3 for details on types of data needed), a more thorough analysis could be undertaken using a standard benefit/cost framework.

This type of framework has recently been applied to an analysis of the use of Tilemsi rock phosphates in Mali (IFDC 1999). If we are able to get at least 10 cases of the questionnaires recommended in Appendix 3 filled in, some effort should be made to use them in a benefit/cost framework similar to that used by

IFDC. A recent MSU staff paper (Crawford and Kelly, 2001) provides useful guidelines on how a simple benefit/cost framework can be applied to analysis of projects promoting input use and/or NRM practices that have both private income and public environmental impacts.

Table A.4.1											
Illustration of NRM yield-increasing potential during 9-year period											
Farmer: Masiamé Coulibaly											
Summary of yield data (kg/ha)										9-Year	Annual
	1990/1	1991/2	1992/3	1993/4	1994/5	1995/6	l996/7	1997/8	1998/9	Totals	Averages
Millet											
Production/ha											
with NRM	800	950	1000	1000	1200		1275	1300	1300	8825	1103
without NRM*	800	800	800	800	800	800	800	800	800	6400	800
NRM millet increases/ha		**150**	**200**	**200**	**400**		**475**	**500**	**500**	**2425**	**346**
Cotton											
Production/ha											
with NRM	1410	1555	930	2590	1520	1520	2110	2113	1410	15158	1684
without NRM**	1410	1368	1327	1287	1248	1211	1174	1139	1105	10058	1252
NRM cotton increases/ha		**187**	**-397**	**1303**	**272**	**309**	**936**	**974**	**305**	**3889**	**486**
NRM yield increases for Rotation A : Millet/cotton											
Millet	0		200		400		475		500	1575	**315**
Cotton		187		1303		309		974		2773	**693**
NRM yield increases for Rotation B : Cotton/millet											
Cotton	0		-397		272	309	936		305	1425	**237**
Millet		150		200				500		850	**283**
Notes: Farmer didn't produce millet in 1995 so cotton yield difference is substituted in rotation B											
* assumes yields are stagnant				** average annual yield decline of 3%							

Table A.4.2											
Illustration of gross income-increasing potential of NRM adoption during a 9-year period:								***Unfavorable price scenario:***			
								Millet		**Cotton**	
Farmer: Masiamé Coulibaly								**F/kg**	**70**	**F/kg**	**130**
Summary of gross income data (FCFA/ha)										9-Year	Annual
	1990/1	1991/2	1992/3	1993/4	1994/5	1995/6	l996/7	1997/8	1998/9	Totals	Averages
Millet											
Production/ha											
with NRM	56000	66500	70000	70000	84000	0	89250	91000	91000	617750	77219
without NRM*	56000	56000	56000	56000	56000	56000	56000	56000	56000	448000	56000
NRM millet increases/ha		10500	14000	14000	28000	0	33250	35000	35000	169750	24250
Cotton											
Production/ha											
with NRM	183300	202150	120900	336700	197600	197600	274300	274690	183300	1970540	218949
without NRM**	183300	177801	172467	167293	162274	157406	152684	148103	143660	1307582	162776
NRM cotton increases/ha		24349	-51567	169407	35326	40194	121616	126587	39640	505552	63194
NRM income increases for Rotation A : Millet/cotton											
Millet	0		14000		28000		33250		35000	110250	22050
Cotton		24349		169407		40194		126587		360537	90134
Rotation Total	**0**	**24349**	**14000**	**169407**	**28000**	**40194**	**33250**	**126587**	**35000**	**470787**	**112184**
NRM income increases for Rotation B : Cotton/millet											
Cotton	0		-51567		35326	40194	121616		39640	185209	30868
Millet		10500		14000				35000		59500	19833
Rotation Total	**0**	**10500**	**-51567**	**14000**	**35326**	**40194**	**121616**	**35000**	**39640**	**244709**	**50701**
Notes: Farmer didn't produce millet in 1995 so cotton income is substituted in rotation B											
* assumes yields are stagnant				** average annual yield decline of 3%							

Table A.4.3											
Illustration of gross income-increasing potential of NRM adoption during a 9-year period:								***Favorable price scenario:***			
								Millet		**Cotton**	
Farmer: Masiamé Coulibaly								**F/kg**	**90**	**F/kg**	**150**
Summary of gross income data (FCFA/ha)										9-Year	Total
	1990/1	1991/2	1992/3	1993/4	1994/5	1995/6	l996/7	1997/8	1998/9	Totals	Averages
Millet											
Production/ha											
with NRM	72000	85500	90000	90000	108000	0	114750	117000	117000	794250	99281
without NRM*	72000	72000	72000	72000	72000	72000	72000	72000	72000	576000	72000
NRM millet increases/ha		13500	18000	18000	36000	0	42750	45000	45000	218250	31179
Cotton											
Production/ha											
with NRM	211500	233250	139500	388500	228000	228000	316500	316950	211500	2273700	252633
without NRM**	211500	205155	199000	193030	187239	181622	176174	170888	165762	1508749	187819
NRM cotton increases/ha		28095	-59500	195470	40761	46378	140326	146062	45738	583329	72916
NRM income increases for Rotation A : Millet/cotton											
Millet	0		18000		36000		42750		45000	141750	28350
Cotton		28095		195470		46378		146062		416004	104001
Rotation Total	**0**	**28095**	**18000**	**195470**	**36000**	**46378**	**42750**	**146062**	**45000**	**557754**	**132351**
NRM income increases for Rotation B : Cotton/millet											
Cotton	0		-59500		40761	46378	140326		45738	213703	35617
Millet		13500		18000				45000		76500	25500
Rotation Total	**0**	**13500**	**-59500**	**18000**	**40761**	**46378**	**140326**	**45000**	**45738**	**290203**	**61117**
Notes: Farmer didn't produce millet in 1995 so cotton income is substituted in rotation B											
* assumes yields are stagnant				** average annual yield decline of 3%							

Table A.4.4											
Present value of gross income-increasing potential of NRM adoption during 9 years:								***Favorable price scenario:***			
								Millet		**Cotton**	
Farmer: Masiamé Coulibaly								**F/kg**	**90**	**F/kg**	**150**
Summary of gross income data (FCFA/ha)										9-Year	Annual
	1990/1	1991/2	1992/3	1993/4	1994/5	1995/6	l996/7	1997/8	1998/9	Totals	Averages
Millet											
Production/ha											
with NRM	72000	85500	90000	90000	108000	0	114750	117000	117000	794250	99281
without NRM*	72000	72000	72000	72000	72000	72000	72000	72000	72000	576000	72000
NRM income increases/ha		13500	18000	18000	36000	0	42750	45000	45000	218250	31179
Cotton											
Production/ha											
with NRM	211500	233250	139500	388500	228000	228000	316500	316950	211500	2273700	252633
without NRM**	211500	205155	199000	193030	187239	181622	176174	170888	165762	1508749	187819
NRM income increases/ha		28095	-59500	195470	40761	46378	140326	146062	45738	583329	72916
NRM income increases for Rotation A : Millet/cotton											
Millet	0		18000		36000		42750		45000	141750	28350
Cotton		28095		195470		46378		146062		416004	104001
Rotation Total	**0**	**28095**	**18000**	**195470**	**36000**	**46378**	**42750**	**146062**	**45000**	**557754**	**132351**
NRM income increases for Rotation B : Cotton/millet											
Cotton	0		-59500		40761	46378	140326		45738	213703	35617
Millet		13500		18000				45000		76500	25500
Rotation Total	**0**	**13500**	**-59500**	**18000**	**40761**	**46378**	**140326**	**45000**	**45738**	**290203**	**61117**
PV Rotation A* **		**327944**	**fcfa/ha**		**man day equivalent**			**437**			
PV Rotation B		**142636**	**fcfa/ha**					**190**			
Notes: Farmer didn't produce millet in 1995 so cotton income is substituted in rotation B											
* assumes yields are stagnant				** average annual yield decline of 3%				***PV discount rate is 10%			

Appendix 5

Contents, Foreword and Introduction from
A Methodology for Estimating Household Income in Rural Mozambique Using Easy-To-Collect Proxy Variables

Directorate of Economics
Ministry of Agriculture and Fisheries
Research Report No. 38, February 2000
Maputo, Mozambique

by
David Tschirley
Donald Rose
Htigino Marrule

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Foreword

Adapting INCPROX and INCPROX Lite to Other Data Sets

This report is a slightly modified version of a report originally prepared for use by USAID-funded NGOs in Mozambique in developing household income estimates for evaluation of their programs and reporting to USAID. Readers interested in the income proxy methodologies but not specifically in Mozambique might skip section II.A (Data Collection and Processing), as it contains primarily information very specific to Mozambique.

The methodologies reported on here represent a general approach applied to specific circumstances. The approach described in section II.B (INCPROX: A Structural Approach to Estimating Income) and II.C. (INCPROX Lite: A Simpler Alternative) could be applied in other countries or in other geographical areas of Mozambique, but would need to be adapted to those circumstances. Adapting INCPROX or INCPROX Lite to other areas would involve:

1. Collecting or gaining access to an existing household level data set that contains all the data needed to (a) directly calculate income for each household, and (b) develop income proxy variables for each household similar to those utilized in this report.

2. Utilizing regression techniques to develop INCPROX or INCPROX Lite models based upon this data set.

3. Developing standard procedures for (a) collecting the proxy variables and (b) converting those proxy variables into estimates of household income and income components.

Income-expenditure surveys are done in many developing countries on a regular basis, for example every three- to four years. Thus, one wishing to develop and utilize these income proxy methodologies would typically *not* need to collect a data set specifically for that purpose; work could focus on developing the models and the standard procedures for utilizing the models to obtain income estimates. Once these models and procedures are developed, various organizations can collect a much reduced set of simple proxy variables on a regular basis (for example, yearly), and easily produce estimates of household income and income components. These organizations do not need sophisticated research capabilities, but do need access either in-house or through consultants to data collection and management skills typical of monitoring & evaluation operations.

Two key issues would benefit from further research. First, how well do the models perform over time? The value of these approaches as cost effective monitoring tools is predicated on the income estimates they generate being acceptably accurate over the course of several years (e.g., 2-4 years). If the models are robust over such a time period, then a rich set of monitoring information—household income and its structure—can be tracked regularly without the burdensome, complex, and costly work of collecting and processing income-expenditure data sets.[4]

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[4] These models are based on objective measures of the *intensity* of a household's involvement in each economic activity, and on the *productive resources* the household had available to dedicate to those activities. These simple proxy variables are complemented by quantitative measures of the production of two key crops–maize and cotton. Thus, this approach should, in theory, be reasonably sensitive to changes in weather (proxied by the production of maize and cotton), in a household's portfolio of economic activities (proxied by the intensity variables), and in the quantity of productive resources available to the household (proxied by *production function variable*s). Factors not accounted for in these models which could affect income include changing relative prices, and pest or other production problems which affect a crop other than maize

In Mozambique, the lack of comparable data sets separated in time has not permitted testing the temporal durability of these models. A country with comparable income-expenditure data sets separated by 2-4 years would be an ideal candidate for such research.

Second, how can the models better deal with changing relative prices? Agriculture is a key component of income for most rural households in developing countries. Prices of agricultural commodities change every year, often in unexpected ways, and these price changes will affect income. Like the issue of temporal durability, developing an approach to deal effectively with changing relative prices requires comparable data sets separated in time (since relative prices will in all likelihood be different for each data set).

Section I of the paper provides a brief introduction. Section II reviews the work that was done to develop the models in Mozambique, and presents basic statistical results. Section III evaluates the performance of the models over space within the research area, and Section IV is a guide to NGOs on how to use the models–how to collect the proxy variables and develop the income estimates. In all these sections, much of the detail is in Annexes.

I. Introduction

This report outlines a method for estimating household income in rural areas of Mozambique using a proxy approach. It is based on collaborative work between Michigan State University and USAID-funded NGOs, and is meant for use by them in their areas of operation.

The development of such a methodology prompts two important questions. First, why focus on household income? Second, why use a proxy approach?

An important overall development goal for Mozambique is the reduction of poverty and improvement in the incomes and well being of rural households. Thus, measurement of household income is a logical choice for monitoring the effects of policies and programs oriented towards accomplishing this goal. To be sure, there are other measures of household well being. For example, some economists have argued that welfare levels are more appropriately determined by measuring household consumption expenditures, in part because of the extensive data collection activities needed to accurately assess household income. But, since so much of consumption in Mozambique is from own production, accurately measuring consumption in practice may be no easier than measuring income.

Income is difficult to measure in rural settings of developing countries, in part because there are so many different sources of income. Households in Mozambique earn income from the production and sale of seven different food staples, such as maize or manioc, seven different cash crops, like cotton or tobacco, and 20 different fruits and vegetables. In addition, income is obtained from the production and sale of livestock, from fishing, from wage labor, and from any of over three dozen different microenterprise activities, such as the weaving of baskets or the production and sale of alcoholic beverages. Thus, surveys attempting to measure household income need to ask questions on all of these activities and collect quantitative information on each.

In addition to the sheer number of sources of income, each of these sources presents different methodological challenges. For example, to get information on income from the production of maize, one needs to know how much maize was produced. This involves getting the farmer to remember how many bags or cans of which size were obtained from the harvest as well as the state of the maize, dried or fresh, on the cob or in grain. Conversion factors are needed for the size of the bag or can, and density factors are needed for the state of the maize. While all this is doable for one or two crops, it becomes very time-consuming and expensive when done for the vast array of crops that are

or cotton. Changes in the productivity of the household's productive assets will also affect income; these are partially accounted for by the quantitative estimates of maize and cotton production, holding constant the household's productive assets. The actual success of the approach in controlling for all these factors is, of course, an empirical issue requiring further analysis.

grown in Mozambique. The expense in human and other resources is beyond the capacity of all but dedicated research projects.

An income-proxy methodology provides the possibility of obtaining regular (for example, yearly) information on household income without performing cumbersome quantitative surveys each time. This report outlines the development and use of such a methodology.

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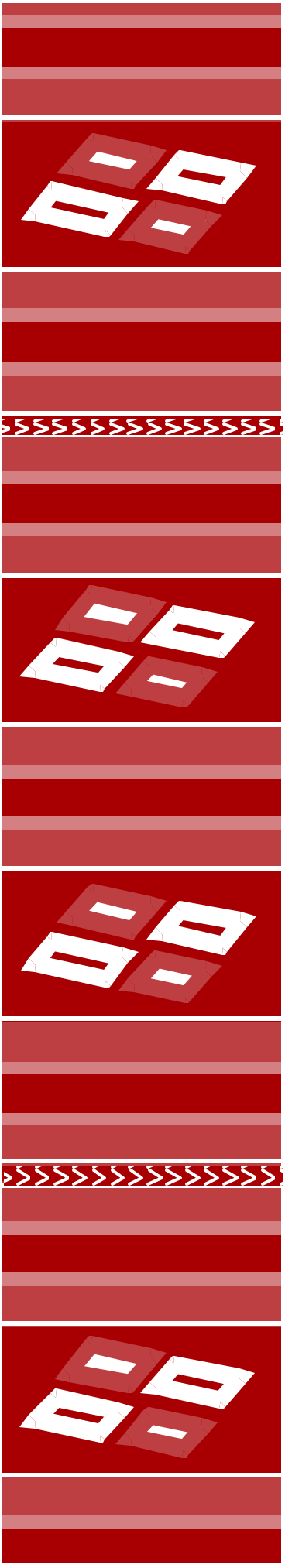

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December 2003