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**Decentralization, Governance, and Management of
Renewable Natural Resources:
Local Options in the Republic of Mali**

**Volume III
October 1991**

Final Report

Studies on Decentralization in the Sahel
(OECD Contract No. 90/52)

Managed by:
Associates in Rural Development, Inc.

Prepared by:
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James T. Thomson



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Managed by:
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Abbreviations, Acronyms, and Definitions

<i>arrondissement</i>	sub-cercle geopolitical jurisdiction in Mali
AV	village association
<i>cercle</i>	sub-regional geopolitical jurisdiction in Mali
CFDT	Compagnie Française des Textiles
CMDT	Compagnie Malienne des Textiles
coppice	to cut a tree at soil level
FAC	Cooperation Assistance Fund
FAO	Food and Agriculture Organization, United Nations
FCFA	franc FCA
NEF	Near East Foundation
NGO	non-governmental organization
OAPF	Forestry Development and Production Project
PLAE	Erosion Control Project
PRODESO	Project for the Development of Livestock Raising in the Western Sahel
RNRG	renewable natural resources governance
RNRM	renewable natural resources management
<i>ton</i>	traditional village organization
<i>tontine</i>	rotating savings pool
UBT	tropical livestock units
UDPM	Democratic Union of the Malian People
UTPADE	Union of Farmer <i>Tons</i> for Development
ZAF	functional extension zones

Preface

This volume on possibilities for decentralizing authority and responsibility for governing and managing renewable natural resources in a Sahelian country was produced by a joint expatriate-Sahelian team during a seven-weeks period of study in Mali during October-November 1990. The Club du Sahel engaged Associates in Rural Development, Inc., to carry out the study as part of a series of activities on the issue of decentralization in the Sahel.

As with many Club/CILSS (Permanent Interstate Committee for Drought Control in the Sahel) collaborative ventures, this study is intended to produce materials and information that will enrich individual and collective reflection on the topics of concern here. The terms of reference called for the team to examine both the formal and the effective, or working rules, of governance and management of renewable natural resources in a Sahelian country. In each case renewable natural resources were to be examined in the context of on-going production systems.

This volume focuses mainly on the working rules of renewable natural resources management and governance in six different sites in Mali. The analysis of formal rules affecting renewables management is contained in the first volume of this three-part report. That volume provides an overview of the problems of decentralization in the Sahel, with Mali serving as the case study. A companion volume addresses the problems involved in the organization and financing of public services. Mali again provides the illustrative case.

Team members approached their task in an inter-disciplinary manner. Much of this report was jointly written at the field sites, and is the product of sustained discussions among team members. Team members, and their responsibilities within the context of the team effort, included:

- Cheibane Coulibaly, a Malien sociologist - land tenure issues;
- Hadiza Djibo, a Nigerienne sociologist - women's issues;
- Paul Marko, an American agronomist - farming systems questions; and
- James Thomson, an American institutional specialist - analysis of resource management and governance arrangements.

Club and CILSS have collaborated closely in conceptualizing these activities, identifying CILSS countries willing to serve as study sites, backstopping field activities, etc. The Government of Mali graciously agreed to serve as the site of the study, gave the team a free hand in selecting sites, and consistently facilitated team investigations.

Materials in the report suggest that the question of "decentralization" is complicated. It involves hard choices and risks. It is the hope of team members that the insights and analytic tools found in this report will prove useful in the on-going debate on decentralization, both in Mali and in other Sahelian countries.

I. Executive Summary

This volume analyzes governance and management of renewable natural resources (RNR) in Mali. In October-November 1990, at Government invitation and with financing and support from the Club du Sahel and the Permanent Interstate Committee for Drought Control in the Sahel (CILSS), a four-person team visited a total of six sites in Regions I - V (Kayes-Mopti). In each site, the team conducted rapid institutional and technical surveys of local production systems. These investigations highlighted how rural people govern and manage RNR in selected local settings.

The team used a form of institutional analysis and design (IAD) to structure the approach to field research. IAD focuses on specific problems, in this case problems of RNR governance and management. It directs attention to the incentives that influence the behavior of different actors. The major sources of incentives are (1) the attributes of the RNR as economic goods, (2) the attributes of the communities in which they occur and (3) the attributes of the working rules that regulate access, use and investment in the RNR. Actors interact based on their strategies selected in light of these various incentives. Interactions produce outcomes, which can be evaluated in terms of efficiency, equity and sustainability.

The team studied a fishery; a large-scale pasture; two woodstocks (or forest resources), including one state forest; a small and a large-scale watershed; and a large-scale state-organized irrigation system. Several of these resources local people governed and managed themselves; in others, management was co-produced by local people and outsiders, e.g., foresters, parastatal extension agents and NGO personnel.

The six case studies show how local people manage or co-manage RNR to protect them and increase their productivity. They demonstrate that rural producers mobilize large amounts of labor, material and cash to sustain the RNR upon which they depend for survival. They also show how outside institutions and actors such as state agencies, donors and NGOs can, at minimal cost, support local RNR management efforts by transferring technical information, modifying rules where appropriate, and providing back-up enforcement and financing.

To further local and collaborative efforts to manage and co-manage RNR, the Government of Mali, the Club and CILSS, donors and NGOs should support a national workshop and a regional conference to disseminate the study findings. They should approve and finance a series of applied studies in Mali and in other Sahelian countries to increase knowledge about how existing local RNR management and governance institutions can be strengthened. They should approve and finance a Regional Unit to Support Local Governance Alternatives (CREDIBLO) linked to CILSS.

II. Renewable Natural Resources and Decentralization in Mali

A. Introduction

This volume explores possibilities for decentralization in Mali in the areas of renewable natural resources management (RNRM) and governance (RNRG). It reports on six case studies conducted in Mali during October - November 1990. Organized and financed by the Club du Sahel, and implemented with the close support of Club and CILSS officials, the study was carried out under the aegis of the Malian Ministry of Territorial Administration and Local Development. The Ministries of Livestock and Environment and of Agriculture also supported the effort.

The study is part of a larger investigation, likewise organized and financed by the Club and implemented with Club and CILSS support, on "Decentralization, Service Provision, and User Involvement: A Process to Identify Local-Level Options in the Sahel." The present study of renewable resources management and governance problems in Mali should be seen in relationship to the companion study on public service organization and finance, as the two closely complement each other. The former adopts a village-level perspective. The latter deals with issues at national, regional, circle and arrondissement levels. The common theme running through both is the problem of devising institutions appropriate to deal with public service and renewable resources governance and management issues in an era when the state's capacity to address these issues has become quite problematic.

This chapter contains four more sections: (1) a brief description of the rationale for the study and its underlying logic, followed by definitions of key terms; (2) a review of the methodology and analytic framework employed in carrying out the study; (3) a description of main elements of the six renewable natural resources case studies; and (4) an overview of the remainder of the volume.

B. Decentralization Issues

This section presents first the rationale for the RNR study within the context of the decentralization investigations in Mali, then discusses the underlying logic of the study, and ends with definitions of key terms.

1. Decentralization Dilemmas and Study Rationale

Mali, like other Sahelian states, faces a serious policy dilemma: how can the government restructure the allocation of authority and responsibility in the country to reduce the policy and fiscal burdens of the national government, while at the same time enhancing chances that other actors will pick up responsibilities transferred by the government? Other actors may include non-national governments, private sector entities, non-governmental organizations and kin groups, families and individuals. In other words, if the government adopts the principle that "the less of the state there is, the better it will be," some attention must be given to the impact of the reduction of state activities on conditions at the local level, including capacity to provide public services and manage renewable natural resources.

The renewable natural resources (RNR) sector was chosen as the focus for this study for two reasons. The first of these is efficacy: many RNR can best be managed and governed at quite local levels. The second reason is the appropriateness of RNR as a focus for self-governance. Each of these reasons will now be briefly developed.

In terms of efficacy, effective management of RNR requires an intimate familiarity with the targeted resource(s). This argues strongly in favor of devolving control over many aspects of RNRM and RNRG to the local communities, families and individuals who depend on them for survival. If such shifts in RNRM and RNRG authority are properly structured, and properly supported when necessary by governmental, administrative and judicial instances at higher levels, significant improvements in management efforts can be achieved. More effective RNRM will, in turn, strengthen the chances for sustainable economic development in Mali.

In terms of self-governance, decentralizing control over RNRM and RNRG to local populations would allow the Government of Mali to share governance responsibility with local people over a sector that is generally not excessively politicized (despite some exceptions), but is of fundamental importance to rural resource users. Grass roots self-governance capacity can be strengthened by such a policy in ways that build on existing local strengths. These include:

- local informal institutions that often continue to function effectively;
- detailed knowledge of local resource systems and the patterns of use that affect their sustainability; and
- demonstrated capacity, in many communities, to mobilize much of the labor, material and monetary resources necessary to govern and manage RNR successfully.

The second reason must be seen in light of current discussions in Mali concerning the desirability of "decentralization," and the range of possibilities for achieving effective and viable transfers of authority from the center and from upper levels of national administrative and technical organizations to governments at the quarter, village, sub-village, and immediately supra-village levels. Decentralization of rule-making and fiscal authority to provide RNRM and governance of RNR systems can be an attractive policy option for the Government of Mali (as well as for national governments of other Sahelian countries). RNRM and RNRG can serve as a highly practical training ground in the arts of governance. Allowing quarter, village and immediately supra-village governments, many of them based on traditional, informal institutions, as well as private individuals where appropriate, to govern and manage RNR provides practical experience in designing, operating and modifying institutions necessary to preserve and enhance Sahelian RNR. Many such efforts, already operational and sustained by local initiative, are financed by resources locally mobilized and controlled. Local dispute resolution mechanisms, complemented by appeals to higher level jurisdictions as necessary, permit local people to work out solutions to the RNRM and RNRG problems that inevitably arise when people seek access to resources.

Mali has strong local institutional resources. Many local communities - though by no means all - retain a very considerable capacity for self-governance. Cases here described show some of the capacities as well as the limitations and vulnerabilities of Malian rural communities in the areas of RNRG and RNRM.

2. Underlying Logic of the Renewable Natural Resources Study

The present study examines the policy dilemma inherent in the concept of "decentralization" from the perspective of RNRM and RNRG. The study assumes that problems create publics. Since problems vary in size, so do the publics they affect. Many problems cannot be solved by private sector or voluntary activities alone. They require intervention and collective decision-making to structure solutions, make sure they are enforced, and to resolve associated disputes.

Renewable natural resources management and governance problems occur at many different scales. So too do the publics they create. The case studies in this report suggest the variation in the scale of RNRG and RNRM problems. They range in scale from problems involved in keeping livestock out of dry season gardens in one small part of a village territory to ensuring that desired amounts of water flow at the proper time from the Niger River through irrigated plots within the Office du Niger irrigation scheme and out the appropriate drainage channels. The former problem can usually be handled entirely within the local village jurisdiction. The latter requires collective decision-making capacity at village, tertiary, secondary and primary canal levels to ensure that system infrastructure is maintained and operated. It also requires collective decision-making capacity at the headworks level on the Niger River. Irrigation districts (special purpose governments) at all these levels must coordinate their activities if the entire system is to function effectively.

3. Decentralization Definitions

The major issue in decentralization is deciding when it makes sense to transfer authority from a higher to a lower level. An useful discussion of this issue demands first some clarification of the terms used to describe and analyze this complex phenomenon. This section thus begins with comments on terminology, and then sets out the rationale that underlies this study. The term "decentralization" as used in this study is a global term covering five distinct concepts. These are: (1) deconcentration; (2) delegation; (3) devolution; (4) deregulation; and (5) privatization.

Deconcentration denotes the shift of administrative authority from a higher to a lower level, e.g., from the national to the regional, or from the cercle to the arrondissement. *Delegation* involves the transfer of decision making authority over a defined domain from the central government to a semi-autonomous organization, such as the Office du Niger or a regional development authority. *Devolution* denotes the transfer of governmental powers (rule-making, resource mobilization and conflict resolution) from a central or state government to an autonomous local government, such as that of a village. Often devolved powers are carefully specified and limited in terms of the domain of their application. *Deregulation* involves a state decision to stop regulating an area, as when price controls on certain commodities are lifted, or NGOs are allowed to organize without first complying with complex governmental regulations. *Privatization*, finally, involves the state withdrawing from an economic sector, for example, the staple food retail trade, and allowing private entrepreneurs to organize commerce in those products as they wish.

C. Methodology and Analytic Approach

The RNR team selected six study sites from a list compiled after discussions with Government of Mali (GOM) officials, NGO representatives and foreign assistance personnel. The six sites illustrate a range of RNR management and governance problems. However they were not chosen in any sense as a representative cross section of RNR problems in Mali today. While success of RNRM efforts

was not a criterion for selection, each case had to involve activities deliberately intended to contribute to RNR management or governance. It was desirable that the RNR activities have persisted for some time, to provide a clearer picture of RNR opportunities and issues in each setting.

Team members conducted the field research using a form of rapid institutional and production system appraisal. Field visits involved three distinct stages. First, team members contacted regional and sub-regional government administrators and technicians, project personnel and others in the area judged to be knowledgeable about the problems in question. Second, the team visited the site and conducted group interviews and individual interviews with selected informants. Generally two team members investigated production systems issues, while the other two gathered data on local institutions and their roles or potential roles in resources management. To obtain as much local detail as possible, the team concentrated on a single community in five of the six cases. In the third stage, information gathered was assessed and a rough draft of the case study prepared jointly by all team members. Those drafts form the basis of the present report.

The team used an analytic framework in organize data collection. The framework directs attention to four categories of information:

- attributes of RNR viewed as economic goods, that is, whether a specific resource is inherently a private good, a private good with positive or negative externalities, a common pool resource or a public good, with emphasis on the incentives generated by these attributes of RNR for people to manage or overuse them;
- local working rules for governance and management of the target RNR(s), and supra-local formal rules where informants considered them relevant, again with an emphasis on the incentives the rules generate for resource management or abuse;
- interactions that arise among people (resources users and others, whether citizens or officials) when they seek to obtain from the target RNR the inputs they need for their production systems; and
- outcomes of interactions, evaluated in terms of the efficiency and equity of the results for resources users and the impact of RNR use, management and governance on the condition of the targeted RNRs (sustainability, degradation or in the best of cases enrichment).

It was not always possible to gather complete data on each of the four categories. Case descriptions may contain occasional imprecise information on some points and gaps on others. The team feels however that they present a largely accurate picture of RNRM and RNRG problems in the six sites.

D. Case Studies

A four-person team conducted studies in six different sites over a period of six weeks, following a week's preparatory work in Bamako. The sites are listed in the table below. For each case study, the village name, location by region, and focal renewable resource(s) are noted.

Fatola	First Region	Fisheries, woodstock, gardens
Yaguinébanda	First Region	Pastures
Mamaribougou, Soribougou, Farabana	Second Region	Woodstock
Sanankoro Togola	Third Region	Watershed/soils
Bagadadji	Fourth Region	Irrigation waters
Anacanaa	Fifth Region	Watershed/soils

Highlights of each case will now be described.

1. Fatola: Fisheries, Woodstocks, and Gardens

Fatola, a village on the banks of the Senegal River in Kayes Cercle, involves three different types of RNR: Senegal River fisheries, woodstocks - that is, all kinds of woody plants from trees to bushes - and gardens. The river fisheries have long been managed by local people, in the context of a traditional regional fisheries management institution based at Kayes, the capital of the First Region. Local woodstocks are still relatively abundant, but under pressure from local herders and from non-resident pastoralists who move through the village area on annual transhumance routes. Village women garden on the river banks, and face conflicts with herders whose animals sometimes enter and destroy garden produce. While local institutions have been adequate to deal with garden problems, both woodstock management and fisheries have benefitted from support offered by foresters who patrol the local area. The latter have reinforced local fisheries management institutions, and worked with villagers to create new woodstock management arrangements. Both seem quite productive. A final aspect of the Fatola case are the activities of a local NGO, UTPADE. This organization has played an important and generally positive role in local life over the last several years. But careful analysis of UTPADE's development strategy reveals some weaknesses.

2. Yaguinébanda: Pasture Management

Yaguinébanda, in Yélimané Cercle, in the far northwest of the First Region, poses the issue of pasture management at the local level. Local production systems include both field agriculture and pastoralism. The RNR management problem is protecting pastures during the dry season from bush fires. Here again, collaboration between villagers and foresters, building on local institutions, has produced a working relationship that successfully protects and manages a valuable local resource. In addition, villagers have drawn on funds repatriated by village migrants to upgrade water supply investments originally financed by foreign assistance funds. The high degree of local initiative, and capacity to mobilize and manage funds, is characteristic of the area. So also is the willingness of local people to use national courts to resolve problems.

3. Opération Aménagement et Production Forestière and Co-Management of a Classified Forest

Women in the three villages of Mamaribougou, Soribougou and Farabana are involved in management efforts in the Monts Manding Classified Forest near Bamako in the Second Region. Mamari-

bougou men are as well to some extent. This experiment in popular co-management of a classified forest is in its very early stages, but appears quite promising. It poses fundamental questions concerning the capacity of local institutions to undertake such activities, how they might be modified if necessary, the role of the private sector, both within the communities and outside them, in these activities, and the means by which OAPF personnel and villagers can work together most productively. In addition other, non-forestry activities could be developed within the Monts Manding forest, reinforcing the opportunities for local people to participate in viable economic enterprises.

4. Sanankoro Togola: Watershed Management

In Sikasso Cercle, in the Third Region, the village of Sanankoro Togola demonstrates what villagers can accomplish by way of watershed management. Five years ago the village was threatened by soil erosion so severe that local people almost abandoned it in despair. Then, with assistance of the Compagnie Malienne des Textiles (CMDT), villagers received assistance on soil and water conservation problems from the Soil Erosion Control Project. They organized themselves to manage the village watershed on a collective basis, installing various water management structures (berms, drainage ditches) with labor resources mobilized entirely at the local level. Families also undertook soil erosion control measures on their own fields. The combination of the two activities has reestablished the viability of farming in the area. In this situation, village institutions have been deliberately reshaped by collective decision (elimination of age classes). Villagers have shown an impressive capacity to mobilize labor on a continuing basis. Some local farmers demonstrate ingenuity in trying to improve the productivity of their farming operations. The role of local women in collective decision-making is however extremely restricted, as is their access to economic opportunities.

5. Office du Niger: Managing an Irrigation Scheme

Bagadadji in Niono Cercle, Fourth Region, is a community populated entirely by immigrant or "colon" families. Their parents and grandparents were brought to the Office du Niger to engage in irrigated farming. Water management capacity within the system had deteriorated very seriously, and production was falling. In recent years, some of the primary canals have been rehabilitated, and the parcels resurveyed and adjusted so that proper water management is again possible. The former monopoly exercised by the Office du Niger over all activities within the scheme has recently been relaxed. The private sector, and men's and women's groups in local villages, are beginning to play a much more productive role in rice farming, milling and marketing. The relationship between the Office du Niger and the colons is evolving rapidly. Production is increasing, both because of rehabilitation of the irrigation system and because of the liberalization of relationships between the Office, colons and private sector actors.

6. Anacanaa: Watershed Management

Anacanaa in Douentza Cercle, Fifth Region, poses the institutional problem of watershed management across several jurisdictions. The local production system combines field agriculture with stock raising. For the past several years runoff waters from the large watershed upstream have begun to erode soils in the Dianvelli Valley where Anacanaa is located. An international NGO has been working with local people in several valley communities to help them build flood control structures in the valley. Whether these efforts will be technically successful is still unclear. Coordination of efforts among the various valley communities could however improve chances for success by reinforcing the effect of each dam in coordination with others. Local farmers will probably also have to adopt more intensive soil and water conservation measures on their own fields to complement the effect of

the dams. This case reveals both the limitations of isolated local effort, and possibilities, based on traditional pre-colonial structures, for overcoming these limitations by establishing a local special flood control district.

E. Study Contents

The six case studies make up the heart of this document. They are presented in the order they appear in this introduction. Each tries to situate the RNR management and governance problems in the context of a local community, with its production system(s), local institutions, relationships with outside actors such as the CMDT, the Office du Niger, local and international NGOs, and GOM representatives.

Each study ends with conclusions and recommendations. Some of the latter are institutional, but others address technical issues. The analytic approach adopted in this report highlights the relationships between technical and institutional issues. Resources management, as people in the study sites conceptualize it, is first and foremost a matter of stabilizing or enriching production systems. Concerns with protecting the environment flow from their interest in maintaining their production systems.

The last chapter presents general conclusions and recommendations.

Many of the recommendations presented in the study, as well as the suggestions for further applied research on the decentralization theme, turn on the idea of devolution of power from the central government to what are now informal local governments.

Figure 1
MALI



<u>Village</u>	<u>Region</u>
Fatola	Kayes
Yaguinébanda	Kayes
OAPF	Koulikoro
Sanankoro Togola	Sikasso
Bagadadji	Segou
Anacanaa	Mopti

III. Fatola Village: Rainfed Agriculture, Truck Farming, Pastoralism, and Fishing

A. Introduction

The village of Fatola is located in the First Region 17 kilometers upstream from Kayes on the right bank of the Senegal River. With 800 plus inhabitants, distributed more or less equally between Bambara and Khassonke, the community relies on the following main production systems:

- agriculture (rainfed cultivation of millet, sorghum, peanuts, and maize, and kitchen gardens cultivated by women);
- vegetable crops (notably onions, manioc, tomatoes, and cabbage) cultivated almost exclusively by women, and orchard crops (primarily mangoes, papayas, and bananas) cultivated only by men; and
- fishing (angling and various types of net fishing).

Renewable resource management problems arise at various levels and are characterized by great diversity. This study deals, first, with problems relating directly to resource management. Second, it looks at a number of bottlenecks that cause these problems. These bottlenecks are related to economic, legal, political, and technical factors, such as a shortage of forage in the dry season, a lack of outlets for certain products, the land tenure question, and the resource management code.

The local environment has very substantial potential, including:

- the possibility of producing crops in the preharvest period and opportunities for flood-recession agriculture and counter-seasonal cultivation;
- very easy access to watering spots for livestock; and
- additional financial resources derived from fishery products, which are substantial enough for purchasing improved production means.

At the institutional level, Fatola people show a great capacity for organization based on a long tradition of local self-governance. Moreover, the establishment in 1984 of a local NGO--the Union of Rural Tons for Development (UTPADE)--may have reinforced this capacity somewhat, although the outcome is still unclear.

This chapter contains ten additional sections: a description of the three local production systems and their strengths and weaknesses; information about local and overlapping institutions; a comment on the interrelationships among institutions, production systems and renewable natural resources management; the current status of RNR management issues in Fatola; analysis of the management and governance of market gardens, village forest resources and the Senegal River fishery; an assessment of the impact of the local NGO, UTPADE, on local self-governance potential; conclusions and recommendations.

B. Three Production Systems

The population of Fatola has two major production systems: an agro-silvo-pastoral system and an artisanal fishing industry. These systems are supplemented by a third involving transhumant pastoralists who exploit village forage resources on an intermittent, seasonal basis. The elements of the three systems are noted below (see Figure 2).

1. Agro-Silvo-Pastoral Production System

The components of the local mixed agriculture/grazing/agro-forestry system include:

- millet (*Panicum miliaceum*) sown in light, sandy soil, and sorghum (*Sorghum vulgare*) planted in black/clay soil;
- ground nuts (*Arachis hypogea*) sown in light, sandy soil located two to four kilometers from the village;
- market garden crops cultivated along the banks of the Senegal River in raised beds;
- small plantings of fruit trees and manioc (*Manihot esculenta*) placed on high ground along the river's edge;
- small ruminants (sheep and goats) pastured as family herds near the village; and
- large ruminants (cattle) generally pastured in small family herds on village lands.

2. Senegal River Fishery

The Senegal River fishery is an artisanal production system. It involves the following elements:

- harvesting six or seven local species from a 50-kilometer stretch of the Senegal River;
- using nets and hook and line tackle to harvest local species; and
- using pirogues to transport fishermen, work most nets, and fish with line tackle.

3. Transhumanant Pastoral System

The transhumant livestock system involves the following components:

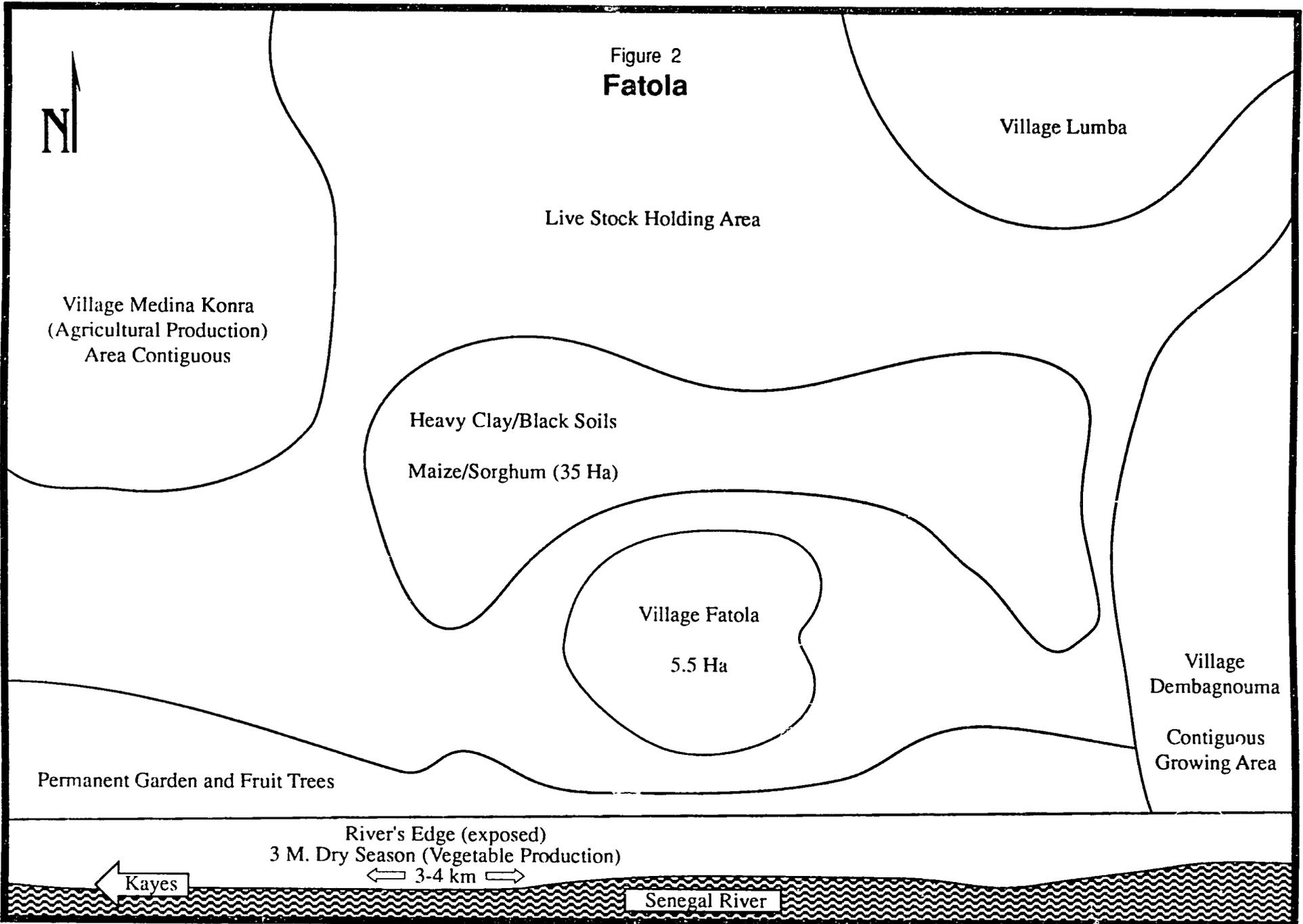
- small ruminants (sheep and goats) are pastured in large, mixed herds by transhumant pastoral families who spend part of the dry season on village lands; and
- large ruminants are pastured separately by transhumant pastoral families.

4. Strengths and Weaknesses of Production Systems

Each existing production system has weaknesses. Following are the systems' agricultural, animal husbandry, and fisheries problems, respectively:

- lack of a systematic crop-rotation scheme for producing millet and groundnuts on light, sandy soil;
- farmer-improved varieties of millet and sorghum have not been developed to cope with abnormally shortened growing seasons due to late rains and/or extended drought;

Figure 2
Fatola



- farmers perceive the need for controlling insect and plant diseases but lack access to markets for chemical inputs and to technical assistance for information about improved cultural practices;
- livestock producers also lack access to systematic technical assistance for animal disease control using improved husbandry practices or phytosanitary products;
- sources of forage for ruminants near the village become rare during the dry season or during extended periods of drought. Stock owners and herders shift their animals to crop residues found in market gardens located on the banks of the Senegal river. However, during extended droughts, villagers are forced to reduce herd size often by selling animals below market value;
- the coexistence at the river's edge of traditional watering points and market gardens cultivated in the recessional plain of the Senegal river has resulted in conflicts between livestock producers who often do not control their grazing herds adequately, particularly during drought years, and garden owners whose crops are destroyed by foraging animals. The latter accuse the former of putting their animals into unharvested gardens; and
- since the Manantali Dam was put into operation, the river regime has been sharply modified. Because the river level fluctuates less now, river grasses grow higher making it more difficult to work the nets effectively. In addition, fish are behaving differently, and Fatola fishermen now have much more difficulty predicting their movements.

Existing production systems also have strengths presented below with regard to agricultural, animal husbandry, and fisheries issues, respectively:

- an improved inter-cropping system is practiced on the clay/black soil near the village, which protects soil against wind and water erosion. Good cultural weed control is achieved through light interception from a densely intersown crop of groundnuts or cowpeas;
- currently, land tenure problems pose no limitations on expanded production of field crops within the village. However, property rights associated with fruit trees discourage planting by all but land owners;
- diverse soil types and topography found on village lands will permit sustainable production of cash and subsistence crops;
- villagers have integrated improved cultural practices for tree production into management of field crops and grazing areas;
- innovative village farmers have successfully experimented with alternative cash crops, including both fiber crops and market vegetables;
- a strong emphasis on ad hoc experimentation with labor-saving innovations exists within Fatola. For example, farmers use an animal-drawn seed drill to sow millet and sorghum in lines, reducing labor for sowing and permitting mechanical weed control. This labor-saving device was adopted in response to a perceived diminishing pool of family

and collective labor. More innovative farmers have begun to practice elementary forms of zero tillage planting on unprepared seed beds by hand or using animal-drawn seed drills;

- recent introduction of labor-saving devices for harvesting (a mechanized stationary thresher) and village grain-milling equipment represent villagers' efforts to eliminate some of the more onerous tasks associated with improved agricultural production. These innovations also reduce dependence on a diminishing pool of costly temporary agricultural laborers;
- maintenance of bio-diversity by both livestock producers and agriculturalists is a strong feature of each production system. Each year, producers select what they consider to be improved seed or stock for their particular micro-production environment. This contributes to the maintenance of a random collection of diverse germ plasm within the village;
- village livestock production has permitted a rational use of manure and compost; and
- fishermen have historically well-organized institutions that provide the basis for adequate management of the river fisheries.

C. Local and Supralocal Institutions

This section describes the institutions that function as primary concerns at the village or sub-village levels and those outside the community with which villagers frequently or occasionally interact. The village of Fatola, founded in the late 1800s at the end of the reign of El Hadj Oumar Tall, is composed of two quarters, one Bambara in origin and the other founded by Khassonke people. Formally, each was an autonomous unit, but they were consolidated into a single village at the request of the Malian Government shortly after independence. This political evolution continues to structure interactions within the village today.

1. Age Groups

Traditional forms of organization are demonstrated by the existence of groups that organize individuals according to their age or around certain types of activities. There are now five male and five female *rons* (traditional organizations) that demonstrate considerable initiative in pursuing the following activities: mutual assistance for agricultural work, social events, and cultural activities. In earlier times, these groups were organized by quarter, one from the Bambara quarter and another from the Khassonke.

The age grade societies, which generally have between eight and 15 members, work for pay during the growing season. Roll call is taken at these work sessions, and members absent without a legitimate excuse are fined. If the group is rewarded in livestock for its work, members choose a local shepherd and have him care for the animals until the society needs them for festivals during the dry season. Money is held by the head of the age grade unit. Funds are reportedly managed carefully and embezzlement is not a problem.

Problems, for instance disputes over fines levied on members accused of unexcused absence from a work party, are generally resolved within the group but can be appealed to the head of the village youth group if the age grade cannot resolve them. This same group provides an additional, overlap-

ping unit for collective action and problem resolution which issues exceed the capacity of the age grades.

Another activity undertaken only by female *tons* is the *tontines*, a rotating savings system that women value highly, particularly because they are excluded from the modern forms of credit.

2. Local Chieftaincy

The village headman represents the entire village. Seven councillors, chosen from the two quarters, assist him with village governance tasks. The chief can be removed from office, but that rarely happens. The chief and his councillors advise on activities in the village, resolve disputes at the local level, and serve as intermediaries between the villagers and agents of the administration.

If conflicts cannot be resolved at sub-village levels, most are handled locally by the chief and his councillors. Typical sources of conflict involve damage to gardens by foraging livestock. Often such cases are resolved by arbitration. The local host of the herder involved, in the case of transhumant pastoralists, arbitrates the dispute between the herder and the gardener or, as is often the case, the gardener's husband representing her. If informal arbitration fails, the matter is brought before the village headman and his council. They usually manage to settle the matter, often by imposing fines of a specific number of goats or sheep as a function of the damages the gardener has suffered.

The chief has also handled conflicts with representatives of the administration, particularly foresters. The chief has backed villagers' refusal to obtain permits to cut wood for personal use at the nearest Water and Forestry Agency post in Kayes. Village informants claim there have been no bush fires on their territory for the last twenty years and that they take from nature only what they need to survive. Relationships between villagers and foresters appear rather positive.

3. Superlocal Administrative Jurisdictions

Fatola lies 17 kilometers upstream from Kayes, the capital city of Mali's First Region, on the right bank of the Senegal River. The village is situated some four kilometers from the *Arrondissement* (sub-cercle geopolitical jurisdiction) of Lontou on the left bank of the river. The *arrondissement* is a constituent administrative unit of Kayes *Cercle* (sub-regional geopolitical jurisdiction) and has played an occasional yet important role in fisheries management in Fatola.

D. Institutions, Production Systems, and Renewable Natural Resources Management

The insecure situation of land use rights, particularly parcels dedicated to fruit tree crops and vegetable crops (the latter of which is primarily a women's activity), is an important obstacle to production. In practice, this insecurity limits many investments in agricultural production. It impedes developments that would promote a reasonably stable and more productive system. The same insecurity explains why women are motivated to invest in small livestock rather than in agricultural activities: they are prevented from inheriting land. The parcels they farm can be taken from them after any cropping season, because a woman's access to any given parcel derives from a limited grant valid only for a season rather than from a permanent use or property right.

E. Status of Renewable Resources Management Issues in Fatola

The larger issues to be addressed, namely shortages and management of forage, protection of trees planted in fields against damage from transhumant herders lopping branches, management of grazing areas (particularly the banks of the river), and management of fisheries have been aggravated by the traumas of the last thirty years. These traumas were the peak drought years (1973-74 and 1984) and construction of the Manantali dam. The drought has resulted in more transhumant herders coming from Mauritania and from the northern part of the First Region to the village lands and adjacent areas. During bad years, transhumant herders make a practice of severely lopping trees standing in the fields, and in so doing, not only impair the dry farming production system, but also damage the silvicultural system. Periods of drought also encourage people to look for alternative sources of income, including the production of a wider range of vegetables and fruit in their gardens. These shifts in production strategies have aggravated conflicts between herders and gardeners. Since the Manantali Dam was put into operation in 1987, the river regime has been considerably altered with drastic effects on the reproductive cycle and seasonal migrations of fish. Fishing activities around Fatola have been negatively affected by these changes.

It is useful to describe these resource management problems thoroughly and to assess them in light of the following framework:

- the type of good embodied by each resource assessed relative to the techniques involved in its exploitation;
- formal and informal management institutions, in conjunction with the use rules, codes, and locally applied sanctions, organizational patterns, and modes of financing;
- interactions, that is, how individuals and groups faced by problems select strategies given the constraints surrounding them and the motivations inherent in the goods and institutions involved; and
- the implications.

F. Vegetable Gardening on the Banks of the Senegal River

This section: (1) analyzes the attributes of the fenced gardens situated along the banks of the Senegal River; (2) describes the working rules governing their use; (3) indicates why they are sometimes private resources and sometimes open access resources; (4) describes the interactions that develop when the two different classes of users--gardeners and herders--implement their strategies to exploit garden resources; and (5) characterizes the outcome of these interactions.

1. Introduction

The causes for lengthening the gardening period and extending vegetable production to a wider area must be analyzed. The three main vegetable crops, prior to the severe drought years, were onions, eggplant, and small tomatoes. These crops were harvested step by step over the five months following the end of the rainy season between December and April. The herds were then invited to feed on the crop residues and given access to the gardens for about a month. Drought changed this system. More herders now frequent village lands during this period, because they cannot find enough forage for their livestock in the lands of Yelimané Cercle, which lies just north of Kayes Cercle.

While conflicts have always occurred between herders and gardeners (the latter of whom are primarily women) as the local tradition of fencing gardens attests, these conflicts are more frequent than they used to be. Conflicts not only pit gardeners against transhumant herders, but also pit the same gardeners against local shepherds. There are three levels at which such disputes can be resolved:

- amicably between interested parties, often by arrangement with the transhumant herder's local host serving as arbitrator;
- by recourse to village authorities; or
- by requesting intervention of arrondissement officials.

2. Attributes of Vegetable Gardens as Economic Goods

According to the analytical framework defining the types of goods represented by the various resources covered in this report, vegetable gardens are private resources. They are subject to exclusion by fencing. The use units that vegetable gardeners derive from these resources, that is, the different vegetables produced, are characterized by separable and competitive consumption.

3. Use Rules Governing Access to the Goods in the Gardens

Livestock was kept away from the crops, including garden crops, during the rainy season. After the harvest was in, and by decision of the village chief and his advisers, transhumant herders and local shepherds were at liberty to graze their animals in the gardens. At this moment, a change would occur in the nature of the economic good represented by the gardens. That is to say, from private resources, these gardens became open access resources. Resident and non-resident herders alike were allowed to obtain more forage in the form of crop residues by pasturing their animals in the gardens.

4. Interactions between Herders and Vegetable Gardeners

Since this use rule was well known and observed by almost all concerned, relations between (a) farmers cultivating vegetable gardens and (b) transhumant herders and local shepherds were mostly peaceful and devoid of conflicts.

5. Outcomes

During this period, which might be characterized as idyllic, the strategies of the two groups made possible the efficient and effective use of the space along the river banks and of resources located there.

G. Management of the Forest Resources of the Village

This section addresses the problems involved in managing woodstocks--all ligneous vegetation, whether trees or bushes--found on Fatola village lands. The section does not address the issue of fruit trees planted in gardens though they fall within the definition of woodstocks given here. Fruit trees are subject to exclusion, consumption of the goods they produce is separable, and property rights concerning them are quite firm.

This section begins with general information, then examines woodstocks as economic goods, considers the rules governing access to and harvesting of woodstocks, proceeds to interactions, and ends with a brief discussion of outcomes.

1. Introduction

Fatola is not heavily wooded by Malian standards. Nonetheless, trees are found in some abundance on cultivated fields and in uncultivated commons where local and transhumant livestock are pastured. Women collect the fuelwood they need within three or four kilometers of the village center. Men harvest building poles and construction timbers in the same area. Given these distances, wood is still relatively available. On the other hand, it is no longer abundant enough to be considered a free good. Local concerns about controlling harvesting reflect this sense that wood is becoming a scarce good.

2. Attributes of Woodstocks as Economic Goods

The trees that grow in fields and commons pasture around Fatola have a complex character as economic goods. The complexity arises, in part, because woodstocks produce some on-site goods and services, and others goods consumed off-site. Changing patterns of land use over the annual cycle also render the characteristics of local woodstocks complex.

Fatola woodstocks located in farmers' fields produce both on-site services and on-site goods. Trees and bushes in fields help protect soils and growing crops against wind erosion. They also shield soils and crops against water erosion. By recycling nutrients leached into the soil (from fallen leaves that molder on the ground and enrich surface soils) below depths field crops can reach, they help maintain soil humus and fertility. On-site services are primarily private because they are subject to exclusion and separable in consumption. Farmers cultivating their fields and harvesting crops are able to control access to produce in their fields. Crops are subject to separable consumption.

Woodstocks have the characteristics of common pool goods as far as consumptive uses are concerned. That is, they are not easily subject to exclusion, while consumption of products harvested from trees and bushes is separable or rivalrous. Trees and bushes, like growing crops, are subject to exclusion during the farming season when people are in the fields. After the harvest however, people do not spend much time in their fields. It is easier, then, for animals to browse on growing seedlings or fallen seedpods without being detected. Likewise, people can harvest fuelwood, building poles, or leafy branches as browse for their animals and other woodstock products without much risk of being caught.

In this situation, the dry season, common pool attributes of Fatola woodstocks dominate the growing season, private property attributes. If trees and bushes are mutilated or destroyed during the dry season, production of private, on-site goods and services will suffer. Residents of Fatola understand this cause and effect relationship, as the next section reveals.

3. Rules Governing Access to Local Woodstocks

The rules governing access to woodstocks in Fatola appear to be evolving as wood becomes less available and concern mounts at the local level about conserving the existing supply. The same concerns have long provided the formal basis for foresters' approach to woodstock institutions. The forestry code mandates that foresters enforce a series of restrictions on woodstock harvesting by local people as well as by outsiders. However, a significant change has occurred recently in the character of the relationship between foresters and Fatola residents.

Since roughly 1980 by local account, forestry agents have patrolled Fatola village lands on a quarterly basis looking for evidence of illegal cutting. When they find it, and if they can identify the per-

petrators, they impose fines on the villagers responsible for the infractions. This approach was resisted by local people. Village leaders generally refused to participate in this effort to control cutting on the grounds that they and their fellows did not engage in abusive harvesting, but took only what they needed. One resident did pay a 10,000 FCFA fine for cutting a large tree in 1986 to provide leafy forage for his sheep. Others have paid lesser amounts.

The change in the forester-villager relationship concerning the local woodstock has occurred largely as the result of two factors: (a) the spread of field agriculture and (b) increased demand for consumptive goods produced by trees and bushes. Villagers readily admit that they clear small trees and bushes from cultivated fields, though they allow natural regeneration in fallowed lands. They claim they want to preserve large trees in their fields. Even if they do, however, systematic suppression of natural regeneration in a rotational cultivation system guarantees that lands will gradually be denuded of all woodstocks as the old growth is cut or dies off.

Drought conditions since the early 1970s and changes in production strategies designed to cope with them have forced transhumant herders to move south from the Mauritanian frontier pastures to the Fatola area and to spend more time there during the dry season. During the dry season, herders lop branches from trees or cut small trees to provide their animals with vitamins in the green leaves. Fatola residents report that damage caused by transhumant herders to the local woodstock has increased sharply over the last decade. Local herders also degrade the woodstock by lopping or cutting trees. This popular perception of change in local environmental and resource use conditions set the stage for an effort to regulate access to the woodstock as a dry season, common pool resource.

In 1988, foresters from the Kayes cantonnement proposed to villagers that they create a "bush fire control" committee. Locals claim there have been no fires on village lands for the past twenty years, with the exception of one in 1990. Nonetheless, they organized the committee with the aim of controlling access to village woodstocks. The bush fire committee was created in the course of a special village assembly. In effect, the assembly made a

constitutional decision, based on unanimous consent after public debate, to create a special district, or jurisdiction, including all village lands.

The base rule is a prohibition on lopping of branches from large trees. The assembly budgeted the labor mobilization necessary to provide for periodic monitoring of woodstock users' behavior in light of the local regulations. Five volunteers were selected to monitor woodstock use on village lands. They cannot legally impose any penalties for infractions. They can only inform forest guards, who then take measures to enforce cutting restrictions. Fires are apparently also reported if they occur.

4. Interactions Concerning Local Woodstocks

When many herders are grazing their herds on village lands, the patrol, under the leadership of its eldest member, circulates over village lands for several hours two mornings per week. When fewer herders are present and the danger of bush fires as well as unauthorized lopping is limited, the patrol makes its rounds only once a week or less.

The local coalition behind this action consists of Fatola farmers. Some 20 percent (20%) of local families are reported to own livestock. Sheep and goats are herded by a single local shepherd. Five local men now herd cows for local owners. This replaces a single very large local herd, which apparently often caused considerable damage to local gardens. Local herders seem as likely as transhu-

mant pastoralists to lop branches for their animals because they are responsible for the well-being of their herds.

Local informants suggest that this system is not perfect, but that it does provide the community of Fatola some collective leverage over use of the woodstock on their lands. The monitoring system is dissuasive at the village level rather than punitive. A herder who consistently ignores the advice of the committee could be asked to take his animals elsewhere, according to Fatola elders, but that has not yet happened. The costs of lodging a complaint in any particular instance of unauthorized cutting are substantial. At a minimum, it involves a trip to the Water and Forestry Agency office in Kayes unless a forest guard happens to be present on the village territory when the incident occurs.

In response to a hypothetical question, the elders maintained that the village assembly could decide to impose its own fines for violation of locally formulated rules governing exploitation of the woodstock, were it not for the Forestry Code preempting that authority.

5. Outcomes

Fatola elders believe their woodstock is still a threatened resource. Local controls, carried out through a locally-instituted special district, over woodstock exploitation, including treatment of natural regeneration on fallowed lands when they are cleared for farming, are inadequate, though definitely an improvement over no controls.

H. Exploitation and Management of the Fisheries between Kayes and Moli

1. Introduction: Fishing Problems

Fishing on the river is a very old, established practice in Fatola. The activity is so important, it is governed through a sophisticated special jurisdiction with its own set of locally devised rules to regulate fishing activity and preserve the resource. Self-governance is nothing new among fishermen along the Malien segment of the Senegal River; it dates back to very ancient times. Self-governance occurs through four special jurisdictions. Of these, three are local and one regional, which oversees the others. It is appropriate to consider these four special jurisdictions as three local and one regional special purpose governments.

Three Periods

The institutions fishermen developed for themselves over many generations were sufficiently solid, and the fishermen who controlled the institutions were sufficiently committed to permit settlement of a major fishery management problem that arose over the past three decades through processes political in the broad sense of the word. The problem involved fishermen who came from Mopti and Ségou to the 50-kilometer-long Kayes-Moli section of the river in 1964. The problem reached an acute phase in 1983 when the Niger River fishermen were confronted with a severe reduction of fish availability.

Fishing in Fatola has evolved through three periods:

- from pre-colonial times to 1964 there was a system of self-management by the local fishermen;
- from 1964 to 1987 there was a system of management of the local and non-residential fishermen by the members of the enlarged group; and

- from 1987 to the present the Manantali dam has been in operation, with the attendant technical disturbance of the fishery production system in Fatola, a situation which has yet to be remedied.

Inter-Period Changes

The community of fishermen expanded in the second period. Fish availability has dropped off severely in the third period. Despite these changes, the traditional set of rules and institutions governing the Fatola fisheries has stood the test of time. Strains are apparent as fishermen's incomes fall with reduced catches, but so far local institutions continue to function. In the second period, local institutions were reinforced by assistance from the Water and Forest Agency but not modified much in terms of content.

The fisheries exploited by the Fatola fishermen contain a large number of fish species. The behavior of various species was well understood by the fishermen before 1987. In earlier times, fishermen would practice their activity to earn their subsistence, either directly by consuming the fish or by bartering the fish against other consumption products. Until 1987, the individual income for a five-day week's work (a normal work schedule for the thirty Fatola residents who fish professionally) ranged from 7,500 to 12,500 FCFA depending on the fishing devices and the work agreements binding the fishermen to the net owners. Since 1987, incomes and, indeed, days spent fishing have fallen off sharply.

2. Attributes of Fisheries as Economic Goods

The fisheries on the Kayes-Moli section of the river have the characteristics of common pool resources. There are no natural barriers blocking access to these waters abounding with fish except for the investment required to obtain a use right to a pirogue. The use units--the desired fish which can be taken in these fisheries--once caught by a fisherman are consumed separately, whether used for immediate consumption or for trade. Therefore, fisheries must be classified as common pool goods.

Natural boundaries do exist, however, in the form of falls and tributaries that divide the river into a series of clearly demarcated stretches.

3. Rules Governing Exploitation of Fisheries

This section (a) discusses rules of the fishermen's association, and (b) outlines enforcement mechanisms and operational rules governing access to and exploitation of the river fisheries.

Fishermen's Association

According to information supplied by the vice-president of the traditional village fishing association (called *ton Somono* in the Bambara language), fishing in Fatola is an activity open to anybody interested, on the condition that candidates serve a two-year apprenticeship. Without this preliminary training, a fisherman would not know how to maintain the fishing devices nor where to find fishing places at different times of the year and could not make a living as a fisherman. The capacity of an individual to obtain enough professional training to earn his subsistence in this type of job was a matter of concern not only to the individual himself but to the other members of the group. In fact, the mutual assistance structures organized by the Fatola fishermen's group are based on the presumed professional capacity of each member. During this period, fishing on the Kayes-Moli section was abundant enough so that there was no need for other controls over access to the profession.

The Fatola fishermen's association provided social security for its members at least until the Manantali dam became operational. Before independence, members were required to contribute 25 FCFA per week. After independence, the amount was increased to 1,000 FCFA per month. Any fines assessed by the association are also added to the communal treasury. These funds serve to take care of fishermen's families in the event that they are wounded or die while plying their trade. The funds also can be drawn on to replace pirogues that have been destroyed or lost.

The local fishermen's chief (*Somono kuntigui*) resides in Fatola. The chief is chosen by the fishermen gathered in a general assembly. The criteria for the selection of a chief are fishing know-how, moral character, and, in particular, the occult fishing powers manifested by a candidate for the post, that is, his capacity to control the water spirits and the spirits of the water creatures. The fishermen's chief can be removed from his office for serious transgressions.

Besides the fishermen's community of 30 people residing in Fatola, two other communities pursue the same activity on the Kayes-Moli section. They are located in Medine, 12 kilometers upstream from Kayes, and in Kayes proper. Each of these communities controls a section of the river bounded by rapids, the entrance point of tributaries, or both. The chief of the Kayes fishermen also has supervisory powers over the chiefs of the two other communities; he, in fact, is the supreme chief. Thus the Fatola, Medine, and Kayes fishermen's institutions are special districts for fisheries management. The overlapping, larger, special purpose fisheries jurisdiction at Kayes deals with problems common to all three local jurisdictions, which they cannot easily handle alone.

Overriding Jurisdictions

The Fatola fishermen's association, apparently in response to problems posed by nonresident fishermen intervening in the Kayes-Moli fisheries on the Senegal River, decided in a general assembly to petition Malian Government agencies for support of their local fisheries management institutions. Mamadou Sangaré, vice president of the traditional association, led a delegation of 10 Fatola fishermen who presented the petition to the then-arrondissement head, M. Robert Keita. The fishermen sought not to restrict access to the local fisheries, but to ensure that all who exploited it would respect their local operational rules. Keita investigated and concluded by requesting a meeting with the head of the Kayes Water and Forestry Agency.

The meeting led to preparation of an official, written document recognizing the local fisheries management and governance systems. The agreement stipulates that all non-resident fishermen must obtain permission from the local *Somono kuntigui* before fishing the river. They must abide by the local working rules as established by the head fisherman. If an infraction cannot be resolved at the local level, the local fishermen can appeal the case to the arrondissement head at Lontou. If the issue is not settled there, it can be appealed either to the *Somono kuntigui* in Kayes or, as a final recourse, to the Water and Forestry Agency. The national agents reportedly apply the applicable regulations with considerable severity, whereas the local jurisdictions tend to be lenient with those who admit their fault. The leniency of local regulations - except concerning obstinate repeat offenders - and the time and effort costs of appealing disputes to Kayes create incentives that facilitate dispute resolution at the local level.

Operational Rules Governing Fishing Activities

The operational rules controlling fishing activities are complex. They appear to have been designed to achieve the three following essential objectives:

- ensure reproduction,

- concentrate fish in temporary reserves to enhance catches, and
- regulate fishing behavior to avoid unnecessary conflicts that could perturb the local fisheries.

The operational rules adopted to achieve these three goals within the Fatola special jurisdiction are fashioned by the fisherman's chief at Fatola. Each of these goals is promoted by a specific set of rules.

Protecting Spawning Grounds

In order to facilitate the access of adult fish to prime spawning grounds and to ensure adequate reproduction of the five or six main species, the *Somono kuntigui* prohibits fishermen from placing their nets at the entrances of preferred spawning places (usually swamps and tributaries) during the spawning period.

Temporary Reserves to Concentrate Fish

The *Somono kuntigui* also periodically declares selected sites on the river off limits to all fishermen for defined periods. This encourages fish to concentrate in these protected sites. Once the fishing ban is lifted, the concentration of fish enables a plentiful catch and ensures efficient use of the time spent fishing. These bans are publicly announced and publicly lifted with notice given beforehand locally and via the Kayes paramount chief of the fishermen. This policy allows all fishermen active on the river to participate if they wish. The focus of these operational rules is not on excluding potential fishermen, but on regulating their fishing practices to preserve the common property fishery resource.

Avoiding Unnecessary Conflict

The *Somono kuntigui* regulates how fishermen conduct their fishing operations to avoid excessive competition and conflicts that might harm the cottage industry represented by fishing on this section of the Senegal River.

Certain types of fishing tackle and fishing tactics are prohibited. It is illegal within the local fisheries to use trot lines ("the line of a thousand hooks"), and it is illegal to draw fish into nets by baiting them.

Specific rules govern the use of the three major types of nets employed in the local fisheries: set nets, draw nets, and throw nets. Set nets, which can be 300 meters in length, must be spaced at least five meters apart. Once a draw net is being set, nonmembers of the net team are absolutely forbidden to fish within the closing net. The only limitation on throw nets is that fishermen must avoid casting their nets on others. This selection of rules gives some flavor of local approaches to fisheries exploitation.

National Regulations

The Forestry Code overrides local regulations in some areas. For instance, any Malian can fish on any body of water in the country if he pays the required license fees. These fees vary with the type of equipment used. Fatola fishermen obtain licenses from the Water and Forestry Agency in Kayes. This regulation allows untrained persons to work the river, a policy which may lead to conflict with local professionals.

Monitoring and Enforcement Mechanisms

Monitoring and enforcing the working rules controlling fishing activities near Fatola is the job of all fishermen in the community. No one is appointed to serve as a guard, and fishermen do not assume

this role by turns. Actually, each is interested in seeing that the others comply with the established working rules to ensure the efficient management of the fisheries. When a fisherman observes another violating a working rule, the normal procedure is for the former to seize the fishing equipment of the latter. The equipment is usually a net. The *ad hoc* fisherman-guard deposits the equipment with the fishermen's chief in Fatola. The chief sets a date for the trial and informs the other fishermen in the community. The normal delay does not exceed two or three days. The accused may go on fishing if he has other equipment, but no other member of the fishermen's community will lend him a net before the trial.

The trial takes place before the general assembly of the fishermen's community. Each fisherman can address the assembly. Once the facts have been presented and the decision made, the community sets the amount of the fine to be paid in light of the gravity of the infraction. Before 1960, fines were usually set at 100 FCFA per infraction; since independence, the amount has been increased to 1,000 FCFA. Only when the fine is paid does the guilty party get his net back. If he refuses to pay the fine, the fishermen's association can reportedly sequester his pirogue to prevent him from fishing until he complies with the ruling. Thus the penalty for an action (non-payment of a duly assessed fine) by a fisherman convicted of an infraction is graduated to reflect the severity of the offense: contempt of court or, in other words, rejection of the local special district's authoritative power to regulate the fishery.

4. Interactions

Fishermen, according to the vice-president of the Fatola association, recognize that they will be tempted to violate the rules to score a big catch, particularly rules against fishing in areas temporarily off limits. Fishing in a temporary reserve a month after it has been placed off limits will produce a good catch. Fishing in a reserve after six months will almost certainly yield a very abundant catch. Fish are a fairly expensive local commodity. The fines are small enough that they do not entirely discourage illegal fishing. Fishermen must keep their eyes open for violations of local rules if they want the reserves to achieve the desired result.

Local fishermen do, in fact, enforce this law as the following case illustrates. In a series of incidents from 1983 to 1986, a nonlocal fisherman (a native of Segou on the Niger River) arrived on the Fatola stretch and systematically ignored fishing regulations, particularly concerning temporary reserves. One day, after repeated warnings on top of repeated offenses, four Fatola fishermen caught the outsider once again fishing in a temporary reserve. He refused to give up his net, a struggle ensued and, when the outsider beat a retreat, the four Fatola fishermen chased him down and beat him up.

After the outsider recovered, he complained to the head of Lontou Arrondissement, who was across the river and several kilometers downstream. The arrondissement head gathered all the parties. After hearing both sides, he settled the matter by reminding the Fatola fishermen that they should not take the law in their own hands and suggesting to the outsider that he would do well to be less recalcitrant. Because this decision imposed no penalties on the Fatola fishermen, it reinforced their management and governance authority over the local fishery. Indeed, the outsider eventually had to apologize to the Fatola fishermen's association for his behavior before his net was returned. He has since left the area.

I. Comments on the Role of UTPADE

UTPADE is a local NGO that was created at the initiative of a villager who spent more than 15 years in France. He worked there and simultaneously pursued his master's degree in sociology and economics at the University of Paris. Fatola is the home of the mother of the UTPADE founder. One of her brothers resides there. In Mali, whenever an individual is in difficulty, the first persons he or she turns to for support are his maternal uncles. This practice played an important part during the foundation and development of the pre-colonial empires (for instance, in the case of Soundiata Keita who created the Mali Empire only with the help of his mother's family). This practice clarifies the foundation of the relationship between UTPADE and the village of Fatola, where many of the activities of the NGO are concentrated. As noted above, the operation of the village structures in Fatola is characterized by a real sense of democracy, because the centers of decision are dispersed, rather than resting with one man or one minority, and the working rules are carefully enforced.

By contrast, the way UTPADE operates is characterized by a certain amount of centralization with a vertical hierarchy structured around criteria of competency. UTPADE core staff are not truly representative of the population. In fact, what happens here occurs not just in UTPADE, but in most local NGOs created under conditions where rural communities are being reorganized at the initiative of individuals born in the local environment who return after spending much time away. These NGOs are very dependent on foreign donors, particularly NGOs representing the "North." Thus, local NGOs have a tendency to copy the logic of their funding partners. Many leaders of local NGOs believe the way to solve the region's development problems is primarily through mobilizing exterior financial resources. This faulty diagnosis underlies and influences everything including the types of structures being established and their modes of operation. Other organizational features depend on the personalities of the NGOs' leaders and on their ability to manoeuvre, which is sometimes dictated by the type of relationship they have with the village.

Of those who comprise the leadership of UTPADE, the founder, like any true creator, is a "scrapper," with all the qualities and faults inherent in this personality type: a strong capability for mobilizing people and a marked tendency to impose control; a vision of problems beyond the village level and a tendency to minimize the importance of local stakes; and a desire to establish a regional entity representing a constituency large enough to wield negotiating power against the state. In seeking rather single-mindedly to build up UTPADE as a major regional organization, he risks short-circuiting and almost demolishing a grassroots process of democratization and broadcasts his belief that village organizations are merely pawns on his chessboard.

Such risks are multiplied if the leader cannot rely, within the NGO, on a team capable of helping him reach larger objectives while being careful to reinforce the grassroots organizations. To say that UTPADE does not have such a team is an understatement. At most, one or two people are sensitive to such problems, and, unfortunately, they often lack the clout necessary to present these problems to the leader. The deficiencies that affect the UTPADE team result from the manner in which it was created. The first officials were appointed on the basis of personal relationships and were chosen from a group of unemployed people with some schooling. The individuals finally hired were city people who had been civil servants and who were jobless for one reason or another; they have very little experience in rural development, yet some behave as if they have all the answers and the villagers who constitute the UTPADE membership know nothing.

The risks are further increased if, as already mentioned, the leader enjoys a privileged relationship with the villagers such that they cannot express their views with complete frankness. The maternal uncle of the Fatola leader is one of the village notables and is a religious chief from one of the village's oldest families. "His nephew's project" is considered his family's project, and any substantial criticism amounts to an attack on his family. This partially explains UTPADE's loss of momentum within the village and in the other villages.

UTPADE built up momentum after a period of trial and error. The NGO's supporters attributed their early difficulties mainly to a lack of necessary start-up funds. The period of euphoria following the arrival of the first large amounts of funding did not encourage the leaders to reflect on the type of relationship that should be maintained between the existing local organizations (ton somono, age grade tons, etc.) and the various village units that UTPADE wanted to establish. Everything was organized as if UTPADE was starting from a blank slate.

But, if UTPADE's objective is really, as stated, to strengthen village institutions and make them more capable of meeting villagers' needs, it is necessary, first, to reinforce these local entities, namely:

- to support existing institutions in the sectors where they encounter failures or meet with difficulties;
- to create structures or institutions for the new activities where necessary; and
- to abstain from intervening in all cases where the working rules are well understood and observed, because these rules meet the needs of the existing situation and are clearly capable of being adjusted to accommodate some changes.

If the creators of UTPADE do not understand that their role, and their strength, are based on their willingness to allow villagers' own organizations to function as fully as possible, UTPADE will progressively lose any meaningful content and become merely a mechanism for the management of external funds.

J. Conclusions

The Fatola case study highlights four important ideas:

- capacity of local institutions to manage resources in selected sectors (gardens and fisheries);
- necessity of local institutions in some other sectors (primarily woodstocks) to obtain some limited amounts of assistance from overlapping jurisdictions;
- potential for that assistance to produce highly positive results in terms of reducing the management burdens of state agencies while strengthening local institutional infrastructure for resources management (fisheries and woodstocks); and
- potential for and limitations on a role for a local NGO in assisting local people to master their problems.

The first three points are closely linked. The case illustrates nicely that productive collaboration is possible between local populations and government, on condition that state agents be prepared to

they have done in several cases concerning management of renewable resources in Fatola, particularly concerning the fisheries, and to a lesser degree management of village woodstocks. Neither of these arrangements is perfect; both provide a very solid basis for future good faith collaboration between locals and government agents.

The last point raises in many ways the same issue, except that "outside" partners are NGO staff members rather than state agents. UTPADE can contribute to the future well-being of people in Fatola and other local villages, but again, only on condition that NGO personnel work with and try to strengthen existing local renewables governance and management institutions, rather than seeking to replace them with imported, imposed models of organization that transfer power and authority from locals to outsiders.

K. Recommendations

Several recommendations can be offered:

- the NGO UTPADE should give more consideration to the existing capabilities of the already established organizations, such as the traditional fishermen's *ton*, particularly when these organizations have proven their effectiveness. Some local organizations neither require help, nor should their activities be subordinated to an alien collective framework. Some other organizations need support in certain areas where they may have weaknesses. Finally, for certain activities, adequate organizations do not exist and in this case, there should be a process of "invention," in collaboration with the people concerned, of new and specific forms of organization. Collective action is not necessarily the ideal solution for all problems;
- the fishermen should be assisted to help them learn more about fish behavior under the new conditions of the post-Manantali Dam river regime;
- more attention should be focused on land tenure issues and the institutions governing them, provided this is done in a prudent manner;
- with regard to appreciable income women derive from vegetable gardening (a substantial part of which they contribute to meet family expenses), plans should be developed to support women engaging in such activities and to assist them in increasing their productivity;
- it is desirable to invest in research to find better adapted crops and productions; and
- forage resources should be improved.

As a general recommendation:

- for any initiative, it is recommended that a precise description of the existing local organizations, their capacities, and their limitations be obtained. The survey should highlight primarily the specific mandate and the sphere of activity of each organization or local association. In addition, it should draw on the lessons of the accomplishments and failures of each organization to support the villagers in their efforts to select or create the organization best fitted to their needs and aspirations.

IV. Yaguinébanda, Yelimane Cercle: Pasture Land Management in a Sahelian Agropastoral Community

A. Introduction

For a case study of problems facing pastoralists in the Sahelian zone, the village of Yaguinébanda on the road between Yélimané and Kayes in the arid northern part of the First Region in Mali supplies a favorable context. It is about 19 kilometers to the south of Yélimané, seat of the cercle. The village land extends over a relatively vast area measuring 20 kilometers east to west and 12 kilometers north to south. This land consists partly of hills that are often covered with pastures. Other large, productive pastures lie west, north, and south of the village.

Yaguinébanda's population is close to 1,500 inhabitants, about half of whom live outside of the village. Many villagers have migrated to countries in Europe, Africa, North America, and even to Japan. The vast majority are Soninke (or Sarakolle). Peuhl and Moorish minorities also reside in the village.

Villagers own about 1,100 head of large livestock (mainly cattle) and 3,000 head of small ruminants (sheep and goats). These figures reveal the importance of livestock raising for the Soninke. In fact, a number of farms derive the main part of their income (in cash or in kind) from this activity, and only a few families possess no livestock. The number of animals owned per family varies widely.

A large percentage of the small livestock belong to the women who tend to concentrate their wealth in this type of ownership; the livestock plays the role of a bank deposit that can be easily converted into cash. Village women invest in livestock because they have very little access to land; most women have only a usufructuary right to land because it is inherited through the male line. Thus women are usually excluded from ownership.

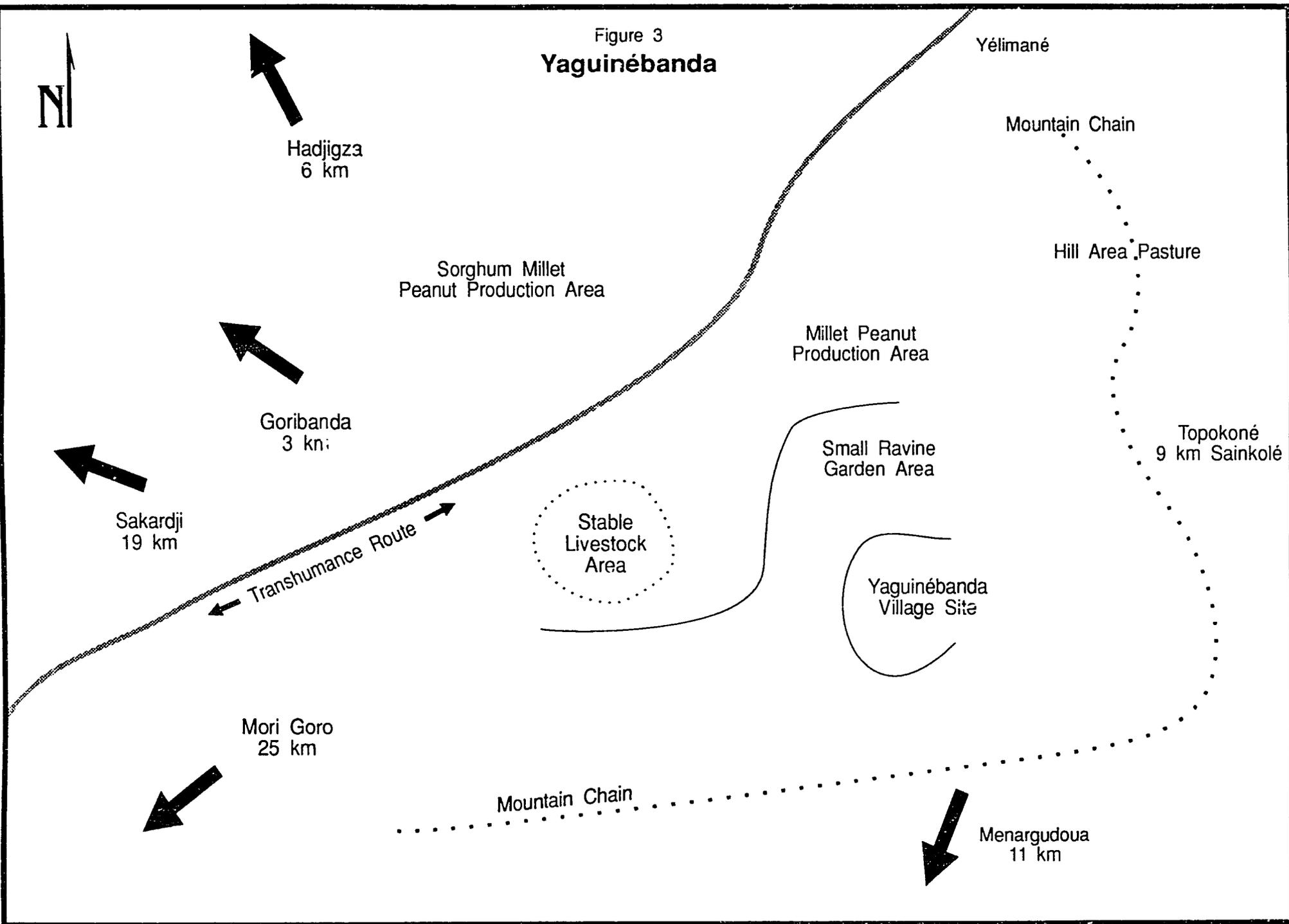
Villagers cultivate sorghum and maize and practice truck gardening in the bottomlands of a few streams that cross the village from east to west from their sources in the hills (see Figure 3). Other crops are cowpeas, peanuts, and okra, which are grown mainly, if not exclusively, by women. Women sell their agricultural products to acquire the money needed to buy livestock. As a rule, women and children do most of the work in the agricultural sector.

This chapter includes seven additional sections: the village's history, its social organization, the production systems, livestock problems, future prospects, conclusion, and recommendations.

B. Village History

Formerly a rainy-season farming hamlet established in the late 19th century, Yaguinébanda broke away from the authority of Yaguiné, the parent village, in 1962, after repeated urging by administration representatives and the USRDA party. After some hesitation, the people of the hamlet finally asked for their autonomy. The consequences of this separation from the parent village continue to influence events, including the constitutional crisis in October 1990 when the village of Yaguiné had to choose a chief.

Figure 3
Yaguinébanda



Yélimané

Mountain Chain

Hadjigza
6 km

Sorghum Millet
Peanut Production Area

Hill Area Pasture

Millet Peanut
Production Area

Goribanda
3 km

Small Ravine
Garden Area

Topokoné
9 km Sainkolé

Sakardji
19 km

Transhumance Route

Stable
Livestock
Area

Yaguinébanda
Village Site

Mori Goro
25 km

Mountain Chain

Menargudoua
11 km

C. Social Organization

The village has 55 farm heads. The size of farming units varies from eight to forty people. The village is divided in two quarters, each with a head who is usually the oldest member of the founding family. The village chief is also the oldest member of the founding family (the 'Tourés). The tasks involved in managing the community are the responsibility of the chief's sons. Aside from collecting taxes and solving disputes that can not be solved at the quarter level, the role of the village chief is to serve as the link between the population and the administration. Seven development and political committees have been established by various technical departments, projects, and the Democratic Union of the Malian People (UDPM):

- the Bush Fire Control Committee;
- the Herders Committee;
- the village brigade for plant protection;
- the commission to link women to the FAO Project; and
- the "democratic organizations," namely,
 - the local UDPM Committee,
 - the local committee of the National Youth Unions of Mali, and
 - the local committee of the National Women's Unions of Mali.

The age group system exists but is not as structured as among the Bambara, in part because of the very strong tradition of migration. Money that village migrants send from foreign countries is so important that it plays a considerable role in the social and economic life of the village and strongly influences the behavior and strategies of the various actors. The same holds true of the other villages in the cercle.

Yaguinébanda has some infrastructure facilities that have been financed entirely by migrants, such as the water supply system installed in 1988 which brings water to eight public fountains in the village. In the same year, money sent by migrants financed equipment upgrades for two tubewells built and equipped with manual pumps by the Project for the Development of Livestock Raising in the Western Sahel (PRODESO) in 1982. The manual pump on one of the tubewells was replaced by a motor pump. To protect the supply system from being interrupted by motor failures, a large diameter well was dug next to the other tubewell and linked to it. This cistern-well system operates on artesian pressure. The total cost of these infrastructure investments is estimated at 23,700,000 FCFA.

Such investments must be assessed within the larger context of politico-economic behavior. The independence exhibited by the Soninke toward representatives of the central power is not a recent phenomenon. It is apparent in the conduct of day-to-day business with the administration, in relations with persons outside the community, and in the choice of long-term investments for the community's future. Engaging lawyers to contest what they consider abuses by the local administration is, for them, an old and common practice. In 1914, for example, an appeal was taken to the General Governor of French West Africa in Dakar by one of the parties to settle a land dispute between the villages of Hongou and Dioncoulanou. Even today, it is not unusual such conflicts to be appealed to the Supreme Court for resolution. Local administrators and technical personnel in Yélimané admit will-

ingly that the Soninke "don't let themselves be pushed around." Authorities try their best to respect the relevant formal rules when settling problems involving residents of the cercle.

Local populations mobilize investment financing for projects they have agreed upon among themselves, often without consulting the administration. In many cases, such an enterprising spirit gives the villagers the capacity to initiate action by identifying urgent problems and dealing with them; they are capable, through self-help, of raising the standard of living of their local communities without using state money. In fact, administrative bodies, from the level of the cercle to that of the region, often approve such initiatives for local self-help and encourage them.

This positive attitude is due, in part, to local populations' proven capacity to manage considerable sums of money. Cases of misappropriation are extremely rare. In spite of some painful failures (mosques, schools, and some other public works often prove too costly and are left unfinished because of a lack of preliminary studies), local populations have developed efficient strategies for a number of service sectors (village water management, for instance). In other sectors, a de facto partnership is achieved among the local populations, the technical personnel, and the administration, often through friction and disagreements that clarify the alternatives and lead to sustainable arrangements.

Such a situation provides a favorable context for achieving decentralization. It offers an efficient, concrete learning process for all parties to practice democratic choices. However, major risks may exist in such a system if necessary measures are not taken swiftly to keep behavior within reasonable bounds. The high-level jurisdictions to which local populations address their claims for redress must, themselves, comply with the rules of equity and justice--the foundations on which durable institutions may be built. In other words, the Supreme Court, to which the local populations of Yelimané Cercle often appeal their disputes, must guard against favoring one party at the expense of the other, and against reversals of decisions on grounds that the concerned parties have difficulty understanding. Because these parties must comply with the decisions of the Court, they expect logic and clarity in its resolutions and a firm, consistent attitude toward previous decisions.

The team believes there is no need for the administration or technical personnel to review these grass-root development activities to ensure conformity with the criteria of a presumably rational development plan. Such a review process would encumber local initiatives given the additional transaction costs (time, resources, and energy spent in obtaining state authorization). It would eventually discourage and reduce local-level efforts at self-management and self-development. On the whole, the team considers the risks of making mistakes, even big mistakes, of less serious consequence for rural populations than the dangers of expecting the state to provide everything.

D. Production Systems

Investments in agricultural production are not very large. Equipment is not sophisticated and there is infrequent use of village donkeys, horses, and oxen for animal traction. A striking fact, when one considers the villagers' wealth, is the rudimentary nature of cultivation practices: direct sowing, frequent reliance the hoe as the principal farming instrument, and frequent recourse to human labor, particularly women and children. Chemical fertilizers, organic manure, insecticides, and selected seeds are not widely used. However, the parcels on which women grow peanuts are treated with insecticides and fungicides. That some of these inputs are not utilized is due, in part, to difficulties in pro-

curing them and to a poor understanding of the techniques required for their application. Attempts to develop truck farming meet with a number of problems, primarily the lack of seeds, the lack of water, and caterpillar invasions. Since 1987, a component for supporting women in their truck-farming endeavors was included in an FAO project to improve the status of women. Women have cultivated a plot of nearly two and one-half acres. Unfortunately, the beneficiaries are discouraged because they have not been able to harvest anything at all in the last three years.

1. Crops

During the years of satisfactory rainfall, the agricultural system relies on the joint practice of dry farming and flood recession agriculture. In general, sorghum is the only grain crop produced by dry farming. Farmers may choose from a range of three to five varieties with short- to long-term maturation. They select from among these varieties according to the start date of the rainy season and the frequency of rainfall. Some farmers also sow maize in the bottomlands during the rainy season to fill the gap between crops.

Most of the weeding is done by family members (mainly women). Threshing is done through a collective operation using all available workers. There is no monetary payment for this type of work because salaried labor is expensive. (A day's work earns 1,500 to 3,000 FCFA.) Compensation is based on reciprocal relations.

In addition to participating in various tasks for the family farm (particularly weeding), women have individual plots where they grow peanuts and other foodcrops (okra, cowpeas, and maize). The produce of these plots can be used any way the women wish.

When flood-recession cultivation is feasible, the farmers of Yaguinébanda sow a short-cycle variety of sorghum and some maize. This type of cropping is possible only during the years when the waters overflow and spread beyond the river bed to flood the bottomlands.

2. Livestock Raising

Livestock raising is expanding dramatically in the village. The growth of this activity results, primarily, from the efforts of PRODESO. The first phase of this project from 1979 to 1986 (including its extension) was financed by the Saudi Fund. Financing for the second phase has not yet been obtained. This has prevented implementation of some planned activities, such as installing pumps on certain tubewells, building infrastructure facilities, and organizing marketing circuits for livestock. In this context, a large portion of money sent by village migrants is used to buy more livestock.

The livestock population in Yelimané Cercle is estimated at between 100,000 and 150,000 head of cattle, 200,000 head of small livestock, and 3,000 donkeys. The census reports a population of 107,335. Thus, on the average, there are 1.4 head of cattle per person and 1.86 head of small livestock per person. In Yaguinébanda proper, the figures are:

- 1,100 large livestock (1.375 per capita), mainly cattle, and
- 3,000 small livestock (3.75 per capita).

Village cattle are of the Zébu Toronké breed. A likely explanation for the relative predominance of small livestock over cattle compared to the cercle average is that Moorish families live in the village. For a long time, the Moors have preferred small livestock, particularly goats, because they provide a

more reliable basis of subsistence, they give more milk during the dry season, and they require less care.

Local herders face a major problem: lack of stock water. In the village, animals are watered twice daily for a total of forty liters per day per cow. Thus, the local herd requires an estimated 61 cubic meters of water per day (7 head of small livestock are equal to one cow; $1,100 \text{ plus } 429 = 1,529$ Tropical Livestock Units [UBT]; $1529 \times 40 \text{ liters/day} = 61,160$; $61,160/1,000 = 61$ cubic meters per day). PRODESO installed two tubewells equipped with hand pumps. Two other wells have been financed by migrants, the first of which was dug in 1972. One individual financed another well. In the dry season, the reduction in the rate of flow is a major source of concern for the herders, whether local or transhumant. Two wells are completely dry as of February or March. To remedy this situation, village migrants repatriated money to finance several attempts to drill wells, all of which failed. Moreover, toward the end of the dry season, even the supply of potable water for the village population is insufficient.

According to informants, pastures on village lands are plentiful and can satisfy not only the needs of the local livestock population, but also those of many transhumant herds. Moreover, the village is a stopping place for the growing number of herders who follow this transhumant trail between the salt pastures of Gana in Mauritania and the dry season pastureland in the Bafoulabé Cercle.

PRODESO has achieved excellent results in helping stock owners improve the health of local herds. It has also provided herders with supplementary feed for their livestock during the critical period at the end of the dry season.

E. Livestock Problems and How the Agropastoralists Deal with Them

Aside from the water problem, no major constraints impede livestock raising. Villagers, first inspired by PRODESO in 1984, have established a Herders Committee. A cooperative was established at the cercle level in December 1982. The primary duty of the cooperative organization (Herders Committee) in Yaguinébanda, as in the other villages of the cercle, is to facilitate all members' access to selected inputs, including livestock vaccines and cattle cake of cottonseed and peanut.

Each year, bush fires threaten the pastures during the dry season. Another committee that PRODESO established in 1986 (which became the responsibility of the Water and Forest Service in 1988) organizes bush-fire control activities. According to reports by officials of the Water and Forest Service in Yelimané, the villagers are advised to build a firebreak along the range of hills in the eastern part of the village territory starting in October. By providing two days of collective work per week in the midst of the harvest season, the villagers succeed in clearing a strip three to nine meters wide along 20 kilometers at the foot of the hills using the primitive tools available (axe and machete). To reduce the work as much as possible, they include existing bare spots, sometimes wider than nine meters, in the fire break.

Such an effort shows that the agropastoral population recognizes its interest in protecting a renewable natural resource that is a key element of their production system.

Every time a bush fire occurs in the hills and threatens to spread to the plain, the villagers fight it en masse. Since 1986, they have succeeded in controlling bush fires in their milieu. Foresters believe the village of Yaguinébanda offers a fine example of fire control. Since 1986, village members have

invested 1,000 person-days of collective unpaid work annually to open firebreaks. To keep individuals from free-loading, members of the committee and the village chief appoint one of the chief's advisors as site supervisor. The supervisor notes any able-bodied workers who are absent during collective work sessions. Age group leaders also tell him when a member of their group is not present. The chief calls the absentees to a meeting at the village mosque and asks why they failed to appear. If they cannot justify missing work, the absentees must pay a fine of 2,500 francs FCFA per day missed. Such cases are extremely rare.

1. Analyzing Livestock-Raising Problems in Yaguinébanda

It is possible to look at livestock raising in Yaguinébanda as a management problem involving two renewable resources: water and grass. After specifying the attributes of these resources as economic goods, this section describes the rules governing their use. Motivations tied to these two aspects of the resources affect the behavior of the participating actors. The actors are:

- the agropastoralists in the village;
- the transhumant herders who spend only a day or two on the village land which they use as a resting place, on a much longer route that takes them to the south during the dry season and to the northern salt pastures during the rainy season; and
- some families of transhumant herders who remain on village land and are integrated into the management systems for renewable resources.

2. The Attributes of Water and Forage as Economic Goods

To properly understand the economic nature of the various forage and water resources, they must be analyzed separately. Four types of resources can be identified, two forage and two water. All are extremely dependent on the amount of annual rainfall. The resources are:

- forage resources
 - grass fodder and
 - tree fodder (leaves and branches of trees and shrubs), and
- water resources
 - surface waters (for example, ponds, waterholes, and streams) and
 - groundwater (tubewells, wells, and cistern-wells).

Among these four types of resources, only groundwater is easily subject to exclusion. Tubewells, wells, and cistern-wells, particularly those close to the village, are easy to monitor. It is difficult, though not impossible, to control access to the three other types of resources in their natural condition because they are spread throughout the village land, whereas residential compounds are concentrated in the same place. Thus, to control use of these resources, there must be some kind of monitoring system.

The consumption of each of these four resources is divisible and competitive. From this analysis, it appears that in its natural state, the groundwater of Yaguinébanda is a common pool resource with a tendency to be a common property resource--more easily subject to exclusion and rivalrous in consumption. Grass fodder, tree fodder, and surface waters present serious management problems be-

cause exclusion is costly and consumption rivalrous. They can easily become open access resources if agropastoral groups do not mobilize their members to maintain them and regulate their use. To conclude, it is easier and less costly to organize sustained management of groundwater than of surface waters and forage resources.

With regard to exploiting these resources, the maximum output rates of the tubewells, wells, and cistern-wells impose hard limits--limits difficult to circumvent without making new investments to improve the pumping systems. Thus, groundwater cannot be easily over-exploited given current pumping techniques.

With regard to the other three resources, the danger of overuse is considerable: the herds that are brought to drink surface waters and to graze on local grasses are able to consume these resources at will without any limit beyond depletion. A soft limit exists for tree fodder because the herder or shepherd must lop branches to make leaves accessible to the herd. Yet several herders and shepherds can find branches to lop on village land without having to stand in line as is the case for groundwater, so there is no even partial natural impediment to access.

3. Use Rules Governing Development, Use, and Protection of Renewable Resources for Stock Raising

This section deals with each of the four resources separately. In each case, the report explains the use rules for development, protection, and maintenance of the resource involved before describing the use rules governing exploitation.

Groundwater

The funding that has helped the village of Yaguinébanda develop access to subsurface waters comes from three sources:

- labor supplied by the villagers for digging wells
- PRODESO (from 1979 to 1986), and
- money sent by village migrants (from 1979 to the present).

Shallow, Hand-Dug Wells

From July to December or January, shallow aquifers recharged by summer rains can be exploited via temporary, hand-dug wells. After that period, the aquifers dry up. While they can be exploited, anybody is at liberty to dig, maintain, and enlarge his or her well. The use rule seems to be one of access controlled by well owners, but, in fact, the relative abundance of surface waters during this period tends to reduce the importance of property matters.

Deep Wells, Tubewells, and Cistern-Wells

The wells, tubewells, and cistern-wells have been created through the efforts of either PRODESO or migrants who send money to their families. Funding may also come from a collective contribution to create a common property resource for the village or an open access resource that non-residents may use. PRODESO has routinely donated these infrastructure facilities to local communities for further development. PRODESO is supposed to maintain the waterworks it creates. In the absence of PRODESO financing (operational support), the Government's Livestock Service is supposed to maintain them. The villagers, actual residents of Yaguinébanda as well as migrants, asked PRODESO to change the pumping system on the tubewells by replacing the hand pumps with diesel pumps, or by installing cistern-wells operating under artesian pressure. These requests were met

with positive responses, conditional on villagers' willingness to pay recurrent expenditures and support the expense of infrastructure maintenance. Yaguinébanda villagers have done so on two occasions.

As when everything was under PRODESO control, the current use rule for the five sources of groundwater in Yaguinébanda is largely a matter of open access. Whoever is willing to stand in line enjoys full liberty to draw water at will. However, a few restrictions apply which specify water users may not employ for washing clothes or dishes, and that users must not water livestock within a 2.5 meter radius around the tubewells, wells, or cistern-wells. Apparently, members of the Bush Fire Control Committee enforce these rules, but no specifications or details are available on how the enforcement takes place or on sanctions for infractions.

Surface Waters

On village land, surface water points capable of supplying a very large number of livestock can be found in three areas: the eastern hills, small waterholes to the south, and a larger pond to the north. No specific action has been taken to replenish these water points, so there is no resource mobilization problem concerning construction of infrastructure to harvest surface waters.

The use rule controlling access to these water points is a recent one. It was issued by the Herders Committee and replaces a former rule authorizing open access. The new rule, an attempt to avoid damage to field crops during the rainy season and to preserve, for as long as possible, the surface waters in the proximity of grass fodder resources, establishes a rotation system for grazing. During the rainy season, the herds are kept in the hills to the east of the village. Once the harvest is over, livestock are brought to the pastures south of the residential center where the surface water points dry up faster. When these sources are no longer usable, the herders are granted permission to use the pond to the north of the village. This pond is generally used as a water point until the end of January or February. When March comes, the herds supported by local pastures must be watered at local wells.

Compliance with this rule is verified by three members of the Herders Committee. They patrol in three different areas of the village land to inform transhumant herders of the rule applicable during any given period. They are also supposed to ensure compliance with regulations by local herders (there are five cowherds and three shepherds for the small stock) and by the large families of transhumant herders who spend most of the dry season on village land.

Partially contradictory observations have been made on how efficient enforcement of this rule is. The president of the Herders Committee, together with some advisers of the village chief, insist that the local herders and the transhumant herders who stay in the local area comply with the rule. They admit that the transhumant herders using the village land as a stopping point and staying only a couple of days may sometimes escape the monitoring system organized by the Bush Fire Control Committee, but they see such an impact on surface waters as rather negligible. The only local herder interviewed insisted, on the other hand, that he could take his cattle herd wherever and whenever he wanted to. Without a more extensive survey, it has been impossible to verify who is right.

Grass Forage

No measures have been taken to improve the quality of grass forage. And until 1986, nothing was done to protect it. But starting that year, and with the establishment of the Bush Fire Control Committee, the Yaguinébanda villagers have deployed the considerable efforts described at the beginning of Section E., investing human labor to protect the lowland pastures by creating firebreaks along the

range of hills spread across the eastern part of the village land. Such investments must be seen as an annual mobilization of resources to ensure an adequate supply of grass forage.

Similarly, the efforts made by the three members of the Bush Fire Control Committee to make anyone present on village land aware of the dangers that uncontrolled fires present for grass resources, and to enforce the rotation system for grazing (based on the sequential use of water points) amount to measures taken by local special district governments (bush fire prevention and control and regulation of use of the available forage). These measures are meant to safeguard and promote efficient use of a renewable natural resource which is a key element of a local production system.

One aspect of this system was not clarified during the discussions held with villagers: are the members of the Bush Fire Control Committee paid for their monitoring efforts? If they are not, they are making sacrifices to maintain a common property resource which, in this particular case, is used almost exclusively by other individuals.

This report has described the use rules for implementing these measures. The grazing rotation system transforms pastures into a common property good because access to them is partially regulated. It is an approach that, according to the agropastoralists of Yaguinébanda, is quite reasonable given the ample supply of pastures in an average year. A more elaborate organization for pasture use would be meaningless because there is no overuse.

The role assumed by the administration--in this case, the Livestock Service, the Water and Forest Service, and PRODESO--in such activities remains limited, to a large extent, but very positive. PRODESO took the initiative to create the two local committees (local special district governments) charged with management of these renewable resources. Since 1988 the Water and Forest Service has supervised efforts to control bush fires. The foresters in Yelimané report that they impose fines for any bush fires within the plain, assuming they can identify the culprit. The only exceptions are fires that leaped the firebreak while the villagers were doing their best to extinguish them. This policy represents a major shift for the Forest Service. Before, it was Service practice to impose collective fines on a community rather than only on an individual who confessed responsibility.

Incidentally, this year foresters have refrained from fining an individual who, while stricken with an epilepsy attack, set fire to several acres of village pasture.

Tree Fodder

The regulation concerning access to and use of tree fodder is premised, at the village level, on the well-defined need to preserve plant cover. Villagers observed that cutting trees causes a loss of pasture in spots which were previously protected by the tree crown, small as it might have been. The technical explanation for this is clear. The trees--frequently *Acacia seyal* and *Acacia senegal*--protect the grass from the winds and from too much exposure to the sun. The improved micro-climate achieved in this manner, promotes the grass's growth.

The Herders Committee, shortly after it was formed, decided that the harvest of live wood on village land had to be forbidden. When a violation is proven, a fine must be imposed, but such cases are infrequent.

4. Interactions Concerning Water and Forage Resources

This section summarizes information the team gathered in the field on strategies adopted by resource users and by officials charged with managing subsurface and surface waters, grass, and tree forage.

These comments reflect observations and interview results but are the result of a rapid institutional appraisal and may, therefore, be inaccurate on some points. Each resource is discussed in turn.

Subsurface Waters

Shallow, Hand-Dug Wells

Villagers continue to exploit these seasonal water resources as much as they have in the past.

Wells, Boreholes, and Cistern-Wells

Residents of Yaguinébanda, supported financially by their absent relatives, persist in their efforts to improve the availability and reliability of local water supplies. They have mobilized impressive sums of money and are also apparently monitoring well use to ensure that users observe rules designed to maintain water quality.

Surface Waters

It is reported that the surface water rotational system is respected by most local users.

Grass Pastures

Pastures appear to be quite well protected as a result of the joint efforts of the Forest Service and the villagers in creating firebreaks annually. Considerable amounts of labor are mobilized in these annual efforts, and unexcused absences are sanctioned by fines. The Bush Fire Control Committee also functions relatively well in terms of informing herders of the importance of avoiding wildfires.

Tree Forage

Apparently, the anti-cutting control system works well. The rule prohibiting cutting live trees, enacted at the local level, may have become a use rule, but this was difficult to determine during a short visit. The representative of the Bush Fire Control Committee insists that there are very few violations of this rule. A local shepherd maintains that the opposite is true. In his opinion, shepherds of small livestock cut trees so their animals can eat the leaves. This should be confirmed through further investigations.

5. Outcomes

The effect of the interactions noted above on the quality and quantity of renewable natural resources in Yaguinébanda are summarized below.

Subsurface Waters

No program to improve recharge of shallow aquifers exists in the village. Nonetheless, these aquifers provide water on a seasonal basis, particularly when the annual rains are adequate.

Shallow Hand-Dug Wells

Villagers continue to produce these wells and to exploit them as long as they can during and at the end of the annual rainy season.

Wells, Boreholes, and Cistern-Wells

The residents of Yaguinébanda have made considerable efforts to develop dry-season water sources. These efforts, financed by a combination of PRODESO grants and migrant donations, have generally increased the amount of water available and, as far as potable water is concerned, have doubtless improved its quality through the installation of the local public distribution system through pipes and fountains.

Surface Waters

Surface waters are now managed in a general sense. This appears to have improved the efficiency of water use for stock raising somewhat by coordinating pasture and surface water use through the rotational grazing system.

Tree Forage

Preserving trees in an arid environment is a difficult matter. However, sustained protection against bush fires contributes to their survival.

F. Future Prospects

Under conditions typical of Yaguinébanda's environment managing pastoral resources (surface and ground waters, grasses and tree browse) is a complex proposition. So long as most transhumant herders use village pastures only during brief stopovers on their seasonal treks north and south, there seems little danger that village herds will overexploit extensive local forage resources. Water supply systems of limited output establish severe constraints on the capacity of Yaguinébanda residents to continue increasing their herds. Currently limited market demand may also discourage herd expansion since most residents seem to approach stockraising as an investment proposition.

G. Conclusions

The Yaguinébanda case study contains material rich with suggestions about possibilities for decentralizing authority to promote more effective management of renewable natural resources, and about the means to encourage local initiative in a variety of sectors. The role of migrants, and the financial resources they place at the disposition of villagers in Yaguinébanda as well as in other communities in Yélimané Cercle, is clearly significant. Villagers can mobilize financial resources through their own networks. They can thus co-finance development activities in their community. Yaguinébanda residents also mobilize considerable amounts of labor, for example, to create firebreaks annually, and to monitor renewable natural resource use on their lands. They co-produce renewable resource management services in their own local jurisdictions.

The undoubted willingness of Yélimané Cercle Soninké populations to contest official decisions, both in the courts and through political channels, sharply modifies the relationship between officials and citizens in this jurisdiction. Officials report that they take great pains to exercise their powers in an appropriate manner in order to avoid unpleasant confrontations with local populations.

From this situation, in which officials' exercise of their powers is subject to checks and balances that citizens can bring to bear, flow several productive, if sometimes rancorous, relationships linking local populations with administrators and technicians. These relationships foster, or at least strongly support, a spirit of local initiative that bit by bit is creating and reinforcing the physical and institutional infrastructure upon which sustainable development depends.

H. Recommendations

1. Action-research: carry out a survey in Yaguinébanda as well as in other villages of the Yélimané Cercle--especially in the Terakolé valley--to find out the specific rules for mobilization of resources in view of investments in the field of water management, for operation and maintenance of such in-

infrastructure facilities and especially for access to and use of these resources. The important points to explore by means of this survey would be: opportunities for developing groundwater resources, and the specific nature of resource management rules to be applied to such facilities so as to ensure access to water sources by the transhumant herders, while covering operating expenses.

2. Action-Research: conduct comparative, in-depth case studies of renewable natural resources management activities in some ten selected sites within Yélimané Cercle, with special attention to local access and use rules, and enforcement mechanisms and conflict resolution mechanisms that local populations use to implement the rules and handle disputes. Target resources should include surface and ground water, trees, pastures and bottomlands, in the context of pastoral production systems. Institutions investigated should include both the local dispute resolution fora and the courts of the national system.

This applied research activity should build on the prior investigations by PRODESO and Livestock Service personnel.

3. Action-Research: investigate the extent to which traditional (pre-colonial) political jurisdictions might offer a useful additional level of organization for dealing with specific development problems, for example, investment in infrastructure facilities, land use management, and conflict resolution. This investigation should incorporate a geographic information systems (GIS) methodology that would allow graphic comparisons between former and contemporary resource management jurisdictions, practices, methods of mobilizing resources and supervising their investment, conflict resolution, etc.

4. Action-Research: undertake a rapid rural appraisal of the sorghum/millet cropping system in Yaguinebanda and the surrounding villages of Yélimané Cercle. Rapid assessment should pay particular attention to farmer capacity to multiply and distribute short cycle varieties of sorghum and millet. In the particular case of Yaguinebanda the potential for a systematic introduction of animal traction plus improved rotations of legumes, cereals, and forage crops should be initiated without delay.

5. Since the women have given proof of their commitment to pursue cultivation efforts on the parcel given them for truck gardening, the FAO project should use all possible means to help them overcome the hurdles impeding completion of this enterprise, especially by facilitating the procurement of seeds and phyto-sanitary products.

6. A livestock marketing study for Yélimané Cercle should be initiated with particular attention to:

- infrastructure improvements needed to upgrade access to southern cattle markets;
- relationship, if any, between de-stocking and improved herd management; and
- economic advantages of better access to national and regional livestock markets.

V. OAPF: Present Status and Future Options

A. Introduction

This case study analyzes the possibilities of pursuing development of a system of co-management for the Monts Manding Forest outside of Bamako. The classified forest was created 40 years ago. Nearly twenty years ago, international assistance agencies began financing an ambitious project to replant Forest land with fast-growing species. The Forestry Development and Production Project (Opération d'Aménagement et de Production Forestières--OAPF) is considered a technical success, but two major issues have emerged concerning OAPF's future: (1) how to reduce costs of the operation and (2) how to increase the involvement of local populations in managing the forest as a multiple-use resource. This introduction presents an overview of the forest's development and co-production possibilities and briefly characterizes the three study sites.

1. Overview of the Monts Manding Classified Forest and of OAPF

The possibilities of co-production of the Monts Manding Forest must be seen within an historical context that has evolved considerably since the initial creation of the national forest. This historical evolution structures the way neighboring populations think about forest development possibilities.

History of the Creation of the Classified Forest

The Monts Manding classified forest was created in the year 1948. Later the classified forest was enlarged substantially.

Creation of OAPF, Goals, and Activities

The OAPF was begun in 1972 with initial funding in the form of a grant from the Cooperation Assistance Fund (FAC). In 1980 and in 1985, OAPF received loans and grants from the World Bank, the Central Fund for Economic Cooperation, and FAC.

2. Geographical Context of the Villages

The three villages where the team's survey was conducted are located approximately 30 kilometers southwest of Bamako on the right bank of the Niger River (see Figure 4).

One of these villages, Soribougou, is not far from the river. Soribougou villagers have routinely cultivated rice.

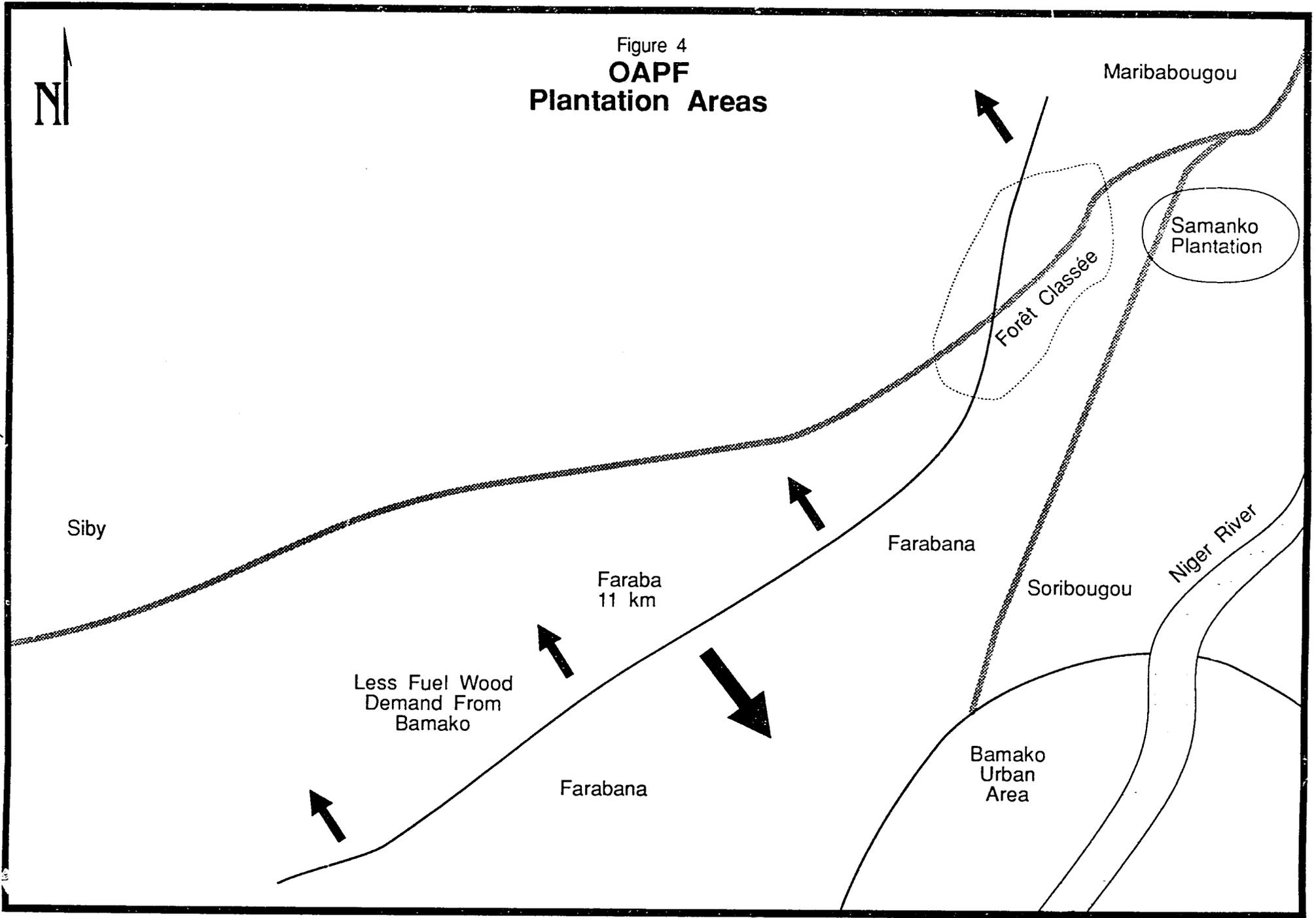
Soribougou

Soribougou is a hamlet of about 120 inhabitants divided into about a dozen families and is administratively tied to the village of Sembalé. The founding group was Malinké, but now the majority of inhabitants are Dogon. The Dogon arrived 12 years ago. The primary activity is farming, and the main crops are grains (rice, sorghum, and maize).

Mamaribougou

Mamaribougou is an autonomous village, somewhat larger than the hamlet of Soribougou. The greater part of the population is Malinké. Just as in Soribougou, agriculture is the main activity, though land availability is more limited.

Figure 4
**OAPF
Plantation Areas**



N

Siby

Faraba
11 km

Farabana

Soribougou

Niger River

Bamako
Urban
Area

Less Fuel Wood
Demand From
Bamako

Maribabougou

Samanko
Plantation

Forêt Classée

Farabana

Farabana

The Farabana population is estimated at 120 inhabitants, most of whom are Malinké; the second largest group is Bambara. Bambara is the language spoken by all residents. Agriculture is the dominant activity; in this hamlet more than anywhere else, the shortage of land creates serious difficulties.

3. Content of the Case Study Concerning OAPF

This study contains eight additional sections. The first section describes the three study villages beginning with Mamaribougou. Only those characteristics of Soribougou and Farabana that distinguish them from Mamaribougou are described. The five succeeding sections identify:

- the actors involved in using the forest and potentially in co-managing the resource,
- the characteristics of the various types of goods and services which the Monts Manding Forest does or could produce,
- the formal and working rules governing access to and use of forest goods and services,
- the interactions that result when actors choose strategies in light of the working rules and the characteristics of the forest goods and services that interest them, and
- the outcomes of those interactions.

The study ends with conclusions and a series of recommendations.

B. Specific Characteristics of Three Villages: Mamaribougou, Soribougou, and Farabana

1. Mamaribougou

Four features distinguish Mamaribougou from the other two villages:

- exploitation of the forest is done by men as well as by women,
- the existence in the village of a would-be businessman looking for opportunities to increase his personal enterprises as a logger and wood merchant;
- cultivation of the hillsides due to the scarcity of available lands, and
- the difficulties encountered by women in the acquisition of a collective field for the women's association.

Outline of the Production Systems

The pressure on the availability of land for traditional cropping patterns has put the accent on maize production instead of sorghum. The creation of a controlled forestry zone and the OAPF plantation have displaced traditional cropping areas to areas farther removed from the village, namely, the nearby hill area. This has increased production costs. The OAPF is trying to demonstrate the increased stability of income that accrues from the management of a perennial crop, in this case plantation wood lots, and incorporation of this activity in the existing annual subsistence cropping system. The inclusion of a perennial crop in a rainfed cropping system may allow farmers to escape some of the instability in annual crop output caused by yearly fluctuations in rainfall. Villagers interviewed say current efforts to include them in the management and revenues of the OAPF forest have not

convinced them that income from these activities will replace their need for increased agricultural production.

Farming and forestry compete for available labor, particularly the male work force. Villagers are still uncertain about which activity to favor. For the moment, there is nothing surprising about their hesitation, given that villagers have been involved in forest exploitation for barely 14 months.

Village Organization and Use Rules

The villagers demonstrate a remarkable capacity for association. There seem to be multiple opportunities for creating small specialized groups or structures to address various problems. On the distaff side, there is an association to which all the married women of the village belong. For men, besides the *ton*, there are other structures of fellowship and association wherein four to eight friends combine forces for specific goals (for example, field work during the rainy season, gardening in the off-season, and occasionally wood cutting).

Age Groups and Tons

There are no age groups in the village. The male and female *tons* are extremely active, especially concerning field work. Work of this type is usually organized on a mutual assistance basis but commands substantial compensation. Thus, a day's work for weeding may bring 15,000 FCFA to the women's association. The money is collected to form a fund serving the following purposes: hospitality for strangers and loans to members in difficult financial straits (this fund contributes to the family budget in an indirect way, inasmuch as the loans granted to the members of the association enable them to take care of some family expenses). For men, a half day of hoeing by 50 people commands a fee of 3,500 FCFA. The men's association may, in this way, establish a fund of 50,000 FCFA in a good year.

The chief of the youth *ton*, the *ton tigui*, has occupied this position for 16 years. He is in charge of organizing work done by the association. He writes the names of missing members in a register and imposes a fine of 500 FCFA on those absent without excuse. Women who don't participate in a day's work must serve a meal to all the members of the *ton*. At present, the cooperative spirit among women is still emerging, because most of the women are highly individualistic. The *ton* may not be the most appropriate framework for an activity, whether in forestry or another field.

Groups of Friends

Friendship groups are formed even among very young people. Some individuals join one when they are only nine or ten. These small associations, involving four to eight people, may earn as much as 1,250 FCFA for a day's work (from eight to 15 hours).

Relationship between the Villagers and the Forest

The relationship between the Mamaribougou villagers and the Monts Manding classified forest has undergone a marked evolution during the past year. In 1948, the forest lands were expropriated in accord with Forest Code procedures and were, therefore, out of bounds for agricultural activity. Because the OAPF has recently involved villagers in co-management activities, the forest again has become a resource open to exploitation at many levels including wood cutting, cropping lands, forage, pasture, and beekeeping. The forest may even generate valuable income.

Land Availability

Since the state expropriated village forest lands, Mamaribougou's fields are now located on the hillsides. They suffer the effects of serious erosion on the slopes--a critical situation. Family heads pressure the village chief to get them more land, and contest his authority because the latter is old and

does not have a male heir capable of exercising a strong hand in a power struggle. The village chief incessantly renews his requests to OAPF to obtain more arable land but does not have the energy to follow up on the requests. It seems that the farm heads of Mamaribougou support the present type of forest exploitation (wood cutting) less strongly than do the farm heads in the two other villages. If this is true, it could be explained by the urgent demand for more land existing in this community, a pressure bearing at least on the good lands. It is also possible that the situation explains the resistance of many villagers to involvement in collective action regarding forest work. The emergence of a private entrepreneur, determined to invest in this type of activity, is, therefore, not surprising. Obviously, villagers' unwillingness might be due to other reasons. In any case, it is important that the OAPF consider such possibilities with great attention.

Tree Management Outside the Forest

Interviews with villagers imply that the forest product harvesting techniques taught by OAPF have been well assimilated by a majority. However, it is rare to see those same techniques applied in areas outside the forest. Is this because the techniques are too difficult? Might farmers think the techniques will not work in areas outside the forest because of the tree species, soil type, or other factors?

Traditional Firewood Supplies

Before the tree plantations of the Monts Manding Forest were open to exploitation, wood used as firewood came only from the following species: *tabango*, *tchadjgéré*, *balimba* (*Crossopteryx febrifuga*), *gérengéli* (*Prosopis africana?*), *geno* (*Isobertinia doka*), and *soo* (*Pterocarpus erinaceus?*). The number of fuelwood-collection trips varies between one and three times a week. Wood gathering required an average of eight hours, and gatherers had to cover distances of from three to five kilometers. The frequency of this activity is related to the type of household (monogamous or polygamous) and to the size of the family. Fuel gathering is done less often by a woman who has a co-wife than by a single wife. The amount of wood consumed daily for cooking depends on the number of people to be fed in the household.

Village Activities for Forest Exploitation

Before the Monts Manding Forest was opened to participatory exploitation and co-management, villagers played a subordinate role, as hired laborers, in managing the resource. After co-management activities began, many more villagers, mainly women, became involved in exploitation and management.

Salaried Work

Some men in the village are employees of OAPF and work in the Monts Manding classified forest. They receive a daily salary of 525 FCFA for this type of work. They are also granted the privilege of cultivating firebreak lands inside the forest.

Women's Group Activities

Unlike men, women take part in wood cutting¹ during April and May. The desire of the women to limit their work to these two months reflects two constraints they face: field work and the length of

¹ There is nearly total participation of able-bodied women from the three villages. The only exception are some women of the Wahabite sect of Soribougou who do not participate because their religion limits their movement. They represent a small minority.

time needed for wood to dry during the rainy season. The women derive great satisfaction from the new co-management system which allows them to exploit the forest. They appreciate:

- the considerable time saved obtaining firewood compared to the situation before the project. Indeed, since access to the plantations has been opened, the amount of wood women bring to the village can last for months (for some of them until November, but after that month they return to traditional gathering). Thus during the rainy season the load of household activities is considerably reduced. It must be emphasized that the greatest part of this wood is for consumption. Very few women market the wood, and if they do, the sale takes place in the village and brings in amounts of money varying between 150 and 2,000 FCFA; and
- the fact that they are at liberty to cut wood without fear of being punished by Forest Service officials.

Women deplore:

- the quality of the plantation wood, which burns very fast, supplying only a small amount of charcoal;
- theft of wood stored in the forest, a frequent occurrence except in Farabana which is close to the forest. The wood is stored because it is not possible to take it home after each day's cut. Moreover, women report the wood is all the heavier when they have to head load it without letting it dry; and
- the lack of transportation which, in itself, is the cause of this type of theft because the wood is left in the forest long enough for thieves to operate undisturbed and remove the wood undetected.

Carts can be hired to move wood from the forest to the village. However, the limited budgets of most of the village women do not permit them to put aside even the required 150 FCFA per cutload.

Some of the women's husbands own carts. However, women rarely have access to them because (a) their husbands may also be involved in wood cutting and use their carts to transport their own wood, and (b) husbands prefer to rent their carts to other people in the village who will pay them on the spot.

If lack of transportation is the major factor limiting women's participation in forestry activities, it is understandable that they talk of the increased gains that should follow their integration into the wood marketing circuit as "potential benefits."

Activities of the Men's Group

The five activities that men pursue in the OAPF framework include:

- wood cutting;
- maintaining trees (thinning, pruning, and coppice selection, for example);
- transporting to the edge of the forest those portions of the cut trees belonging to OAPF so that they may be disposed of according to its instructions;

- maintaining fences and, in particular, cleaning around the poles supporting the wire mesh; and
- collecting seeds for planting.

The men of Mamaribougou are organized loosely, if at all, for woodcutting, transporting, and marketing. Most of these activities are undertaken by individuals working alone. Wood is cut in the forest by groups of men working under the supervision of OAPF foresters. But these groups do not function as logging teams. Instead, each man is assigned a row of trees which he cuts by himself. When he completes one row, he is assigned another, and so on, until the trimming, thinning, or logging operation is finished in that section. Each individual is responsible for removing his share of the harvested wood from the forest. Generally, the wood is taken to the village where it is stacked to dry prior to home use or sale. Those who sell wood generally split the cut logs before marketing them in Bamako. At this point, transporting cut wood to market is up to the individual. Those who have carts use them and rent them to those who have none.

2. Soribougou

Four features distinguish Soribougou from the other two villages:

- a dike being built for rice production to ensure a more reliable food supply for the village;
- village lands traditionally assigned to crops are not located in the forest or even on its borders, greatly reducing competition between agriculture and forestry activities;
- there is a large Dogon community which came from Koro and currently outnumbers the village founders, a situation which might generate conflicts; and
- some women will not participate in the activities of the village women's associations for religious reasons; this refusal to participate deprives them of certain sources of income.

Outline of Production Systems

Soribougou's systems have some characteristics that diverge from those of Mamaribougou, described above:

- a greater role is assigned to rice production; this crop has become more important than maize and millet considering the large mobilization of labor to work on the dike; and
- the influence exerted by the Dogon population, particularly with regard to changes in cultivation practices; there was not enough time for the team to look into this matter, but a new variety of sorghum native to the Dogon's home region has been introduced locally.

Land Tenure Aspects

The village did not traditionally farm lands in the forest area. Consequently, the ongoing extension of the forest exploitation project had no impact on the availability of land for agriculture. The village's capacity to continue receiving farmers from elsewhere and granting them lands to farm confirms this. Indeed, twelve years ago, in one year, the village received about twenty Dogon families who had emigrated from their place of origin (the Mopti region) in search of better land. After two or three years, about ten of these families went to Marakakoungo (Segou region) where the land appeared more productive. New arrivals have followed, the latest in 1987.

This relative availability of land is a contributing factor in the preservation of traditional forms of land management. Here, a newly arrived individual who wants land addresses a request to the village chief (to whom he brings 10 kola nuts as a sign of respect). "The land belongs to God. Thus nobody is the owner, but there are rights of first occupancy," says the village chief. The newcomer is faced with two prohibitions: the land must not be sold and he must not plant trees (fruit trees) except in the area of parcels adjacent to dwellings (*soforu*). When leaving the village, an individual cannot sell his house, and, moreover, he cannot sell the fruit trees planted in the courtyard or near the dwellings.

3. Farabana

Farabana's only distinguishing characteristic is the greater pressure on land resulting from state expropriation of most of the village's arable areas, located in what is now the classified forest. Flooding of some parcels also increases pressure on the land. The consequences are:

- overcultivation of most parcels, which do not benefit from fallow periods or sufficient inputs;
- on the social level, the weakened state of the youth association whose members no longer have the use of a collective field, formerly their main source of income; and
- the village's lack of growth because it cannot accommodate new families.

C. Actors Involved in Plantation Co-Management Activities

In order to fully understand the possibilities for co-management of the Monts Manding Forest, it is important to identify all the actors who now use forest products and who play or may eventually play a role in forest management. The list includes six types of actors:

- the villagers of both sexes from neighboring communities who are already participating as co-managers of the forest;
- the villagers of both sexes not integrated in the co-management system who are using the forest as free riders;
- the members of the transportation cooperative responsible for moving the cut wood from the forest to the OAPF factory;
- the foresters and technical specialists of OAPF;
- OAPF officers, operating on technical as well as financial and economic levels; and
- the lenders funding OAPF.

Motivations for the behavior of these various actors must be understood on three levels: first, at the level of the "economic" characteristics of the various goods that are incorporated in the plantations (or in the whole classified forest); second, at the level of the use or property rights attached to these goods--a very strong source of motivation (as underlined in an October 1990 OAPF technical report on the system, these rights (a) are evolving and (b) offer OAPF management a powerful means to enhance local people's participation in the management, maintenance, and preservation of the forest, including the plantations); and third, other possible sources of motivation for the actors, whether social, economic, or religious, must be identified and integrated in the analysis.

D. Characteristics of Plantation and Forest Goods

The characteristics of plantation and forest goods are a major part of the study because of their impact on the motivations of the various actors. Currently, the following goods may be identified:

- the plantations; these goods under a common property system are managed by OAPF; consumption of products derived from the plantations (the "use units")--industrial timber, construction wood, and other utility wood, firewood, and forage--is both separable and competitive; access to the plantations is subject to imperfect exclusion;
- beehives produce honey which may be viewed as a private good; access to this good is subject to exclusion, and consumption of the product is separable and competitive;
- the sacred sites located inside the plantations (in the forest); sites are public goods for all members of communities traditionally interested in the religious aspects of those sites; access cannot be controlled easily; consumption of the "use unit"--the spiritual well being of the community members--is joint and non-competitive;
- the tourist aspects; these goods may be considered, for potential tourists, as toll goods (goods that are subject to exclusion; their consumption is joint and non-competitive); and
- arable lands may be considered private goods, access to which is subject to exclusion; products produced on those lands are subject to separable and competitive consumption.

E. Formal Rules and Use Rules

It appears, in the context of this study, that additional motivations for various actors' behavior results from the rules giving some persons rights against others concerning access to and use of the use units of the plantations, as well as liberty of access and exploitation of these same use units. These benefits are linked to duties to abstain from exploiting the use units in some cases. The problem is determining precisely what the use rules are, how they evolved over time in light of OAPF policies, and how the plantations and their preservation, management, and exploitation were understood by the various actors. The formal rules OAPF applies to the plantations and to the Monts Manding Forest must be identified first. Then the use rules applying to the forest as they are understood by the various actors engaged in those activities must be identified.

1. Formal Rules

The current formal base rule governing access to the forest and its plantations is authorization by OAPF. From the creation of the state forest to the beginning of the co-management period, only foresters and forest service employees, working in accord with a service or OAPF management plan, were allowed to harvest wood in the forest. Others were strictly forbidden to cut wood there. When the first efforts at co-management began, people included in the program were authorized to cut wood in accord with specifications established by OAPF personnel. Rules governing allocation of the harvested products vary in light of the operation (thinning, trimming, promotion of coppicing, etc.), but in all cases, residents of neighboring villages who participate on a non-wage basis are to be paid in kind with a portion of the wood they cut. Those who don't participate in co-management activities, with the exception of villagers who work for the OAPF for a daily wage, are still prohibited from harvesting wood in the Monts Manding Forest. Members of village groups formally organized

to participate in forest management are authorized, like any Malian, to monitor activity in the forest and to report to foresters for punishment those who violate forest management regulations.

Selected individuals are authorized to place beehives in the forest and to harvest honey.

Currently, only OAPF and Forest Service employees are authorized to farm specific areas of the firebreaks established inside the forest. They are encouraged to do so as a way of controlling natural regeneration and keeping the firebreaks clear.

Access to the sacred sites within the forest is unregulated. Those who wish to use the sites for religious ceremonies are at liberty to do so.

Tourism within the forest is not encouraged. However, it is not forbidden as long as tourists do not violate management rules.

2. Working Rules

Information gathered by team members suggests that the formal regulations of co-management are generally accepted as the working rules governing exploitation of wood in the forest. Women members of co-management groups, in particular, appear to accept the new formal rules willingly.

F. Interactions

After creation of the Monts Manding Forest and before the co-management program was initiated, many individuals apparently harvested wood and forage in the forest without authorization. The forest was a common pool resource. Because it was difficult though not impossible to control access, and because consumption of harvested forest products was separable, users had an incentive to take what they could while they could as long as the threat of detection and punishment was not great. Users entered surreptitiously, cut what they wanted or needed, and left if they could without being detected. Residents of surrounding villages undoubtedly participated in this illegal activity if they could not find adequate wood or fodder elsewhere. Only if they were caught by foresters or OAPF employees did they risk fines. Fellow illegal users were unlikely to denounce them to authorities.

Since the introduction of co-management activities, co-management group members seem to abide closely by the working rules governing wood harvesting in the forest. However, some people still make unauthorized use of the forest. A number of individuals ride from Bamako on bicycles to harvest green leafy forage during the dry season. They cut and transport large amounts of forage to Bamako where they sell it on the open market for use as fodder by urban livestock.

Members of co-management groups do not generally attempt to prevent unauthorized users from exploiting forest products. They do not believe they have any definite and enduring use rights to exploit forest resources. They remain to be convinced that they can establish defensible claims concerning use rights to the forest which their grandfathers lost to the state. Moreover, since many co-management group members formerly exploited the Monts Manding Classified Forest illegally, given then prevailing formal rules, they may be hesitant to report those who violate current rules.

Religious ceremonies pose no threat to forest management activities, so OAPF makes no attempt to control them. Tourism is undeveloped, so little regulatory activity is apparent in this sector.

Farming in the forest is still restricted to OAPF employees. It is too risky to try to farm surreptitiously within the plantations or elsewhere in the forest.

G. Outcomes

After the state forest was created and during the period of monopoly exploitation by OAPF, the Malian Forest Service managed the resource adequately, though at what is now considered an unacceptably high cost.

The co-management system is so new that no judgment can be made as yet about its effect on the resource. Certainly, the idea of co-management contains a number of interesting possibilities, but these must be explored, tested, and evaluated before the outcome of this initiative can be assessed in terms of efficiency, equity, and participation criteria.

H. Conclusions

OAPF efforts to encourage and then institutionalize participation by neighboring populations in management of the Monts Manding Forest are in principle very promising. Realities currently fall short of the ideal. However, if the organization commits itself firmly to these efforts and shows sufficient persistence over a ten-year period in pursuing the goal of sustained-yield co-management of the Monts Manding Forest (as well as others under its jurisdiction), the potential for a productive and profitable arrangement between OAPF and local people, that also benefits Bamako city dwellers, is appreciable.

The keys to success in this effort are (a) OAPF willingness to share power; and (b) OAPF recognition of the fundamental importance of working with existing local institutions; and (c) OAPF flexibility in allowing co-management institutions for marketing as well as for harvesting, exploitation and governance of the forest to evolve over time in light of popular constraints as well as those affecting OAPF. This will most probably mean accepting a role for individual as well as collective entrepreneurship.

I. Recommendations

1. Reinforcement of Women's Organizations

Several recommendations concern the potential roles women might play in co-managing the forest. The first of these involves a base-line study of socio-economic conditions; the second, support for women's efforts to organize; and the third, a technical recommendation about tree species to be employed in any future in-forest plantings.

Socio-Economic Base-Line Study

The efficiency of OAPF action is premised, among other factors, on a thorough knowledge of the communities bordering the forest--their history and religious beliefs. Therefore, it is necessary to initiate a socio-economic study of the project area.

Female Extension Worker

Women are already organized within traditional associations. However, the efforts they have made, up to now, occur exclusively in the framework of agricultural work. In the other areas, and particularly in forestry activities, they do not yet feel the need to engage in collective action. Thus, they

face a number of constraints, the greatest of which is the lack of means of transportation to move wood from the forest to the village. They have yet to solve the problem of such constraints. Because individual strategies are not practical, women must organize to find collective answers to their concerns. To expedite the process, it is necessary to foster action through an external initiative such as the intervention of a female extension worker. It will be necessary to include a training course for this agent to prepare her in the techniques of group dynamics, participative approaches, and functional literacy.

Preferred Tree Species

Women in the three villages of the OAPF project zone have criticized gmelina wood for the following reasons:

- it burns up very rapidly, and
- it produces relatively little charcoal.

It would be appropriate to take into consideration women's preferences, their needs, and their specific knowledge, and to inventory the tree species that are traditionally utilized. Any future program for planting trees should draw on the findings of this inventory.

2. The Challenge of Land Tenure and OAPF Action

It is obvious that land pressure is a factor felt strongly by the villages of Mamaribougou and Farabana. OAPF should consider starting talks with populations residing in the neighborhood of the Monts Manding Forest on the matter of access to arable land in the forest. There are two possibilities which may be considered: further development of farming on forest land by authorizing villagers wider access to firebreak cultivation, and using some cleared areas in the forest and some land that may be more suited to cultivation for agriculture.

However, such an option involves certain dangers, notably, the possibility that people not included in such benefits would resist or even oppose efforts to develop the co-management system in the forest. Therefore, before entering into any serious discussion on this issue, communities that lost land during the creation and extension of the forest should be identified, and an investigation should determine to what extent their requests for land might be satisfied.

3. Securing Stable Use Rights for People Participating in Exploitation

Two issues must be dealt with: (a) increasing access as much as possible to arable forest lands for farming, and (b) institutionalization of use rights for local people involved in co-managing the Monts Manding Forest. Without progress on these issues, local communities will probably lack the incentives to encourage the type of long-term, continuing investment in co-management necessary to ensure its success.

Access to Arable Forest Lands

Team interviews conducted with residents of the three communities reveal the latter have not interpreted their inclusion in the forest harvesting operations as constituting the basis for incipient use rights of which they may (perhaps soon) avail themselves against OAPF or other people who are now using the forest without authorization. They view themselves as laborers taking advantage of an occasional opportunity rather than viewing their inclusion as a development which could eventually bring them security by guaranteeing them access to benefits the forest generates.

OAPF should hire a cropping systems agronomist to test a range of subsistence and high value cash crops that would be compatible with management of both plantation and natural forests. The primary areas of investigation should concentrate on differing forms of relay cropping, inter-cropping, and over- and under-story cropping.

Highlighting Benefits for Villagers of Forest Co-Management

During years of low rainfall, OAPF might increase the number of days when the local people work in the forest, attempting in this way to convince them over time that forest work is a more reliable source of income.

OAPF should organize more exchanges between OAPF agents and agriculturists to determine the proper periods for working in either activity (agriculture and forest exploitation) and to arrange a better system for distributing work assignments among the male and female villagers.

OAPF must engage in major information and training tasks to address the needs of the riparian populations. These activities should emphasize the benefits and uses of this type of woodstock management.

Legal Specialist to Act as an Arbitrator between the Two Parties

To help convince neighboring populations that OAPF is serious about definitively granting them certain use rights (contingent on their proper use of those rights), the project should consider appointing an individual to serve as an impartial third party to help develop institutions for achieving a system of forest co-management. This person could also arbitrate disputes between project personnel and any of the co-management groups on an ad hoc basis. This individual might be a member of a local consulting or legal firm. Essential qualifications are that the person have a clear sense of how to structure institutions to achieve desired goals, and that he or she have experience promoting dispute resolution. The arrangement should be made with a firm rather than with an individual to provide for continuity if the original person cannot carry on with the work as necessary.

4. Market Survey for the Forest By-Products

The market survey should identify activities to be conducted by OAPF on force account, activities to be shared with the villagers, and activities to be left to the populations to manage themselves. It should also permit an accurate estimate of the anticipated earnings after firewood is processed and sold in Bamako. In addition, it should highlight which processing techniques local people find least costly and easiest to master.

From this study, it should be possible to assess the processing costs and the costs of packaging and transportation, by different actors interested in marketing wood and its by-products. It would then be possible to specify which activities neighboring populations would find in their interest to pursue and which activities would be better managed by others (for example, transportation cooperative, wood wholesalers, and private carriers). These issues must be addressed for each wood category: wood fuel (firewood and charcoal), construction wood (building poles, poles, stakes), and timber (gmelina logs). Moreover, the survey should study how consumer demand for the Monts Manding plantation wood has evolved.

If it proves necessary to entrust marketing at the Bamako level to private traders (individuals or cooperatives), marketing wood removed from the forest should be organized by the neighboring population. For such a system to succeed, the best institutional arrangements for the management of this

market must be identified in a thorough study carried out in collaboration with the concerned populations.

5. Extensive Research on Other Possibilities for Exploitation of the Forest

Several existing activities could become the basis for productive forest-based, co-management enterprises. These include exploitation of pasture grasses and browse available in the forest, either through hand harvesting or regular grazing.

Livestock Raising

Given substantial demand for urban livestock fodder in Bamako, as well as exploitation of forest fodder resources by local and transhumant herds, the potential for revenue generation and for more effective management of the Monts Manding Forest pasture facilities is substantial. An effort of this sort would require that OAPF and user populations invest in creating appropriate management institutions.

Beekeeping

Local populations have been allowed to install hives in the forest for many years. The recent introduction of an improved hive from which honey can be harvested without firing the hive (and, thereby, endangering surrounding forest lands) opens new opportunities for apiculture in the forest. Multiplication and dissemination of improved hives and other technical innovations might increase the production potential. While few villagers can expect to make their living from beekeeping, the activity may produce supplementary income for a number of people and may improve local diets.

Tourism

The tourist potential of the Monts Manding Forest is largely unexplored but may be considerable in light of its proximity to Bamako. Several sites of both religious and tourist significance could be developed as points of interest on short half-day or day tours organized for visitors to Bamako.

6. Introducing the New Systems to OAPF Personnel

Given the massive reorientation of behavior envisaged in the course of moving the Monts Manding Forest from a single-use, monopoly wood production operation to a multiple-use, co-managed resource, Forest Service and OAPF employees will require in-service training on a regular, programmed basis. Developing an effective capacity to work with co-managing villagers and to build on their strengths and their institutions will require that OAPF personnel be given opportunities and encouragement to learn about those strengths and institutions. This will be a time-consuming and often frustrating process, particularly if the inevitable disputes that will arise from conflicting interests concerning the forest are to be converted into sources of useful information for better institutional design, rather than suppressed as illegal behavior on the part of various categories of co-managers and OAPF employees.

7. Training Prospective Participants

Potential co-managers will also require training, particularly in the value of their institutions and in the options for adapting them as tools for better forest management. A series of issues will arise, including: selection and control of leaders, relationships with OAPF and other user groups and communities, incremental development of appropriate working rules and arrangements for different activities under a multi-purpose forest resources management program, monitoring and enforcement of those rules, allocations of costs, mobilization of resources, and dissemination of technical informa-

tion. These points should be integrated into a flexible, long-term training operation that draws as much as possible on co-managers as teachers and insitutional designers.

VI. Cotton, Community Organization, and Renewable Resource Management

A. Introduction

1. Geographic Setting

The village of Sanankoro Togola is located 60 kilometers west of Sikasso and 16 kilometers north of the paved road from Sikasso to Bougouni. The community of about 250 inhabitants is situated in a pre-guinean climate zone.

Environmental Conditions

The amount of rainfall varies from 700 to 1,200 millimeters per year. The rainy season begins in May and lasts for six months, with some dry spells. The village lies on hilly terrain. Some hills are cultivated only on their lower slopes. The only stream runs in a half-circle on the northern border of the village, but it dries up as soon as the rainy season ends--a recent phenomenon which has created problems for watering the village herds. The cultivated areas, usually found in the bottom lands and on hillsides, are primarily shallow alluvial soils. Though tillable lands are in limited supply, there are vast pastures on the upper slopes of the hills. About four kilometers to the east of the village is a piece of natural forest that serves as the main source of energy and timber for the village.

Production Systems

Two constraints limit the potential of the present system of production:

- the scarcity of arable land, which explains why present production is located on the hillsides of a micro-catchment area; and
- the lack of agricultural laborers.

These constraints have forced farmers to seek improved cultural practices and opt for an incremental intensification of cropping systems.

The outstanding characteristics of the village's production system are: (a) the predominance of cash crops (cotton [*Gossypium*], maize, and groundnuts) and their rotation with subsistence crops (maize and sorghum, produced in significant amounts) and (b) soil conservation measures. These soil conservation measures are well integrated in the production systems--incorporation of organic fertilizer to improve the efficiency of chemical fertilizer and use of crop residues for protection against water and wind erosion. Use of animal traction equipment is intensive. Only one family in the village does not have a pair of oxen and tillage equipment.

2. Village History

The village was probably founded toward the end of the nineteenth century. The exact date is not clear. A group of Bambara, apparently from the northwest, were involved in the village's founding. According to villagers, the current chief is the thirteenth to head the village. The first occupants settled on lands borrowed from the founders of Ningoni, a neighboring village seven kilometers to the northeast. In 1957, the community gained its administrative autonomy from Djénehi, a village to which the colonial system had linked them. Soon thereafter, the Compagnie Française des Textiles

(CFDT) contacted the village for the first time. This date marks the point when cotton growing began to assume the importance it has now.

3. Village Land Use

In Sanankoro Togola, the villagers probably adopted certain use rules concerning resources found on village lands. However, the first major efforts directed at managing resources jointly were initiated in 1986 when soil erosion became so serious that everyone considered abandoning the village. Attempts by the villagers to control water erosion were ineffective. When all else failed, the villagers approached the Compagnie Malienne des Textiles (CMDT) asking if CMDT could help them stop the degradation of their environment. In response, the Erosion Control Project (or *Projet de Lutte Anti-Erosive [PLAE]*) established a program in the village. The steps initiated to carry out this activity are the subject of this case study.

4. Case Study Contents

This case study contains six sections in addition to this introduction. It begins with a description of the local production system, its constraints and potential. A discussion of the local and supra-village institutions that organize behavior within Sanankoro Togola, as well as relations with the exterior, follows. Some of these institutions are traditional; others are of modern origin. The case then turns to collective and individual land use management efforts within the village. Next comes an analysis of these efforts, in terms of the framework used in all the studies: (1) attributes of soil fertility as an economic good, and of the soil conservation operations that produce it; (2) rules governing access to and exploitation of the good and the associated service; (3) interactions; and (4) outcomes. The study ends with a section on conclusions and several recommendations.

B. Production Systems

The Sanankoro Togola production system must be understood as the essential foundation upon which all watershed management work is based (see Figure 5). This section outlines elements of the production system.

1. Land Availability

The village land of Sanankoro Togola includes a smaller area of arable land (7.4 hectares per family) than do neighboring villages. The arable plots are wedged between the northern rocky stretch beyond which cultivation is impossible, and poorly defined boundaries east, west, and south where Togola lands border those of other villages. In many cases, these borders do not follow natural boundaries, a frequent source of conflict with other villages (between Sanankoro Togola and Djéni, for example). (See the village sketch in Figure 5.)

Good Relations among Villagers

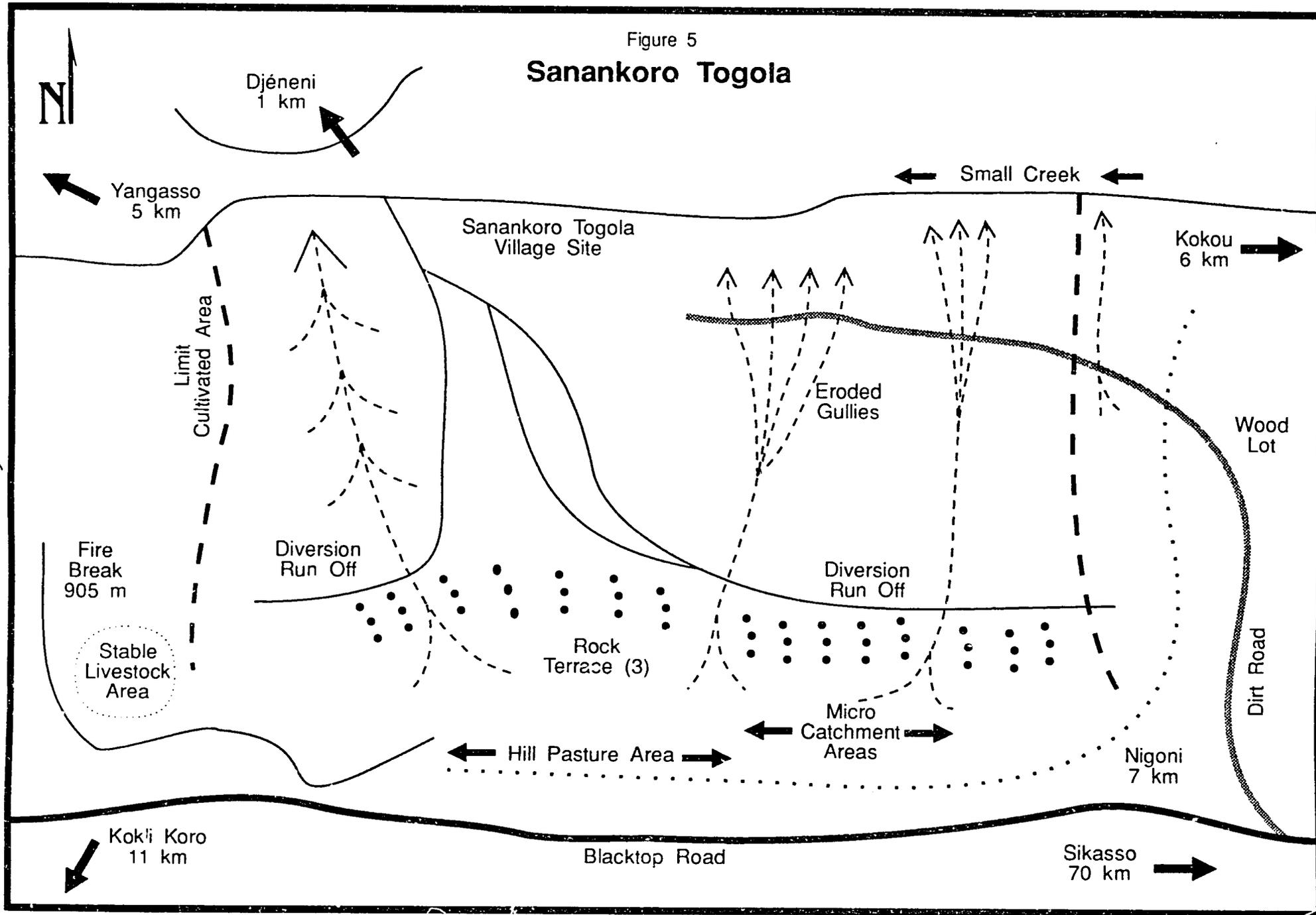
According to local informants, no conflicts concerning land distribution exist within the village. While the villagers said nothing concerning the criteria used, a certain sense of equity seems to have guided land distribution. The fact that the village is made up of a single large family certainly facilitates internal land management.

Conflicts with Neighboring Villages

The location of the village lands of Sanankoro Togola makes conflicts with neighboring villages almost inevitable. However, these conflicts are becoming progressively less violent. "Our problem,"

Figure 5

Sanankoro Togola



(21)

according to F. Togola, a village farm head, "is how to succeed in a common effort to draw fixed boundaries." Achieving this goal might resolve existing conflicts between Djénehi and Sanankoro Togola which have occasionally turned into brawls, have sometimes spread beyond the frontiers of the village and of the arrondissement, and have been brought to the Sikasso court for resolution (as in 1965, for example).

There is a potential source of conflict east of the village. The Sanankoro Togola inhabitants, unable to expand their arable lands either to the south (because of the hills) or to the west and north (because of conflicts with Djénehi), have started nibbling at land of the Kokou and Ningoni villages. This has not yet caused disputes, but trouble may arise in the future.

Another source of the violence, frequency, and duration of conflicts between Djénehi and Sanankoro Togola is the fact that the people of Djénehi have never really accepted Sanankoro Togola's autonomy. In addition, the village of Kountjila, formerly located very near Djénehi, was displaced because the inhabitants found Djénehi's authority over their village oppressive. They abandoned lands that Djénehi has since reclaimed; thus, Djénehi acquired boundaries that extend well beyond the natural limits of the stream.

Recently, relations between Djénehi and Sanankoro Togola have improved considerably, demonstrated by visits between inhabitants of the villages and inter-village marriages. With regard to land issues, both sides show a willingness to compromise. Fires (of criminal origin, according to the inhabitants of Sanankoro Togola) have ceased on the parcel of land in dispute, which the tribunal of Sikasso awarded to Sanankoro Togola. And in 1989, the chief of Sanankoro Togola requested that the youth of his village give up a parcel of collective land, which Djénehi claimed as part of its territory.

2. Cash and Subsistence Crops

Cash crops are mainly cotton and groundnuts. Cotton is cultivated in a bi-annual rotation with cereal crops--maize and sorghum. Cash crops are grown with intensive use of improved chemical inputs: fertilizer, herbicides, and insecticides. Farmers must use herbicides to compensate for insufficient agricultural manpower. Farmers vary their use of improved inputs as a function of the market price for cotton quoted at the beginning of the rainy season.

Farmers cultivate maize and sorghum in the year following the cash crop to take advantage of residual fertility and weed-control inputs. The area devoted to groundnut production is increased when the prices offered for cotton are considered low. Surplus subsistence crops are sold when either the production or price of cotton is considered poor, but this does not often happen. See Annex A for a model farm budget for this area.

3. Soil Erosion and Soil Conservation Techniques

Erosion, resulting from heavy rainfall on sloping ground, led to soil degradation and gulying. According to some villagers and some CMDT personnel, the degradation was such that the residents seriously considered abandoning the village.

To combat this degradation, villagers installed the following devices from the top of the slope to the bottom:

- contour terraces built of stone to break the speed of the water (stone lines); and

- bunds for better control of water--part of this water was supposed to spread out to cover the whole cultivated area regularly; excess water was to be routed into channels emptying into the stream.

One of the objectives of the second technique was to improve water infiltration on watershed soils. This work was carried out collectively and was complemented by individual efforts to increase the efficiency of the erosion control effort (for example, people put live fences along field boundaries).

Integration of Agriculture/Livestock Raising

On the whole, livestock raising and agriculture are highly integrated (especially at the level of food crops). The use of animal traction for creating erosion control devices is one example of this integration. In addition, the integration of livestock raising and agriculture is evident in the large amount of manure used for grain crops. N. Togola offers the most striking example of this practice. He uses up to 50 cartloads of manure on his maize field per year. Cow manure is also used on cotton, but primarily when the high cost of inputs causes a reduction in the amount of fertilizer used on the parcels.

C. Institutional Framework and Resource Mobilization

Associations play a large part in village life and are numerous. They either have their roots in tradition or result from recent interventions. They include, in addition to the village government, age groups, *tons*, groups of friends, the CMDT-inspired committees, a village association (transformed into a *ton* in 1990), the technical team for erosion control, and the local branch of the UDPM. Each organization has its own funding system and its own method for using funds.

1. Traditional Structures

This section describes four types of local institutions. Of these, the village government takes the lead in collective activities, but *tons* and friendship associations play subsidiary organizational roles in village life. Age grades were deliberately suppressed by local initiative, reportedly to reinforce cohesion within the village.

Village Government

The formal government of the village consists of a chief, more or less retired; his son, the acting chief (power being hereditary); and the latter's advisers. The legislative body of the village is the village assembly comprised of all the adult men of the community. The village assembly makes the important decisions--those that have an impact on people's lives. The village assembly is convened as necessary whenever important matters arise. Women are excluded, senior citizens are not. Generally, the latter only attend daytime sessions and follow the discussions and decisions from a distance, leaving the exercise of power to younger men. Team members' observations and villagers' and officials' comments suggest decision making in Sanankoro Togola takes place according to strict, democratic standards. Procedures reflect mutual respect and great mutual concern. Conversations with villagers highlighted the assertion that, "only statements that clarify our thought process are taken into account; the others are ignored." The acting chief never leads the debate. His role, among others, is to address his thanks, at the end of the meeting, to "all the men of good will who have contributed to the discussion."

Tons

These traditional associations are based on a spirit of mutual assistance and solidarity; they intervene particularly in the framework of rural tasks and cultural activities. *Tons* rarely have members of both

sexes. There is a men's *ton* and a women's *ton*. The men's *ton* includes all the men old enough to work. Members assist farmers who have requested help in return for payment. Saturdays and Tuesdays are reserved for the activities of the men's *ton*.

The women's *ton* includes all the married women in the village, a group of approximately 90. The board is composed of three members: the president, the treasurer, and the conflict resolution officer. As compensation for working in the fields (especially weeding), members receive a certain amount of money from the field owner. This rule is not applied when there is a poor crop. In 1989, for example, the women exempted farmers from payment for their services. This policy is maintained, in part, because there are family connections among all the village inhabitants. Generally, money women in the *ton* receive for work is collected in a common fund and allocated to the following uses:

- loans to members when financial difficulties arise, and
- financial help when a family member dies.

The beneficiaries are exempted from repayment when a family member has died. The women's *ton* works on Fridays and frequently on Thursdays.

There is a sub-group of young men who are not old enough to be included in the men's *ton* but who work together just like the adult men. Like all associations, they have a separate fund which they replenish from the payments they receive, usually in kind (for example, goats), from the landowners who have requested their services. The youth's sub-group works on Fridays and often on Thursdays. They had a collective field until 1987 when the land was taken back by the village of Djéni.

Age Groups

The village formerly had age groups, but they have disappeared for the following reason, according to one respondent. He said, "they created an obstacle to the formation of friendly relations between different generations. They disappeared about 30 years ago [around 1960]. Presently we associate according to affinities and it is not rare for a young man of 18 to be friends with a man of 55." This collective decision to suppress age grades constitutes a fairly dramatic example of Togola willingness to restructure social relationships in light of a collective social goal.

Friendship Associations

In the village, there are five groups of friends--men 18 years and older--who gather for farming tasks and for cultural events. The groups plow fields for farmers short on labor. With the payments the groups receive for farm tasks, in kind and in cash, they finance their cultural activities. These financial resources also provide a type of security--they make it possible to grant members interest-free loans.

2. Newly-Formed Associations

The village association (AV) has been in existence for many years in Sanankoro Togola. It was established at the request of the government and the party and includes all the men in the village. CMDT has assumed an important role in establishing and structuring the AV. For several years, CMDT officers have guided the activities of the AV. The board consists of six members:

- a president,
- a vice-president,
- a treasurer,

- a secretary for production and marketing,
- a secretary for procurement and equipment, and
- an organizer.

Board members advise other villagers on agricultural techniques and convey the recommendations of the CMDT. The AV provides multiple services in many fields:

- procuring inputs for cotton production,
- cotton marketing,
- financing credit for members and helping members with bank deposits,
- organizing training and information courses for the villagers,
- organizing functional literacy courses, and
- organizing various investments in watershed management in the village.

With regard to cotton marketing, the AV organizes cotton weighing at the village level and stores cotton in its silo. The silo had to be relocated in 1990 at the request of the CMDT in response to conditions set by its fire insurance company. The silo had to be located at least 200 meters from the village. The CMDT enforced the condition by refusing to buy cotton stored in the old silo, located too close to residences. Rebuilding the silo had a negative impact on the extension of infrastructure facilities for watershed management.

The AV keeps the cotton until the CMDT takes delivery of it by sending, at the request transmitted by one of the AV officers, one or more trucks in the village. The harvest normally ends in December. In February, the AV pays its members with money received from the CMDT, and all individual and collective debts are settled.

The village assembly, responding to a suggestion from the CMDT, decided to take charge of providing literacy courses for 10 members of the village association each year. These courses are exclusively for men. One motivation for the men to become literate was a promise made by the CMDT that it would entrust cotton weighing to the AV when villagers acquired literacy and numeracy skills necessary to manage that process. The AV would save the cost of the weigher's salary and add it to the annual rebate paid to AV members.

The CMDT offers a training course annually to the village community worker in charge of organizing the literacy course in Sanankoro Togola. The village literacy course runs for 45 days. It consists of classes in writing, reading, and arithmetic, all in the Bambara language. For practice and drill, the students go through activities similar to production activities (for example, measuring areas for applying precise amounts of fertilizer and insecticides). The ten students chosen by the village assembly spend a total of five and one-half hours in class each day for over six weeks. While taking the course, they are not available to participate in other individual and collective activities.

As of this study, 29 AV members had participated in the literacy program. The literacy skills of some may still be insufficient, but according to the community worker, the village has agreed to let them repeat classes twice, if necessary. This is a remarkable example of the community's commitment to and motivation for self-help efforts. The loss of income this policy represents is apparent when one

counts the person/days of labor no longer available for collective investments, which the local *ton* and local watershed management organization make during the rainy season (see D.1., below). Eleven person/days (one trainer and 10 students) multiplied by one day per week of collective work, multiplied by seven weeks, equals 77 days per year or five percent (5%) of the collective labor budget mobilized by the village. In addition, each individual who participates loses six weeks of personal time for a total of 462 person/days of time withdrawn from farming unit labor budgets. Students taking the course have a clear personal incentive to learn.

3. Supravillage Institutions

Four external institutions play a role in village watershed management and land use issues: the CMDT, the arrondissement administration, the UDPM, and the Forest Service. Of these, the CMDT is probably the most important.

As in other parts of southern Mali, the CMDT has been the major lever of economic development in Sanankoro Togola for the past three decades. This cotton-production and marketing organization has developed an effective extension service to help local farmers improve their productivity. CMDT agents and the village population appear to have a great deal of mutual respect for each other. Together, they have managed to organize some impressive operations, including the watershed management activity, the creation of marketing infrastructure facilities, and literacy courses. CMDT agents at the local level seem genuinely committed to implementing the agency's official policy of helping farmers play increasingly important roles in producing and marketing cash and consumption crops.

The arrondissement administration provides the lowest level of state government in the Sanankoro Togola area. The administration collects taxes and offers conflict resolution services in land disputes like those which use to arise between Togola and Djéni, for example.

Recently, the UDPM began to play a more active role in local organization by urging the conversion of the AV to a modern *ton*. At the party's request, the AV was transformed into a village *ton* in 1990. It is unclear what long-term effect this will have or what role the UDPM will play as a resource for the village.

The Forest Service patrols village lands occasionally. Because the villagers prepare a firebreak on village lands annually and make efforts to avoid and control bush fires, the Service does not exert a major negative influence on village affairs.

D. Approaches to Village Land Management

Land use management in Sanankoro Togola involves a combination of collective and individual measures described below.

1. Collective Erosion Control Measures

This section outlines the organization of collective soil conservation activities in the village.

Creation of an Erosion Control Team

At the request of the villagers of Sanankoro Togola (see Section A.3. above), PLAE activities were carried out by CMDT personnel and AV workers who helped introduce better techniques of erosion control and disseminate them through the extension process. After sessions from September to November 1986 to increase awareness and sensitize villagers to the problem, local people and technical

personnel surveyed the area west of the village where they planned to build the erosion control structures. A technical team was then appointed by the village assembly. The criteria applied in selecting members were as follows:

- literacy,
- participation in the first attempts at erosion control, and
- motivation and an exemplary record.

The five team members were trained on the job, begun in late 1986, for one day before the rainy season of 1987. The following year they received more substantial training for five days. Technical team members received no special compensation for the time invested in their own training and were not exempted from other activities.

The essential task of the technical team is to identify the contours with the help of a water level and to stake them out. Once the contours have been identified and marked, all members of the men's *ton* present in the village work every Thursday to build the facilities designed to control water erosion. Women's contributions to the effort are limited to bringing water and food to the workers. If the village assembly agrees to skip some Thursday workdays during the harvest or during other peak periods, the number of missed days is recorded and made up during the dry season by increasing the rate of work on the erosion control facilities to more than one day a week.

In 1988 and 1989, the *ton* built 1,000 meters of stone lines per year. In 1990, members of the *ton* only built 400 meters. They also built 2,000 meters of bunds to divert runoff from the fields to the stream. Each year, the community clears a firebreak 905 meters long southwest of the village land to protect the village pastures from fires. The village assembly has decided to build a new silo on a site farther away from the village than the first to meet the requirements imposed by the CMDT. Nonetheless, the *ton* expects to complete and strengthen the erosion control work it started.

2. Individual Initiatives

In erosion control and in production system improvement, individuals have developed a number of different approaches. For example, many farmers use the stems of maize and millet to build half-moon check dams to control gullies. N. Togola, a very resourceful farmer, avoids leveling his fields after the first plowing and traps run-off in the resulting hollows to weaken the erosion effects of heavy storms at the beginning of the rainy season.

Such individual methods do not always conform to the advice of the CMDT soil conservation specialists, who emphasize the following procedures:

- use tilling methods such as contour plowing,
- create vegetation strips between cleared parcels,
- create strips and seed them with forage species such as *Brassicaia stylanthus*, and
- use tied ridges in cultivating fields.

N. Togola has demonstrated considerable skill in improving production systems:

- while using an intercropping system with maize and millet, to cope with a shortage of labor, he developed a method for handling the seeder that saves seven person/days per

hectare during seeding. Nearly everyone has imitated his system because it proved extremely efficient in dealing with the labor constraints during seeding. It is easy to calculate the labor savings this practice represents in a village using a biennial cultivation system with maize, millet, and cotton. The intercropped area in maize/millet covers about half the cultivated area (89 out of 178 village hectares), so for the whole village, $89 \text{ ha} \times 7 = 623 \text{ person/days saved}$; and

- after growing maize for a few years, N. Togola succeeded in perfecting a seed from a variety he developed. The breeding criteria were not set a priori, but have proven, in the long run, to be the most important characteristics for ensuring a good yield on his field. His objective was to create an early maturing variety that was also insect resistant. The criteria guiding the breeding were the following: no signs of insect damage, grains evenly tinted, and ears which were wide and long.

While women do not take part in the collective work, they show an interest in and strong awareness of the degradation of their environment and reproduce the recommended anti-erosion structures on their own plots.

E. Analytical Approach to the Land Management Problems of Sanankoro Togola

This section analyzes the Sanankoro Togola case study materials presented in Sections B. to D. using the general framework applied in this report. First, the economic characteristics of the key resources are analyzed. Second, rules that govern access to and use of these resources are summarized. Third is a description of the interactions that occur when individuals and groups respond to the motivations inherent in the economic characteristics of key resources and in the relevant working rules by selecting strategies and acting upon them. And finally, the outcomes of these interactions are assessed.

1. Economic Characteristics of the Goods: Watershed Management and Soil Fertility

Two resources are key in the efforts Sanankoro Togola villagers have made to manage their village lands. The basic resource is the arable soil on village lands. Its critical characteristic is fertility. Two things must happen to achieve and maintain fertility. First, the nutrients removed from the soil during each cropping cycle must be replaced to maintain or enrich soil structure. Second, the micro-watersheds, within which individual fields are located, must be managed to control surface water flows to reduce hydraulic erosion and enhance infiltration whenever possible. The economic characteristics of adequate soil fertility differ from those of the service of controlling water flows within a watershed. The economic characteristics of soil fertility and watershed management create different incentives for villagers.

If one understands how these incentives motivate people, the appropriateness of the rules adopted by villagers to govern these two activities becomes apparent. In Sanankoro Togola, the match between the nature of the good and the service, and the corresponding rules, is clear and effective. Because the match is good, the institutions (or working rules) serve their purpose. Currently, the village's soil fertility and watershed management problems are under control.

To clarify this conclusion, the analysis deals first with the attributes of the good and of the service before discussing the working rules which govern their exploitation. The attributes of the good and of the service are as follows:

- the "appropriation unit"--the individual farm field where the use units of the resource are harvested--is largely subject to exclusion, because the family that cultivates a given field extracts most of the benefits from enhanced water harvesting and soil fertility improvement on that land;
- the "use units"--subsistence and cash crops--are also subject to exclusion, because farmers are in their fields during most of the harvest period (pilferage, if it exists, is a minor problem);
- consumption of the use units (for example, cotton, peanuts, millet, and sorghum) is separable and competitive;
- the benefits of soil and water conservation are not easily subject to exclusion within the same watershed at points downhill from the water harvesting structures, because water that flows rapidly off a slope causes sheet or gully erosion, whereas water trapped on a surface will infiltrate and increase soil moisture while reducing or eliminating soil erosion; and
- the benefits of soil and water conservation are consumed separately within individual farm enterprises that experience reduced soil losses and greater water infiltration from improved uphill erosion control structures.

2. Rules Governing Access to and Exploitation of Good

In light of their attributes, soil fertility is a private good, and water erosion control measures have the characteristics of common pool services. The analysis now examines the rules developed to govern access and exploitation of the good and the service:

- each farming unit has exclusive rights to the use of fields it controls;
- each farming unit is at liberty to add chemical fertilizer and organic fertilizer to its fields as it wishes and is able;
- each farming unit is at liberty to adopt water and soil conservation measures, such as tied ridges, contoured furrows, minimal tillage techniques, and live hedges on fields it cultivates;
- the decision to provide a land use management program was made by the village assembly comprised of the adult male population of the community;
- the village assembly decided to produce the erosion control structures by creating a special district to manage village watersheds;
- each "active" male (of whom there are twenty-nine present in the village) must participate in community collective labor one day per week unless excused;
 - legitimate excuses include sickness, participation in adult literacy courses (11 people annually for a 45-day course or five per cent of the labor force that can be mobilized),

social constraints (for example, funerals and marriages) and administrative duties (for example, village headman convoked to the arrondissement);

- the hypothetical sanction for an unexcused absence is that the individual explain himself before a village assembly;
 - this sanction, like several others mentioned in connection with collective work, is hypothetical because villagers say it has never been necessary;
 - if this sanction were applied, it would effectively terminate the individual's social life within the village if he failed to comply with the sense of the meeting, even though no physical or monetary sanctions would be imposed;
- the 29 active males are assisted in their effort to manage soil erosion through appropriate erosion control structures by other people only to the extent that everyone in the village is supposed to repair any small breaks identified in the filtering barriers or other soil and water conservation works;
- each year, the village assembly decides where the collective investments will be made in soils and water conservation works, such as building contoured dikes, deviation canals, or water-spreading structures;
 - these activities must be discussed with the families who control any affected properties;
 - any farm enterprise head has the right to veto any planned soil and water conservation work on his land; and
- once a soil and water investment decision has been made, each farm enterprise is treated in turn, with no deviations from the line of march.

3. Interactions

Given the attributes of the good and of the service and the rules developed for their management, people in Sanankoro Togola have devised various strategies to obtain their goals.

- Under this system, the community, through its young people, co-produces the ultimate good of soil fertility within each farm enterprise. Each enterprise invests manure and chemical fertilizer on its own land and adopts farming techniques to ensure soil and water conservation at the field level. The community as a whole provides watershed management.
- Because of the flow characteristics of water moving within a watershed, no individual enterprise has an incentive to invest in watershed management facilities that will benefit other enterprises. But water flows can be mastered within the watershed of Sanankoro Togola only if they are controlled first at the top of each micro-watershed. Thus, the village had a common pool resource--water in the watershed--but failed to manage it until the current program was initiated. Villagers decided that the costs of continued inactivity would be prohibitive--the whole community would have to abandon the site because members could no longer make a living on impoverished soils.

- The decision to manage the watershed as a common property resource laid the framework for a partially joint approach to maintaining soil fertility.
 - The community chose to have the watershed management activities produced by all local young men under the general leadership of a five-person sub-committee of the local, general-purpose government called the Soil and Water Conservation Committee.
 - Given improved soil erosion control structures, individual farm enterprises have a strong incentive to invest in manure and chemical fertilizers, because these contributions to soil fertility are not immediately washed away by surface drainage and will be captured primarily by the same enterprises that make the investments.
 - Apparently, all young men opt to maintain their standing within the community by working hard on the soil erosion control activities each week on the scheduled day unless they have a legitimate excuse.
 - The CMDT soil and water conservation expert who originally organized the activity within the village continues to contribute mainly through the ZAFs--individuals who operate as extension agents at the village level or in a small group of villages. All of these CMDT personnel are paid because CMDT seeks to improve Mali's cotton output, and maintaining soil fertility is considered an indispensable condition for product improvement.
4. Outcomes
- Villagers no longer plan to move away from the site to another area because they have succeeded in controlling surface water flows so that sustained-yield agriculture appears possible, once again.
 - Equity: everyone is treated in turn according to where they are in relation to the starting point of any water control facility. The queue is created by the existing distribution of land holdings along a contour line within a sub-unit of the village lands.
 - Efficiency: the operation is efficient in a broad sense because it protected soil resources and relieved the entire village population of the costs of having to abandon the site and start new farms elsewhere. It is also efficient because private goods--farm fields--are managed privately, and only the common pool resource is managed collectively as a common property good. The villagers may use collective labor in the form of a local *ton* to cultivate their fields, but those activities are always under the private management of the head of the farming unit. They do not try to over-collectivize by shifting activities best left in private hands to the local public sector.
 - Participation: for men, governance within Sanankoro Togola is highly democratic. All resident males are at liberty to voice their opinions on an issue and are then expected to respect decisions made by the village assembly. One cost involved in this strongly communal approach to land use management and other issues is that some village men may find this degree of collectivization difficult to accept. Many young men have migrated from Sanankoro Togola to cities in Mali and elsewhere. It is not clear whether dissatisfaction with village governance patterns or a lack of opportunity locally motivates emigration. Presumably, those who remain are willing participants in the decision-making

and implementation processes. This general constitutional consensus at the village level probably reduces the costs of making the system work for those directly involved in and affected by it.

F. Conclusions

In many respects, Sanankoro Togola is a model of cohesion, organizational efficacy, collegiality, and the integration of young men into the active life of the village. The capacity of the village assembly to debate issues of local importance, make decisions in light of those public debates, and execute them in a regular and reliable fashion is impressive. The village is an example of how local operations, supported by appropriate outside assistance, can save and enrich threatened environments. Environmental degradation, a specific set of institutions, and a high degree of consensus among permanent residents on their common goals contribute significantly to explaining their success at organizing a collective approach to watershed management.

Problems persist in Sanankoro Togola. Women play a very limited role as decision makers within the family and within the village community. Thus, to cite but one example, women cannot dispose of animals they own on their own initiative, and the women's *ton* has no real say in village affairs.

The dissolution of the local gerontocracy did not take place without challenging the traditional conflicts between the old and young. However, the conflicts between men and women are more complex and more problematic.

G. Recommendations

1. With regard to soil conservation activities, the village should seek technical assistance to improve and fine-tune soil conservation techniques in light of the soils and cropping patterns of the area, with special focus on the design of water deviation surface drains.

The technical characteristics of locally adapted perennial and annual vegetation should be reviewed for ease of planting and adaption to recently constructed water-deviation structures.

2. With regard to land tenure, and to avoid potential conflicts, the people of Sanankoro Togola should draw up agreements in due and proper form with the villages of Ningoni and Kokou, giving them access to specific pieces of arable land. The assumption is that Sanankoro Togola does not plan to expand, whether openly acknowledged or not.

3. Village-level adaptive research should be initiated with innovative farmers to introduce a wider range of cash crops and improved cropping patterns. The criteria for the introduction of new cash crops should include their contribution to improving soil fertility and sustainable soil conservation techniques. The main purpose of this adaptive research process is to design a responsive farmer-based strategy that allows individual farmers to cope with changes in local, regional, and international cash crop markets.

4. Efforts should be made to overcome the socio-cultural barriers that underlie the marginalization of women. CMDT agents operating in the village could play a role, working through the men's and women's *tons*, in leading local people to understand the loss of potential involved in so strongly restricting women's roles in local society.

VII. The Office of Niger, Seen Through the Village of Bagadadji: Observations on Water Management and Economic Prospects

A. Introduction

1. Report Perspective: Decentralization and Economic Growth

Located north of the Niger River, in the Fourth Region, about 100 kilometers from Segou, the Office du Niger irrigation scheme covers some 55,000 ha (instead of the million ha originally planned) of which 45,000 are actually under cultivation.¹ This discussion is based on a case study of Bagadadji (see Figure 6).

Since 1932, the official date of the creation of the Office du Niger (ON), an acrimonious debate has persisted over the Office's potential role in Mali's economic growth. Some saw the Office as a tool for rational, operational and planned economic development. Others viewed it as an ambitious undertaking, characterized by an excessive number of subsidiary activities. The situation led the Office to centralize its operations ever more strongly, while at the same time the quality of the results continued to decline. In light of this situation, it is hardly surprising that the ON is often referred to as "a state within the state." However that may be, the low level of productivity and the weakness of the organizational context within which rural populations operate made it indispensable to take certain measures to rehabilitate the Office. These measures were:

- liberalizing commodity trade;
- redeveloping irrigated parcels; and
- increasing the role of farmer organizations in management activities.

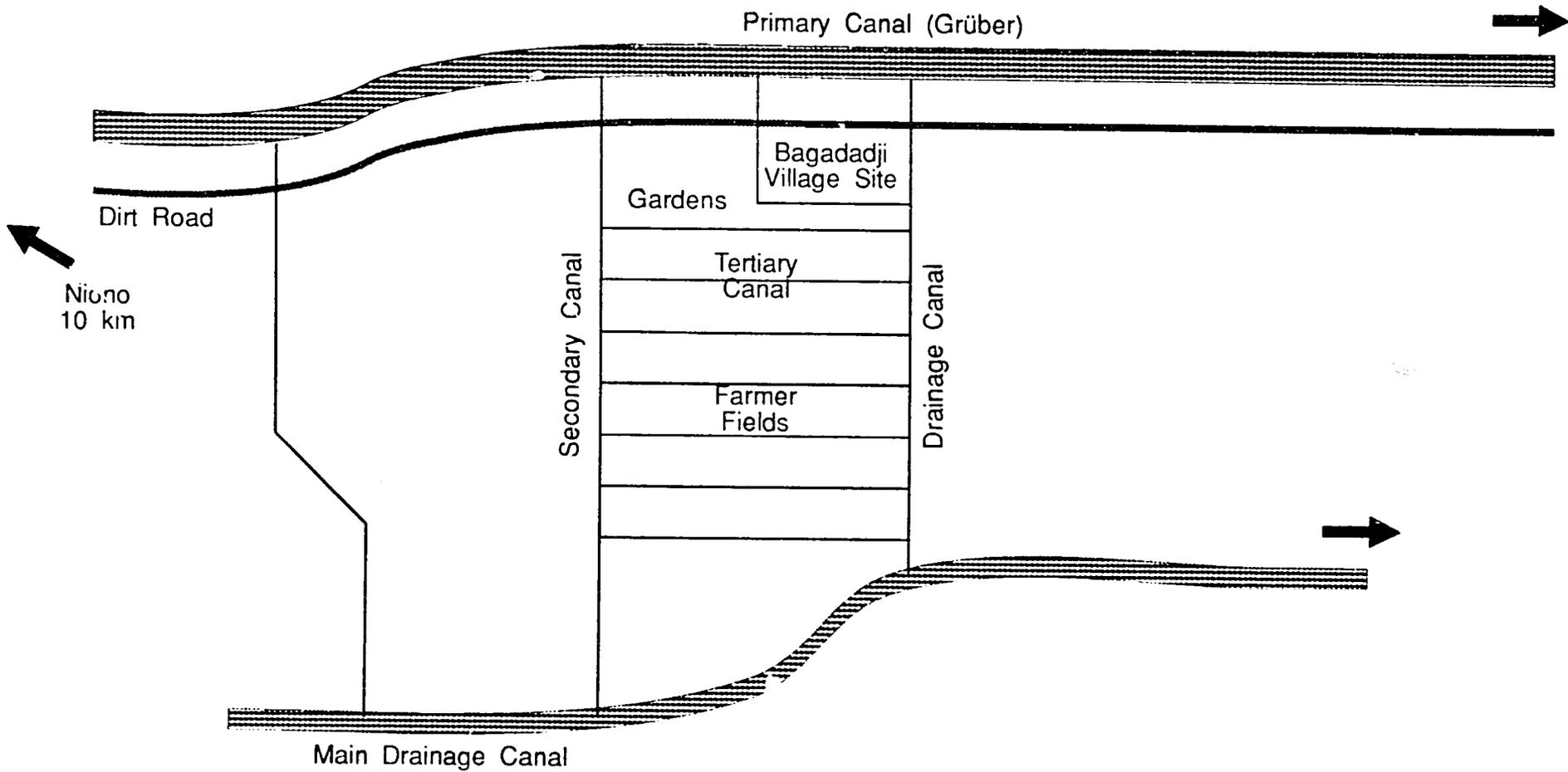
2. Management of Irrigated Waters

Throughout the ON irrigation scheme management of irrigation flows must proceed smoothly with no interruption. From the headworks on the Niger River to the individual plot, the slightest deficiency in water management has a rapid, negative effect on production, causing progressive declines in yields. This is why rice yields fell to an average 2.2 tons per hectare and have remained so low in the five out of eight sectors of the scheme that have not yet been rehabilitated.

By contrast, sound water management will increase productivity, as is the case in the three rehabilitated sectors, where average productivity per hectare is estimated at 4.2 tons. Better water management does not in itself lead to higher yields, but it is a major facilitator. Other factors likely to affect production are mentioned below.

¹ J.Y. Jamin, O. Béreté et M.K. Sanogo, "Une expérience d'intensification de la culture irriguée au Sahel : le projet Retail de l'Office du Niger (Mali) ; contribution au travail de synthèse sur le développement agricole des régions sahéliennes." Office du Niger, Zone de Niono/Projet Retail, September 1990.

Figure 6
Bagadadji



12/

3. Grassroots Development

The policy of commodity trade liberalization, started in 1984, has led to important changes which can be seen in:

- the behavior of *colons* (farmers who exploit parcels developed by the ON), who no longer see themselves as mere gears in the machinery of the Office, but rather increasingly as entrepreneurs in full partnership with the Office;
- a greater capacity for self-management, evidenced in some villages by the existence of powerful farmer organizations; and
- an increasingly assertive role of rice producers in the transformation and commercial distribution of their product.

4. Changes within the Office du Niger

Started in 1932, ON's primary goal was to produce cotton for French industries. Rice was later introduced so that the colons could also raise a food crop. Slowly, cotton was replaced by rice. By 1970, cotton was no longer profitable and its production totally stopped. The new goal of the ON was to produce rice necessary for urban consumption. To achieve this goal, the ON set up a powerful extension service that included not only technical agents, but also the army (Economic Police) and a paramilitary wing (Gate Guards).

A major decline in production (1.8 tons per ha on average between 1979 and 1984) shows how ill-advised the policy was. Trade liberalization measures adopted for rice in 1984 allowed the colon to make a higher profit from his production. This led to a radical change in the behavior of the producers who became more interested in problems of water management and more efficient farming methods. The rehabilitation of the canals and parcels made it possible to create the necessary physical conditions for a notable increase in production as well as setting the stage for closer collaboration between the producers and the ON concerning water management. In institutional terms, the Office allowed farmer organizations and the private sector to play a more and more important role.

5. Limits and Potentials for a Decentralized Management of Renewable Natural Resources

Several factors currently limit the potential for decentralized management of water and soils in the ON scheme:

- the inability to manage water in the unrehabilitated sectors of the scheme;
- the inappropriateness of the irrigation system, which was designed for cotton and has not been modified for rice production;
- the institutional weakness of farmer organizations in many communities located within the scheme
- the reticence of some ON personnel; and
- land insecurity, which has stifled the *colons'* spirit of initiative for the past 60 years.

In addition to these limits, there are some major assets. First and foremost is the strong desire of the majority of *colons* to take charge of their lives and to play an active part in the management of their

natural resources. The second asset is the possibility of raising considerable financial resources within the communities of the scheme in a very short period. Finally, the liberalization policies adopted by ON create attractive niches for the private sector. These assets have been reinforced by the timely interventions of the Projet to Improve Peasant Rice Culture in the Office du Niger (AR-PON), and by the Retail project.

6. Conclusions and Recommendations

The Office du Niger and the villages of the rehabilitated sectors are moving towards a new equilibrium in consequence of liberalizing policies. The ON increasingly recognizes the capacity of the villages to supply themselves with inputs, and to take care of irrigation and the processing and marketing of commodities. The private sector is accorded a substantial role in this new situation. Collaboration between the ON and the *colons* is proving effective. The farmers, urban consumers and the Malian state will profit thereby.

Certain problems nonetheless remain, notably land tenure within the scheme, the role of women and the future of ON personnel.

In terms of recommendations, the ON should pursue its liberalization policies by trying to reinforce the capacity of the *colons* to play a larger and larger role in the management of the scheme. This will require sustained assistance for farmers in their efforts to provide for themselves, manage their irrigated fields more effectively and participate fully in commodity processing and marketing activities. Farmers should finally be accorded more secure rights to their fields. Efforts to improve women's conditions within the scheme should be pursued.

B. Water Management at Different Levels within the ON Scheme

This section first describes management of water within the scheme from the headworks to the parcel intake, and then addresses the management of water within the parcel.

1. In-Canal Water Management

The ON controls water management operations upstream from the secondary canals. As far as some production and maintenance activities within community lands are concerned, *colons* cooperate closely with the ON representative who lives in the village or nearby.

At the Headworks Level

The ON is presently responsible for the management of the Markala dam, which is the outtake diverting river water into the scheme. The ON decides on the quantity to be withdrawn from the river. In addition, it manages the hydro-electric component of the dam, which provides a large share of the energy used in various ON activities.

The Markala dam would make it possible to irrigate 400,000 ha, but presently, the area under production is barely 45,000 ha. It should be noted that this irrigation system serves to complement rains that fall during the rainy season, which usually starts in June and ends in September. The ON *colons* only produce one rice crop a year. Moreover, some of them do truck gardening during the dry season, of which more will be said later.

The *colons* currently have no role to play in water management at this level and have no way of influencing this process.

Primary Canal Level

Here also, the ON is totally responsible for management. The sector, of which there are eight, is the largest subdivision within the scheme. It has at least one primary or distributory canal, which supplies several secondary canals (the *partiteurs*). These in turn distribute water to tertiary canals (*arroseurs*). *Colons* get water for their plots from the tertiary canals.

Management of the primary canal involves several activities:

- varying the quantity of water as a function of climatic conditions in the area being served;
- interrupting water flows during the period of annual maintenance on the canal; and
- cutting off the water in cases of breaches in the canal sides.

Secondary and Tertiary Canals Level and Village Lands

The last two levels of canals upstream from the parcels, i.e., the secondary and tertiary canals, are usually located within village lands. *Colons* take part in management of water flows at these levels. Each village is under the control of an ON official, the water agent. He informs the higher echelons of the ON on work progress at the village level. He also transmits his supervisors' instructions regarding the various operations.

Before each rainy season the secondary and tertiary canals are drained, to allow farmers to carry out maintenance work. Holes made by rats must be filled and breaks in the dikes and canal banks must be repaired. The same repairs must be made within the parcels. The water agent refuses permission to fill a tertiary canal until he has verified that all holes and breaks have been repaired.

In Bagadadji, the village in this case study, water distribution at the level of a tertiary is regulated by the farmers on that canal. One of them is selected as the headman of the tertiary. It is his job to regulate water rotations. Water distribution does not always follow a strict headend-tailend progression. Instead, the first one who is ready to start an operation once the tertiary canal is filled takes water. Five years after rehabilitation in Bagadadji (in 1986), the *colons* have now acquired a close knowledge of the nature of soils, the degree of variation of levels within the plots, and of parcel topography. They can even distinguish plots which can be watered simultaneously from those which can only irrigated one after the other. Maintaining the water flow at a level appropriate to achieve effective irrigation and sufficient drainage to clean the plot drains supposes a reliable and high degree of harmony among users of the same tertiary. *Colons* now resort to the water agent only in case of conflict. Immediately after the rehabilitation, and while the farmers were familiarizing themselves with the new conditions, the water agent had to settle a larger number of conflicts by imposing turns in a water rotation after consultation with the *colons*.

It is worth noting that before the rehabilitation of an irrigation system, the physical conditions for close cooperation between *colons* using the same tertiary canal were often not met. Inadequately leveled irrigated parcels had become generalized throughout the whole scheme. The arrangement of the canals -- the relationship between tertiary canals and drains of plots in the same subdivision -- was so inadequate that some farmers irrigated their plots via the drainage system and had to drain them into the tertiary. Under such conditions, water management is no longer possible. The linked unit of tertiary canal-drain was no longer a reality. Access to water became so precarious that the majority of *colons* could no longer abide by the water rotation sequence. Each one got water however he could without regard to the interests of others. He who needed water "stole" it by breaking the intake valve

leading into his plot, or by making openings in the banks of the tertiary. In fact water had become an open access good. The system involved management in name only.

Under these conditions, conflicts were inevitable. It became impossible to irrigate a good part of the scheme. This is still the situation in the unrehabilitated subdivisions. During the production of cotton (stopped "in 1970 because of parasites, poor drainage, and the fact that equivalent yields were being obtained in rainfed agriculture in southern Mali"²), the cultivation techniques required by this crop exacerbated the inadequate levelling of the plot surfaces.

2. Water Management at the Level of Individual Parcels

Problem of Intra-Parcel Surface Variation: Impact on Effective Water Management

One of the main problems *colons* encounter in farming stems from the pronounced surface variations or unevenness within some rice plots. This results in an improper distribution of water which in turn affects:

- soil preparation: the plot is first tilled, then pre-irrigated, then tilled again to eliminate weeds;
- plant growth: after seeding the plot is irrigated. This irrigation helps plant growth and is designed to drown weeds ; if this is not carried out properly, plant growth will be jeopardized.
- fertilizer spreading: an uneven distribution of water leads to inadequate distribution of fertilizer, which will adversely impact productivity in the parcel.

To avoid this, irrigators use more water than would be necessary on a well-leveled surface.

The main reasons for surface variation within parcels are three:

- surface imperfections are not all removed during leveling when the area is being rehabilitated. Some of these only become apparent after irrigation and thus cannot be easily foreseen;
- physical conditions of the soil and excessive salinization of the Niger River adversely affect plots yields. Retail Project staff aptly summarize this phenomenon:

Even though the Niger's waters are a priori of good quality for irrigation, V. Valles et al., 1988, have shown that they in fact tended to over-salinization and that their progressive concentration in the soil because of poor drainage could account for the phenomenon of alkalization and excessive salinization often observed since Toujan, M., 1980. This evolving phenomenon can eventually pose a serious threat to the Office du Niger, especially in zones under intensive production where the limits of soil fertility are becoming more apparent, and where the drainage problem has not been satisfactorily resolved.³

- finally, some surface variations are caused by improper application of certain farming techniques. It is necessary in effect to prepare the seed bed adequately by proper levelling.

² J. Y. Jamin, O. Béréte et M.K. Sanogo, "Une expérience d'intensification de la culture irriguée au Sahel ...," p. 10.

³ J.Y. Jamin, O. Bereté et M.K. Sanogo, "Une expérience d'intensification de la culture irriguée au Sahel...." p. 3.

It is also necessary to make sure that water management techniques within the parcel do not cause variations in the surface of the plot.

Uneven distribution of water leads farmers to lay out superficial channels to move water within their plots to hard-to-irrigate areas. Care must be taken at the end of each growing season to level off the parcel surface by "erasing" these channels to prevent surface imperfections from becoming more pronounced each year.

C. Achievements of ON Villages since Liberalization

1. Technical Progress

Great progress has been achieved by the *colons* in terms of intensifying agricultural production, namely:

- better control of water, which allows more efficient preparation of soils through ever more systematic pre-irrigation, facilitating weed control ;
- use of minimal tillage methods which require a minimum of manpower, permitting important labor and energy savings;
- increased use of triple super-phosphate, diammoniac phosphate and urea;
- closer observance of the agricultural timetables for improved, short-cycle varieties (120 days);
- greater use of improved rice varieties resistant to pericularia (a fungus disease) and non-photosensitive, short-stemmed varieties (BG90-2; China 988);
- farmers have increasingly opted for transplanting for two reasons: to achieve a better density (spacing) per surface area and to deal more effectively with weed control, while making judicious use of the scarce manpower available for weeding during the vegetative cycle.

These activities have also contributed to savings in herbicides of which little or no use is made for weed control.

The use of threshing machines allows farmers to transfer harvests more rapidly from the plot for bagging, thus freeing up the land for possible dry season crops.

2. Progress In Rice Production

Since the *colons* have taken over some operations upstream and downstream from the actual rice growing process, they have been able to increase their revenues in the area of rice production. They are no longer simple producers of raw materials (agricultural commodities such as paddy). Among the various activities are:

- input supply and sometimes provision of oxen undertaken by private operators;
- threshing and hulling/polishing via smaller units introduced in villages;
- purchase, storage and direct marketing to wholesalers by farmer organizations.

Because of their importance, these activities merit attention:

- introduction, operation, maintenance and amortization of threshing machines mainly by farmers allows, as noted, relative greater efficiency in land use;
- introduction, operation and maintenance of hulling/polishing equipment allows producers to increase significantly the value added on paddy rice transformation;
- purchase, weighing, storage and direct marketing to wholesalers in Bamako permits the men in the community to realize a 45% increase in net profit on the price of a kilogram of rice (135 CFA/per kilogram instead of 93 CFA).

3. Women's Dimensions of These Changes

If the changes in ON policies have resulted in considerable progress, improvements have been more noticeable for men than for women. Among other reasons this is because women are still excluded from rehabilitated plots. They are thus prevented from gaining greater autonomy and access to an important source of individual income.

Hulling/Polishing Operations

The impact of the liberalization policy is basically limited to post-harvest activities because of the introduction of rice hulling/polishing equipment. To improve women's living standards within its zone the ON in 1987 undertook, through its Division of Rural Promotion, a series of surveys to identify the weaknesses and strengths of women's organizations as well as their needs. The survey was based on some 38 villages. Even though Bagadadji was selected as a survey village, it was not in fact included in the sample. Preliminary meetings were postponed several times and were finally canceled. In 1987 however, upon learning from the Bagadadji village association of women's interest in hulling/polishing equipment, ARPON added another rice huller/polisher to the two already owned by private individuals in the village in order to:

- ease women's domestic workload; and
- increase and diversify revenues.

It is too early to assess this activity thoroughly. It is clear, however, that the hulling/polishing machine saves considerable time compared with the traditional methods of processing grain.

The hulling/polishing machine management committee comprises five members, namely:

- a president;
- an assistant to the president, who serves as the treasurer;
- a "witness" who monitors the weekly collections of money from the machine operators and witnesses the deposits made to the treasurer;
- a specialist for technical management; and
- a manager.

According to these committee members, the post of "witness" is justified because that officer helps avoid potential disagreements among the women.

It is important to note the critical role of the manager or local women's extension agent, whose job it is to collect receipts daily and then hand them over to the treasurer on a weekly basis. The individual in question has recently learned to read, and receives a monthly salary.

Mention must be made of the two machine operators who run the rice hulling/polishing equipment and who also receive a monthly salary, based on the number of bags they have husked. Their salary is drawn from the gross profit on sales of rice.

Approximately half of the 300.000 FCFA loan that financed acquisition of the huller/polisher has been reimbursed. However for the past few months, reimbursement has been suspended to make possible extension of credit to members. The provision of gas and spare parts is the responsibility of the AV.

The success of the hulling/polishing operations of the women's association stems from the fact that they charge less than private operators (50 FCFA v. 75 FCFA). The success of the hulling/polishing machines (whether privately or collectively owned) can also be measured by the fact that only lack of funds prevents a woman from using it. Women are generally responsible for hulling/polishing fees since their spouses usually feel they have met their obligations once they have provided their wife or wives the daily ration of rice.

While the results of the whole operation are generally encouraging, certain factors nevertheless may hinder achievement of the objectives of the rice hulling/polishing equipment, namely:

- granting of loans to some women because of their relationship with members of the management committee;
- lack of documentation for these loans;
- lack of transparency in financial matters--not even the local women's extension agent knows how much money is in the treasury;
- the fact that the revenues of the association are kept in the village, rather than in a bank;
- efforts by the AV to bring in another hulling/polishing machine to increase its revenues; this would saturate the market and reduce the clientele using the machine belonging to the women's association.

Total success of the operation clearly implies a change in this state of affairs. It is worth noting that if the women's organization needs the support of AV for some activities (especially gas and spare parts supply), in the long run women must become more autonomous and take over the control of the whole operation.

Limited Impact of Liberalization on Women's Situation

As already mentioned, women have not been able to make the most of the liberalization policy initiated by the ON, in part because irrigated plots are still allocated exclusively to men. (Women are only allowed to sow gombo along the edges of the plots.) This exclusion⁴ has been at the core of the

⁴ This situation can be explained by the logic of irrigation schemes, which ignore the traditional division of goods and obligations between the men and women and tend to regard farming units as homogenous as well in their goals as in the

grievances of Bagadadji women. To fully appreciate the loss of rights that their non-access to irrigated land involves for women, one must consider the context that prevails concerning rainfed agricultural lands. In this latter situation women hold plots from the head of the family (or any other individual willing to loan land because of family or friendship ties). Even though their tenure is insecure, these plots allow them relative financial independence because they control the product of their fields. They have moreover fully mastered their production system. The transition from rainfed agricultural lands to irrigated lands disadvantages women (just as it does other dependents). In the second case their margin of manoeuvre is much restricted; they are reduced to the status of family laborers. Although they provide appreciable amounts of labor during rice transplanting, weeding and harvesting, they receive in compensation for their efforts only a ridiculously small share of the output (in certain cases, one sack of rice for fifteen days' work). In light of the fact that some have experienced a clear drop in standard of living by comparison with their mothers (who, not having been involved in irrigation schemes, enjoyed use rights to land); and in light of the fact that their standard of living is clearly inferior to that of women living outside the scheme, Bagadadji women want access to an irrigated rice plot that they can farm as a group. They are asking for a group plot because they are entirely clear that in the short term they will not be accorded individual parcels.

Market Gardening Activity

The women's situation as far as truck gardening is concerned is not much better. Plots were attributed to individuals at the rate of two ares per person, with "person" being defined as a male worker, so that women were automatically excluded. The latter are quite interested in truck gardening (garlic and onions essentially) insofar as they constitute a lucrative niche. This moreover explains why the gardens have been monopolized by the men, concerning whom female informants declared "they earn a good deal of money doing truck gardening, but we get very little out of it."⁵ In the present state of affairs this situation is without solution. Each head of a farming unit refuses, within the framework of his own concern, to allow his wife even the smallest portion, arguing that the restricted size of the plots precludes subdivision. Several women have had the opportunity to buy a plot from their husbands (according to information provided by one of the ARPON staff members, though not confirmed by any of the village women). They are in any case an extremely small minority.

If each cannot have her own garden plot, the women would like to control a collective garden through their group. They expressed their desire to the AV a year ago, without to date having received any reply.

Weakness of Women's Organizations

It goes without saying that, left to their own devices, women would have no means of putting pressure on the men, either as individuals or as a group. It should be noted that the negotiating capacities

allocation of work and income. Such an approach simply does not correspond to reality neither insofar as men and women have distinct, though complementary, activities and revenues nor insofar as the production strategies of the former are different from those of the latter.

5

This sort of statement is understandable in a context where there is no unified family budget (the case in the very large majority of African societies): husband and wife have responsibilities defined within the framework of the family unit; the budgetary items for which each is responsible are quite clear. This being the case, an increase in the family head's income does not automatically benefit the whole family group.

of the two women's associations in Bagdadji are extremely weak. One of these is a type of traditional organization, a *ton*, which engages in social activities (organization of ceremonies, cultural events and *tontines*, or savings circles), while the other is a formal organization, the Local Union of Party Women, created at government initiative.

D. Office du Niger Policy Changes Since Liberalization

These changes, which have amounted to a real revolution in the ON's agricultural policy, involve four major orientations: liberalization of the rice trade, a relative devolution of control over water management, recourse to farmer organizations as partners in certain paddy processing operations, and relatively important openings for private sector firms.

1. Liberalization of Rice Marketing

This measure occurred as the final move in a series of structural adjustment changes, specified by the World Bank and the International Monetary Fund, which sought to reorient the role of the Malian Agricultural Commodities Agency (OPAM) by breaking the state's former monopoly over the cereals trade.

Trade in so-called traditional cereals had already been liberalized in 1982. But only in 1984 was rice marketing liberalized, especially at the Office du Niger, which plays a strategic role in supplying the cities.

Some bureaucrats feared liberalization would cause national rice production to crash in the face of competition from imported rice. The risks of domestic rice going unsold existed in fact, but the bureaucrats forgot that liberalization of the rice trade was the essential condition to motivate the farmer to produce more because he would be assured in fact of getting a large share of the potential profits.

2. Relative Devolution of Water Management Activities

This devolution has in fact been only a partial one because even today it does not extend much beyond the limits of the tertiary canal. The water management committees only really began to function in 1988, and already during this period there was no lack of intra-team conflicts over the organization of water rotations. More than once staff of the Retail Project (where strict water management was an absolute necessity) had to intervene to prevent these conflicts from degenerating into physical confrontations. Considerable progress has since been made, but devolution of authority over water management is an area where further efforts must be focused.

3. Recourse to Farmer Organizations as Partners in Certain Processing Operations

The over-development of the ON cannot be assessed merely as a function of its size (more than 50,000 ha), but also and especially in light of its former ambition to totally dominate the rice supply network, including all operations linked to production (plot leveling, farmer organization, input supply), as well as processing, warehousing and marketing activities.

Extreme centralization led to the creation of a larger and larger organization, which rapidly became practically unmanageable. The financial difficulties of the enterprise, linked to frequent breakdowns of the large-scale rice threshing and hulling/polishing machinery led the ON to proceed after 1985 to substantial reductions in its workforce and a transfer, increasingly important, of certain activities to the *colons*.

The involvement of the latter in processing operations really began in 1986 with the introduction of the threshing machines that served as the basis for organizing Village Associations within the ON. Afterwards came the rice hullers/polishers, intended to lead to the creation and development of Women's Economic Interest Organizations (GIEF). The involvement of the GIEFs in the hulling/polishing of a large stock of rice maintained by the ON over the past several years (approximately 30,000 tons) rather clearly demonstrates that the time is past when the ON thought of its relationships with the farmers only in terms of power and domination. Proof now exists that real collaboration is possible between farmer groups and the ON, and that the two institutions can both benefit very nicely from the relationship.

4. A Role for the Private Sector

The liberalization of the rice trade created opportunities for private sector operators within the ON. The ON's total or partial withdrawal from some processing operations created even further opportunities for private sector operators, who were involved in the rice hulling/polishing operation which began in October 1990 and was to last two months. In effect, a collaborative relationship is now arising among the ON, farmer organizations and the private sector.

It must be noted as well, concerning certain of its activities, that the ON has even been willing to compete with private firms. Input supply, formerly an ON monopoly, is now organized through competitive bidding procedures in which many private firms participate along with the ON.

E. Current Limits on Devolution

Not everything is idyllic in this list of changes that the ON is accepting, either willingly or under the pressure of events. Certain obstacles remain, among which the following: the reservations of certain ON personnel who are trying to impede these changes as much as they can, certain failings in terms of water management, weaknesses of farmer organizations in certain areas, and the perennial insecurity of land tenure, under which the *colons* have long suffered.

1. Reservations of Some ON Agents

The Office du Niger was long considered as a "state within the state" because the ON-*colons* relationships were characterized by extreme authoritarianism. Naturally the majority of ON agents have profited from the often exorbitant privileges linked to the context of a land exploitation system that was not that far removed from serfdom.

Many ON personnel saw decentralization as involving a loss of privileges, and it is fair to say that it was that in many regards. It is surprising that, in these conditions, ON agents do not try to impede the strengthening of the farmers' self-management capacities and those of their various organizations.

2. Inadequate Mastery of Water Management

These inadequacies derive from poor leveling of soils, that is to say, they are caused in part by problems in development or rehabilitation of irrigated plots. Improperly leveled fields make planning water rotations a highly problematic undertaking.

Another reason is certainly farmers' limited technical knowledge concerning water management. The further one goes above the tertiary canals, the more one confronts the problem of adequate tech-

nical training and information for those responsible for water management. Mastery of the whole hydraulic system by the *colons* would require at present much time and certainly considerable patience and self-sacrifice in training.

3. Selective Weaknesses of Farmer Organizations

Farmer organizations within the ON have, within the space of four years, made progress all the more remarkable in that the Village Associations were created for all practical purposes by state decree. It is thus normal that these farmer organizations have some gaps and even suffer from a certain fragility in certain areas.

To the gaps associated with water management must be added, in the case of many Village Associations, a lack of transparency in the management of the large-scale financial resources that the processing operations have made available to the *colons*. There are also problems in the relationships of farmer organizations with the party's popular organizations. The latter often make use of funds belonging to farmer organizations in a manner that is not clearly understood and, even less, welcomed by the farmers.

Reinforcement of farmer organizations involves more thorough institutionalization of these groups, which should also have the authority to form larger-scale units as a function of the size of the tasks to be undertaken.

4. Tenure Insecurity

The "colon" is typically still linked to the ON by an annual contract which is regularly renewed by tacit agreement. In this contract one still finds a clause that accords the Office du Niger rights over both the farmer's irrigated plot and his house. In practice the ON almost never reclaims dwellings. By contrast, farmers are still suspicious as far as his relationship with the ON concerning irrigated plots. More than a clear property right, what the farmers want is more secure usufructory rights.

This demand, first publicized in 1937, remains current today. Farmers' rights are more than precarious, in spite of multiple commitments (never respected) by the state to change the situation, and in spite of pressures applied by donors and farmers.

F. Conclusions: Some Exceptional "Trump Cards"

1. The Capacity of Farmers, Farmer Organizations and Private Operators to Rapidly Raise Considerable Financial Resources

- First, there exists the possibility of creating a public budget, for Bagada'ji village alone, of the order of 11,500,000 FCFA, in addition to the amounts collected for threshing (7 threshers processing an average of 36 bags/day = 250 bags/day x a value added of 3,400 FCFA net to the producer = 850,000 FCFA/day of net profits x 90 days of threshing activity = 76,500,000 FCFA. A 15% tax on the profits would yield 11,475,000 FCFA/year, while leaving producers' hands as additional private profits the sum of 65,000,000/year; or, calculated another way, assuming an average of 4,500 kg/ha x 673 ha of village land = 3,028,500/80 kg/sack = 37,856 sacks x 3,400 FCFA = 128,710,400 x 15% local tax = 19,306,560 FCFA.

2. Importation Options for the Private Sector

As the ON pursues its liberalization strategy, private sector development becomes a real possibility. A series of opportunities have already arisen. If the GOM continues to support current trends in the ON, multiple enterprises can be envisaged in several subsectors. Multiple providers of the same service will ensure the redundancy necessary to buffer producers against a breakdown in services if one or several firms fail or become overloaded with activities. Multiple providers will also encourage competitive pricing. If ON producers can retain extra profits on various operations, they will have money to invest in upgrading maintenance of their parcels and the irrigation system in general, in providing necessary physical and social infrastructure facilities, and in improving their knowledge levels concerning agricultural techniques appropriate under ON conditions.

Small Civil Engineering Firms

Small civil engineering firms could be developed to provide simple services such as parcel leveling and other forms of irrigation system maintenance. These firms could operate initially with limited amounts of capital, relying on small mechanized tractor units to provide annual maintenance services. Building construction and certain aspects of farm-to-market road maintenance under contract to public works agencies are other activities that could be efficiently undertaken by small firms.

Small Consulting Enterprises

As the quality of irrigated farming gradually improves, demand may arise for legal and engineering technical services. Individual farmers and farmers' associations may find they need assistance with preparation of contracts and development of rules and regulations governing local associations. They may discover as well a need for legal representation, e.g., in disputes with private sector firms that have contracted to provide specified services.

Likewise the development of more sophisticated capacities and production systems at the local level, with an associated increase in ON producers' levels of working capital, may be expected to give rise gradually to a demand for more sophisticated engineering services. Consulting civil engineers may find a growing business opportunity in this subsector.

Banking Sector

If the mass of money generated by ON production increases substantially over current levels, as more of the five unrehabilitated sectors are reconstructed and productivity levels increase generally throughout ON irrigation systems, demand for banking services can be expected to increase as well. Initially demand may be concentrated on safe-guarding cash belonging to AV and individual farmers, but eventually loans to finance creation of improved infrastructure and other public works may come to constitute a more important part of banking operations.

3. Local "Public" Sector: Village Governments

The AV and local general purpose and special purpose jurisdictions can be expected to play an increasingly important role in the provision of services. These will include services in direct support of productive activities, such as road maintenance and infrastructure creation (e.g., warehouses). It is highly likely that local jurisdictions will over time play a more important role in providing social services such as preventive and curative health care, primary education, potable water supply, etc.

4. Office du Niger

The Office du Niger will have a continuing role to play in managing the overall irrigation system. ON personnel will probably remain responsible for the operation and maintenance of the headworks

and hydroelectric plant at Markala, on the Niger River, as well as for division of water among the eight irrigation subsectors. The ON will probably also continue for the foreseeable future to maintain the eight primary distribution canals. Under the new liberal regime currently developing, the Office could serve in these various activities as the negotiating agent for irrigators in a subsector seeking to secure financing for a major rehabilitation operation. The Office may also be called upon in future to represent the interests of Office producers in negotiations with other users of Niger River waters, both within Mali and internationally.

5. Women's Situation

It is impossible not to recognize the efforts undertaken by the ON to improve the situation of women, by reducing their daily tasks by introducing rice shellers. However, these efforts are far from sufficient and have not as yet done a great deal to materially improve the position of the *colons'* women.

G. Recommendations

Recommendations are divided into technical and institutional suggestions for action and applied research.

1. Technical Recommendations

1. The following are proposed areas of applied production research:

- crop rotations that incorporate at least one break crop, preferably nitrogen fixing, that will permit farmers to eliminate wild rice and control soil-borne disease and insects;
- tillage techniques that promote low- or no-till forms of land preparation with a view to maintaining the micro-relief of irrigated fields;
- testing of non-traditional, high value cash crops as part of a seasonal rotation on both rainfed and irrigated areas under control of the village;
- testing integrated pest management (IPM) techniques with a view to lowering the amounts of costly chemical inputs to the economic and biological minimum required to produce the greatest income for the farmer;
- testing crop rotations that use only supplementary irrigation to compliment natural rainfall; and
- testing small scale farm machinery that compliments existing use of family hand labor.

2. Institutional Recommendations

1. Roles of farmers and local governments: the Office and the projects associated with it can further upgrade the productivity of Office du Niger operations on condition that they continue to encourage irrigators to organize themselves. This is valid for water management operations at the parcel, tertiary and secondary canal levels. Eventually, it may prove worthwhile to encourage farmer organization at the primary canal level. It is also desirable for farmers to play a larger role in product processing and marketing activities.

2. Roles for the private sector: as suggested above, the Office should continue to promote involvement of multiple private actors in various operations associated with production, processing and marketing Office crops, as well as encouraging supporting institutions such as banks and lawyers.

3. Roles for the Office du Niger: the Office will continue to play a critical role in overall organization of the production strategies in the scheme. In addition, it may be required to assist irrigators in other ways, not least of which will be organization of future negotiations on allocation of water among sectors within the scheme. Thought must be given to protection of irrigators' interests vis-à-vis those of other upstream and downstream users of river water, especially in bad years. In addition, electrical power generation seems important from the perspective of accelerated development.

4. Women's roles: to arrive at a significant change in the life situation of irrigators wives within the ON, it would be appropriate that:

- on the one hand, firms and organizations involved in assistance activities support women's groups and assist them to strengthen their organizational capabilities. It is only by this means that women's groups can win some real negotiating power, that will allow them to get a hearing, to defend their interests and to work out effective strategies vis-à-vis the attempts of men to capture all the opportunities;
- on the other hand the Office du Niger should facilitate women's access to rice production and gardening plots.

VIII. Anacanaa: Management of Surface Waters in Interlinked Watersheds

A. Introduction

This case study, like that of Sanankoro Togola, analyzes watershed management problems. Many of the same issues are posed at the local level. For instance, collective decisions must be reached to undertake the effort. Once the community commits to soil erosion control efforts, people must then choose: (a) sites and the sequence in which they will be treated; (b) conservation techniques and whether they will be applied collectively or by individuals; and (c) resource mobilization methods, (d) in each instance without or without outside assistance. Anacanaa and Sanankoro Togola are similar in these ways.

The two villages face watershed management problems that differ dramatically in scale. Farmers in Togola can approach their soil erosion problem as a local issue. Effective soil and water conservation efforts demand a high degree of organization at the local level, but they do not require coordination of Togola efforts with those of other villages. Anacanaa, by contrast, is situated at the downstream end of a large watershed that drains a part of the eastern Bandiagara Plateau. In Anacanaa, successful erosion control work depends on the willingness of villages upstream to do the same. In this sense, the Anacanaa case poses a classic dilemma in common pool resource governance: how can actions be coordinated effectively across local jurisdictions (or communities) that are independent of each other?

An additional complicating factor is the sheer size of the watershed basin upstream from the village, according to Anacanaa informants and the technical assistants helping them under the aegis of the Near East Foundation (NEF), an international NGO. The steep, rugged slopes of the watershed are not heavily populated, although bottomlands of the Dianvelli Valley are. Thus it may be impossible to mobilize the level of labor inputs necessary to install erosion control devices throughout the watershed. If so, watershed management may have to be organized on mini-watersheds within the larger one. Even so, these mini-watersheds will often involve more than one village.

Therefore, the Anacanaa case study focuses on the problems involved in organizing supra-village jurisdictions, or local special district governments, to address the watershed management problem. While this case focuses on the characteristics of appropriate institutions for soil and water conservation, the problem of organizing inter-community jurisdictions for governing and managing renewable natural resources is generic and of quite general interest in rural settings in Mali and other Sahelian countries. Governance and management problems concerning pastures, woodstocks, surface waters (rivers, streams, and lakes), ground water (aquifers), fisheries, and wildlife populations often affect more than one community. Without a capacity to coordinate action at the local level, such problems tend to worsen, generating avoidable negative results for local people.

This study contains seven additional sections: (1) an overview of the village situated in the watershed; (2) the production systems local people use; (3) village institutions; (4) supra-village institutions; (5) relationships between NEF and the village; (6) an institutional analysis of the problems involved in Anacanaa water and soil conservation efforts; (7) conclusions; and (8) recommendations.

B. Anacanaa: Geographical Context of the Village

The village of Anacanaa is located in the Dianvelli Valley 16 kilometers southeast of Douentza, the cercle seat, in the eastern part of the Fifth Region (Mopti). The Dianvelli Valley abuts the Bandiagara Plateau south of the Inner Delta of the Niger River. Following is a description of the village's location in relation to other communities and the Dianvelli Valley watersheds (see Figure 7).

1. Position in Relation to Other Communities

The Dianvelli Valley and its associated hills contain six villages, the easternmost of which is Anacanaa. Two streams, now only intermittent, flow through the valley from west to east during the rainy season. Both arise in the mountains to the west and join each other east of Anacanaa as they emerge from the valley. From west to east the valley is about eight kilometers long.

2. Position in Relation to the Dianvelli Watersheds

Two bottomlands meet on Anacanaa lands just below Anacanaa. The stream located in the southern part of the valley (Taouaom) flows through lands of the villages of Gamné, Anapin, and Anacanaa, in that order. The village of Gimelle on the hill south of Anacanaa farms plots in the Taouaom bottomland on Anacanaa territory. The other stream, Gounyogoro, flows through the village lands of Béni, Fomboridô, Anapin, and Anacanaa, in that order. In terms of runoff water management, there are two watersheds on the lands of six villages.

C. Production Systems

This section describes the physical and production system background of attempts in Anacanaa to introduce a flood control system on a seasonal watercourse that runs through village lands.

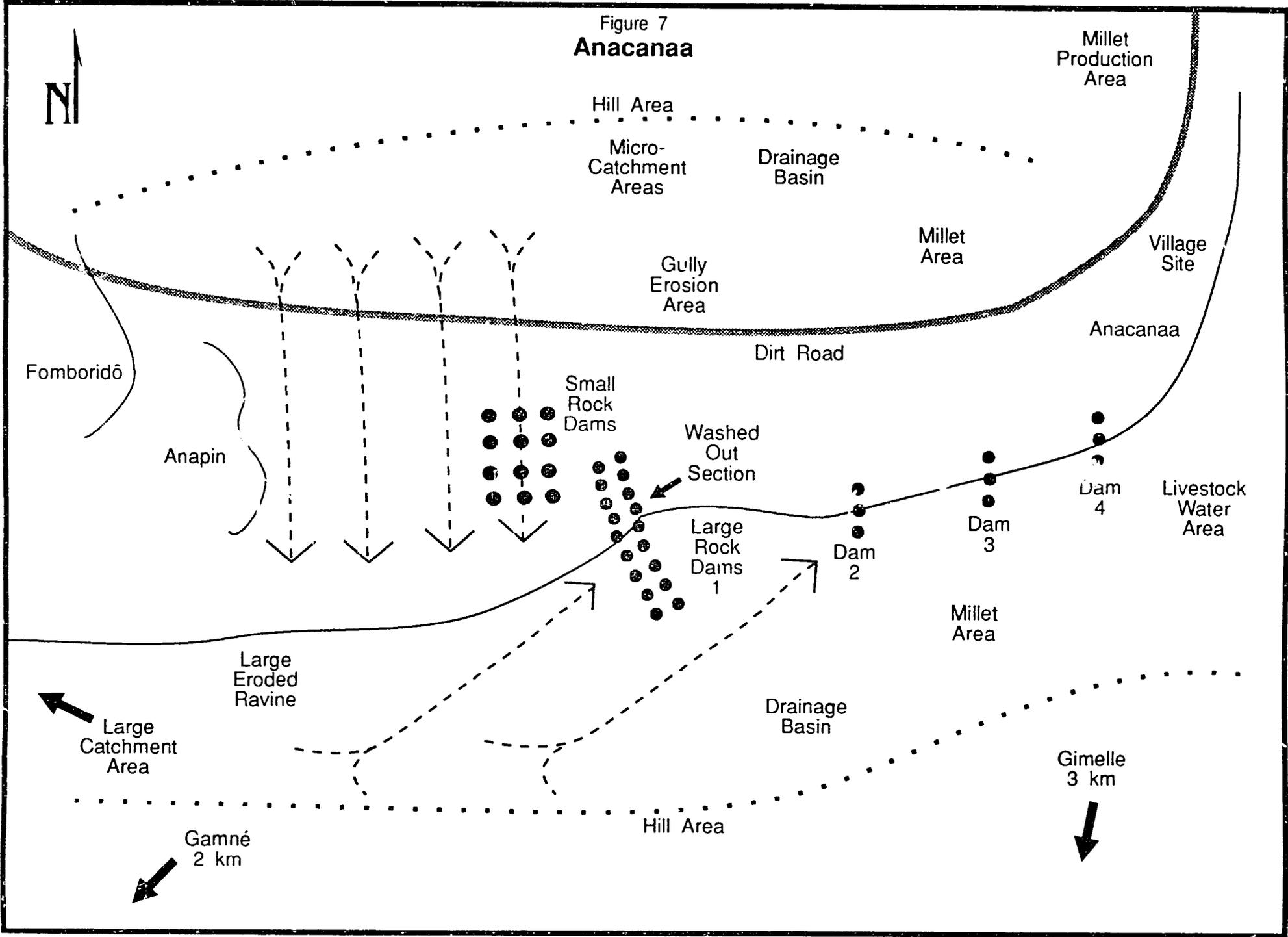
1. Local Context

Anacanaa is situated in a 300- to 350-millimeter rainfall zone. Yet, because of its geographical position, local farmers benefit from excess runoff water, which flows across part of their lands toward the two streams. The fields in the bottomland are especially rich, primarily because they are inundated by surface run-off. Consequently, agricultural yields are higher in Anacanaa than those normally found in a 300-millimeter rainfall zone.

The possibilities for agricultural and livestock development in this zone are closely tied to control of water infiltration. In effect, in agriculture such control means that plants can derive the benefit of soil moisture over a longer period. As far as livestock is concerned, infiltration permits a sustained supply of higher quality forage and through its impact on the water table, also increases the opportunity to water animals.

Anacanaa villagers engage in mixed farming with a heavy emphasis on small cereal grains (millet and sorghum). They produce limited quantities of cash crops, including groundnuts and a fiber crop called *dah* (*Corchorus capsularis*). There is also a small cottage industry based on growing calabash (*Crescentia*) and converting it into cooking and serving vessels. Village lands include a fertile, well managed pasture area that supports a large number of cattle (family herds average between 10 and 20 animals) and fewer small ruminants. The livestock herds appear in good health even at the end of the dry season when forage resources are limited. The reported reproduction rates are average to good in the better managed herds.

Figure 7
Anacanaa



2. Subsistence Cereal Production

The rainfed subsistence cereal production located in the micro-catchment area under improvement was extensive and did not include the use of improved inputs or a rotation with cash crops. Incorporation of animal manure or other organic material to improve fertility was minimal. Few examples were found of innovative agricultural technologies to cope with problems of erosion or lack of rainfall. Traditionally, farmers in the area have trapped moisture on their fields by creating small pockets when they hoe the soil. They also formerly used cut logs to bar gullies on their fields. Near-by villages were using tied ridges to localize and conserve moisture. Anacanaa farmers have not adopted these techniques. In the micro-catchment area under rehabilitation, little thought has been given to improved production practices. Farmers interviewed who cultivate in the improved area were waiting to see if their collective efforts to stop the ravages of erosion would improve the production potential before investing greater time and effort in adopting better cultural practices.

3. Village Erosion Control Efforts

Current efforts to control the major erosion in the large ravines dividing the catchment area have been unsuccessful, partially because of the inadequate designs of the rock dams. The expected effects of water spreading had not occurred, and villagers wanted to correct previous design mistakes before initiating further improvements of the micro-catchment area.

The two micro-catchment areas that villagers, with outside assistance, are currently trying to protect from water erosion have lighter soils than the bottom lands northwest of the village (see map) and have been affected since the 1974 drought by increasing hydraulic erosion. Their productive potential is less than that of the bottom lands located near the village. Erosion control efforts are described in greater detail in Section F.1.

D. Village Institutions

Like all other communities in the valley, Anacanaa is highly organized. It has several types of associations. All may be usefully thought of, in this analysis, as special purpose governments.

1. Quarter Government

The village has more than 1,000 inhabitants related by family and kin ties and residing in four quarters: Ogodjinnè and Ogoyara (from which the village chiefs are drawn), and Tôta and Yérou (whose residents are excluded from the local chieftaincy). Each quarter is headed by several elders who exert a sort of informal leadership in matters such as matrimonial disputes. The whole village elects a total of seven counsellors: one from each of the two quarters whose residents cannot hold the chieftaincy and five from the two ruling quarters. Counsellors guide the affairs of their quarter. If the leaders of a quarter cannot resolve a problem, they take it to the village chief or, for more difficult issues, to the chief and all his counsellors.

2. Village Government

Village government has both formal and effective components. The formal leader is the oldest man in the two founding quarters of Ogodjinnè and Ogoyara. Formal authority is transferred laterally through all the men of the oldest generation. Only when the youngest male of that generation dies is formal authority transferred to the oldest of the next. Formal leaders are generally quite elderly and do not appear to play an active role in local governance. Nonetheless, this system does ensure that

authority is moved around regularly among families in the two founding quarters. The rules for selecting local leaders make it clear to all that no one will hold power for very long. Thus leaders have an incentive to avoid abusing their powers, because everyone knows that others, in all likelihood, will rapidly replace them.

Effective government authority is exercised by a son of the reigning village headman. This individual usually represents the village in negotiations with other villages and in relations with the administration. He is assisted by the elected counselors. Formerly, the village headman's counsellors were spokesmen for their quarters and held the post for life on good behavior. In the early 1960s, the Modibo Keita regime substituted a five-year mandate, but Anacanaa informants report that re-election is a formality as long as a counsellor performs adequately. Under the current system, which is simply a slight variation of the traditional one, counsellors hold office for five years and thus remain in office whether or not the formal headman does.

Informants say that no one campaigns for a post in the local government because such behavior would reveal greater interest in power than local people feel an office holder should have. Villagers confer offices on those whose prior conduct suggests they will not abuse the trust.

3. Age Grades

In Anacanaa, the age grade system exists but is perhaps less powerful than in some of the other villages analyzed in these case studies. Nonetheless, boys become members of an age grade society at about 16 years of age after circumcision. Each of the four quarters has its own age grades. They provide labor for agricultural tasks, generally on the basis of reciprocity rather than for payment. Someone who needs help can request assistance from the age grades of one or more quarters. These requests are directed to the age grade head. As the oldest member of the group, he is responsible for mobilizing his mates. At the work site, the age grade head notes any absences. Unexcused absences warrant a fine ranging from 100 to 1,000 FCFA. If the fine is not paid, the delinquent may find that group members, in turn, refuse to honor his request for assistance when his own family needs help with farm work.

4. Political Committee

The UDPM committee exists but seems to be an appendage of the local authority structure rather than an autonomous body. Many of its members hold posts in the existing institutions of village governance.

E. Supra-Village Institutions

Two sets of institutions affect village-level decision-making and development possibilities: the traditional canton, suppressed in 1960 by the independent regime, and the administrative and political institutions of the contemporary Malian state. Most of the information collected concerned the traditional canton.

According to the village headman of Anapin (Dianvelli Maoundé), Anapin in the pre-colonial era was the seat of a canton that included the six communities in the Dianvelli Valley: Anapin, Anacanaa, Gimelle, Gamné, Béni, and Fômborido. Anapin was the original settlement in the valley. The five other villages were eventually founded by people who moved out of Anapin to colonize new ar-

areas in the valley. Anapin Canton was a subsidiary unit within Ahmadou Sékou's Dina political organization based on the Inner Delta of the Niger River.

Among other activities, the canton chief organized a collective field. He and his counsellors decided what to plant and organized work groups mobilized from all six villages to clear, plant, cultivate, weed, and harvest the field. The grain harvested was stocked in a pair of silos under the canton chief's control. These reserves served two purposes: production of beer to celebrate funeral ceremonies for deceased elders, and as a social security fund to assist needy families and people whose crops failed through drought or other calamity.

At independence in 1960, on the party's recommendation, the new government suppressed the authority of canton chiefs to mobilize labor to cultivate a collective field under a chief's control, as part of a general effort to suppress cantons. The government replaced them with sectors--administrative units at the sub-arrondissement level. Anapin and the five other villages of the old canton were consolidated with the 10 villages of the neighboring canton of Tingé. Later on, the two groups of villages were again separated along traditional lines, although the cantons were not recognized.

Although the village headman of Anapin no longer holds sway over the other five villages of the Dianvelli Valley, Anapin continues to enjoy some recognition as a traditional seat of power and a focal point for supra-village organization in the valley. According to the headman of Anacanaa, in 1981-82 the headmen and counsellors of all six villages met in Anapin and, after thorough discussion, made a collective decision to build a primary school at Anapin. Different villages contributed the necessary materials, and all mobilized their own age grades to help with construction. They completed the work and, according to the Anapin headman, have since helped occasionally with maintenance jobs.

The school construction and maintenance activity may have some significance for watershed management problems discussed below, but to assess that significance accurately, the experience must be placed in context. A consensus existed among counsellors and headmen of valley communities that their children needed French-language education. The public debate at Anapin made this clear, and it also resolved the ticklish problem of location. Anapin was chosen in part because of its historical status and in part, perhaps, because of its relatively central location. School construction required large amounts of labor but could be scheduled for a single time period so that each community's representatives could monitor, without extra effort, the participation of all other communities. Major maintenance, such as replastering classroom walls, can be organized similarly, so again, monitoring other communities does not pose a problem. Furthermore, it was possible that children from communities which failed to participate in school construction would be excluded, thus a potentially effective enforcement mechanism existed, ready-made, to provide additional incentives for compliance. The activity did require some "public entrepreneurship" from leaders of the six communities to create a public agreement. But implementing that agreement exposed no hidden institutional traps. These points must be borne in mind when analyzing watershed management issues discussed below.

F. History of NEF/Village Activities

The NEF-initiated watershed management activities began in October 1987 after the harvest. Earlier that year, a representative of the organization had made inquiries at Anacanaa about local willingness to engage in watershed management activities. Anacanaa people agreed to participate.

1. The Problem: Environmental Degradation

The Anacanaa headman and several of his counsellors maintain that the Dianvelli Valley, in the pre-drought years, contained an abundant woodstock. The many trees found in fields and in the bottomlands immediately adjacent to the perennial watercourse broke the force of early season thunderstorms, slowed the movement of surface waters, and promoted infiltration. It seems likely that the same conditions existed further up the watershed, because the flows in the two watercourses through the Dianvelli were reportedly relatively moderate year round and no ravines were found. In this environment, enough wood existed so that farmers could cut trees for logs to block incipient gullies in their fields.

In the early 1980s, the Dianvelli Valley reflected the ravages of nearly a decade of drought. Trees died off in increasing numbers. The perennial streams became seasonal watercourses as the upstream watershed gradually lost its capacity to retain surface waters during the rainy season. More and more of the first hard rains washed down the valley with increasing force, cutting gullies and then ravines deep below the valley surface. Natural waterspreading that had occurred as summer rains slowly swelled the stream until water spilled gently over the banks and inundated bottomlands was replaced by torrents of water that rushed almost entirely out of the valley before they slowed and spread. As Anacanaa villagers saw the problem grow ever more severe, they were motivated to accept a collaborative water and soil conservation operation with NEF.

2. Negotiations and Construction of the First Flood Control Dam

Anacanaa residents and the NEF representative discussed what they should do to control the water. Most residents, according to the headman and his counsellors, favored building a ford on the stream where it passes the residential center of the village. When the summer floods move down the valley, the waters can become so violent that local herds cannot re-enter the village in the evening when they return from grazing on village lands. NEF declined to support that activity, apparently on the grounds that it would deal only with a symptom rather than with the roots of the problem.

NEF proposed that Anacanaa residents help build small retention dams further up the valley on Anapin land. Anapin had begun working with NEF in 1986. Anacanaa residents declined to work on Anapin land, expressing concern that their efforts would benefit primarily Anapin people, not Anacanaa people. So a compromise was struck: NEF and the Anacanaa representatives agreed to build a small dam on the watercourse just downstream from the Anapin boundary.

Once the site was chosen, materials were mobilized primarily on a self-help basis. NEF provided a truck to transport rocks from where they were collected to the check dam sites in the river bottom. Villagers had to gather rocks on the slopes of adjacent plateaux, load them into the truck, dump them at the dam site, and construct the dam. Villagers, according to Anacanaa informants, mobilized between 20 and 100 youth and men to work five hours a day, three days a week from October 1986 to the beginning of the 1987 rains. They succeeded in building the dam.

3. Additional Structures and Repairs

During the 1987 rainy season, flood waters overflowed the dam and its wings and poured back into the stream bed, creating new gullies. In the next two years, villagers tried to build additional small dams to further control and channel the water on NEF advice. Fewer persons participated in these projects primarily, according to the Anacanaa chief, because bad harvests in those years forced many young men to leave the village in search of work during the ensuing dry season. In 1990, harvests

improved somewhat, and he expects they will make better progress this year. From 1987 to 1990, collective work days were reduced to two per week, partially because labor was not available, and partially to permit individuals to install soil and water conservation structures on their own fields.

4. Technical Problems

The lessons of this effort are found in the technical and institutional problems that arose in the course of implementation. Technical difficulties are symptomatic of the scale of the problem in purely technical and in jurisdictional terms. Institutional problems reveal a potential weakness of a labor-mobilization system based on reciprocity.

The major technical issues appear to be: (1) whether surface water flows can be controlled by a dam at the lower end of the watershed without other structures installed further up the stream; and (2) whether in-channel surface water flows can be managed without accompanying erosion control works on individual fields. NEF personnel recognized these technical issues fairly early on and are now seeking advice on whether they can be overcome at reasonable cost. In the meantime, the NGO has authorized Anacanaa villagers to use its truck to transport stones for soil and water conservation devices on villagers' fields. Only two individuals took advantage of this opportunity in 1989, but in 1990, at least five in the chief's quarter did.

An institutional issue complicates the problem of labor mobilization in this situation. The headman reports that downstream from the dam a total of either eight or 30 fields are protected by the dam from soil erosion. His information varied on the number of fields, perhaps because he interpreted the question differently the second time. In any case, of the eight fields, he indicated six belonged to families from one of the two Anacanaa "ruling" quarters, and one to a family in each of the non-ruling quarters. The other ruling quarter had none. Those whose fields will benefit if the dam finally proves successful in controlling flood waters and halting gully erosion downstream have consistently helped with the work. Others have been less willing to continue the effort.

The village chief says those involved wanted to tackle other ravines elsewhere on village lands following 1987 when the first dam was constructed, but NEF personnel pressed them to finish the work started, and they complied. The tension here apparently arises from the conflict between the technical imperative to consolidate the gains in one place before tackling others, and villagers' desire to respect the local rules about reciprocity that govern labor exchanges. Villagers and their leaders foresaw difficulties in continuing to uphold their side of the collaborative agreement if this conflict could not be resolved or finessed in some way.

G. Analytic Approach to Land Management Problems in the Dianvelli Valley

This section analyzes the Anacanaa information about watershed management and flood control efforts using the same framework as in the other case studies. Each resource, good, or service is first described in terms of its economic attributes. Then the working rules governing management of the resource are specified. The third section describes the interactions that follow when various actors pursue their strategies to obtain their goals in light of the incentives contained in the attributes of the goods and the working rules of management. The outcomes that result from those interactions are discussed in the fourth section.

1. Economic Attributes of Fields, Watersheds, and Water Control Services

Fields, watersheds, and flood control works (described in Sections B. and F.), considered as economic goods, have attributes that influence the way resources are mobilized for their management. Clarifying the incentives inherent in these resources and the goods and services they produce makes it easier to understand how institutions must be structured to ensure that the resources will be properly governed and managed.

Fields on Village Watersheds: Private Goods with External Effects

Each farmer or farm family cultivates its own fields during the rainy season. Because people spend their days in the fields, it is fairly easy to control access to them. Consumption of the crops (goods) produced in the fields is separable and competitive. Thus, during the farming season, fields have the attributes of private resources that produce private goods. The fact that farmers capture the benefits of investments, however slight, in applying soil and water conservation techniques to their fields creates a motivation for individual families to make those investments. Traditionally, Anacanaa farmers have used cultivation techniques designed to harvest surface waters on the field and to promote infiltration. At least a few are now using the NEF truck to install more permanent stone berms or dikes on their fields.

The effects of agricultural activities in a given field are not totally subject to exclusion. Fields cultivated with erosion control in mind will generate positive effects, or externalities, for those further down the slope. By slowing the descent of surface waters, they reduce the extent of erosion on fields further downhill. Conversely, if a farmer makes no effort to control erosion by, for instance, hoeing on the contour or attempting to block gullies before they spread, then downhill fields will likely suffer negative impacts or externalities.

Surface Water Management on Small Watersheds: A Public Good

The negative or positive externalities generated by each field within a micro-watershed accumulate. Those who occupy fields on the watershed cannot be fully excluded from positive effects that managed surface-water flows generate in reducing soil erosion on the slopes of a small watershed. Nor can they be fully protected from negative effects that occur when watershed management services are not provided. The impacts of those positive or negative effects (varying degrees of soil erosion and water infiltration) are consumed in a joint, non-rivalrous manner. Those who farm fields lower on the slope benefit from the effects of water conservation techniques applied on higher fields. One farmer's benefits from proper water management above his field on the watershed does not prevent others on the same watershed from deriving similar benefits. Proper water management affects agricultural conditions on each field within the watershed. Thus management of surface waters on the arable small watersheds within village lands of the Dianvelli Valley has the attributes of a public good. It is difficult to prevent farmers on the watershed, particularly on the lower slopes, from having access to the good, but benefits are consumed in a non-rivalrous fashion.

Non-Management of a Large Watershed: A Public Bad

The large watershed upstream from the Dianvelli Valley may be too large to manage given its size and the limited number of people available to help construct water management works. Vegetative cover has apparently been degraded, in part by human uses, but more dramatically by the effects, in an already arid environment, of recurrent droughts over the last two decades. The downstream flash flooding that results appears to be primarily a natural phenomenon. It has the attributes of a public bad. It is hard for downstream farmers to protect themselves against the negative effects of soil ero-

sion caused by the flash flooding. Consumption of the negative effects is joint: one farmer's suffering does not reduce another's.

No downstream holders can be excluded from the benefits of managing surface run-off better and reducing the public bad of flash floods. If dams and other water control structures are built, downstream farmers will benefit even if they have not contributed--an incentive to avoid contributing. Although the temptation exists to free-ride on others' efforts to build water management devices, it may be overcome with appropriate institutions.

Flood Control Works in the Dianvelli Valley: Public Goods

Dams that are constructed by local people with assistance from NEF staff have the attributes of public goods. It is difficult to exclude those whose fields are threatened by summer flash floods from the benefits of flood control works installed upstream. Consumption of these benefits is joint, not separable: the fact that one riparian owner loses less of his field to gullies and ravines or produces better crops because surface waters are slowed by upstream dams and spread out gently over cultivated fields, does not detract from the capacity of other riparian owners to derive the same sorts of benefits from these structures. Once again, for downstream farmers the combination of access to the benefits of flood control works coupled with non-rivalrous consumption of those benefits creates an incentive to free-ride on others' efforts. This incentive must be overcome with institutions that take into account the economic attributes of flood control works in this setting.

Clearly, the people of Anacanaa, Anapin, and the other villages of the Dianvelli Valley face a complex set of resource management problems. The complexity of these problems derives, in part, from the complexity of the goods and services that must be governed and managed to improve agricultural conditions in fields and on the watersheds. Following is a discussion of the rules governing provision of soil and water conservation efforts on family fields and provision of flood control works.

2. Rules Governing Interactions

This section outlines the working rules governing access to, exploitation of, and investment in production of the goods, services, and structures discussed in the preceding section.

Family Fields

The working rules governing fields during the agricultural season treat them as private goods. Families working their land can cultivate as they wish and can exclude others from access to their fields and to the crops growing there. Therefore, local land tenure rules take into account the economic attributes of fields under cultivation (see Section G.1., above). These rules assume that people have positive incentives sufficient to motivate them to take care of their land.

Surface Water Management on Micro-Watersheds

Surface water management on the micro-watersheds in Anacanaa is not subject to rules requiring families or individuals to use water and soil conservation techniques in cultivating their land. No one is required to make investments in watershed management. Management of these watersheds is, thus, entirely a result of voluntary activity on the part of those who farm there. Unlike Sanankoro Torgola, efforts have been directed at controlling flood waters in the valley bottom, rather than at organizing to build a set of soil and water conservation structures collectively starting at the top of the small watersheds.

Large Watershed

No rules exist, at present, for organizing a program to build flood control structures in the large watershed upstream from the Dianvelli Valley. The problem is simply too large to handle using available village labor and other local resources.

Flood Control Works in the Dianvelli Seasonal Watercourses

The village-NEF efforts to construct dams at Anacanaa, Anapin, and in other valley villages do involve rules governing labor mobilization. In Anacanaa, members of village age grades must participate in this activity when present in the community and in good health. Unexcused absentees may be subject to fines. Men from all four quarters always work on a single collective site at one time. Normally, a rule of reciprocity would require that efforts be shifted around so that erosion problems are treated in different parts of the village and all eventually benefit. However, NEF staff have required three years of work in a single area during the experimental stage while they determine whether or not building dams on the seasonal water courses is an appropriate strategy for watershed management.

Another working rule specifies that men of each village will work only within their own village jurisdictions. They strongly resist constructing flood control works on lands belonging to other communities.

3. Interactions

This section discusses the interactions concerning each good given the motivations individuals face both in the attributes of the goods and in the rules governing their management or construction.

Family Fields

Anacanaa farmers have long used at least rudimentary soil and water conservation techniques on their own fields. Some are now taking advantage of the transportation facilities made available to individuals by NEF to gather materials and build more permanent water management structures in their fields.

Micro-Watersheds

Thus far, the sort of collective approach to watershed management found in Sanankoro Togola does not exist in Anacanaa. Collective and individual approaches to watershed management are currently pursued independent of each other.

Large Watershed

No effort has been attempted to manage water flows in the large watershed upstream from the Dianvelli Valley

Valley Water Control Works

The policy of concentrating on a single site and finishing a project once started appears to cause tensions among landholders within the village. Many who do not benefit from these investments because their fields lie elsewhere have concluded that current beneficiaries will not be called upon to make reciprocal labor investments benefitting them, at least within any reasonable period of time. As a result, they have reduced their labor investments or have stopped working on the site altogether.

4. Outcomes

A few individuals have begun to introduce more sophisticated soil and water conservation techniques on their fields. Most of the others use some types of traditional water-harvesting cultivation

techniques. If more people were to invest more heavily in soil and water conservation techniques, outcomes lower on these watersheds might be more efficient in terms of preserving soils on fields. Equity seems to be achieved in a rough sense, because those who make the investments on their fields tend to reap most of the benefits.

Small watersheds are not managed in any organized fashion, and the cumulative run-off may contribute, in heavy downpours, to the flooding and erosion problems in bottomland fields. This may be inefficient. Available information is insufficient for judgments about the relative costs and benefits of organizing to implement joint management efforts on specific watersheds in the form of water retention structures. Information available permits no judgment on the equities involved.

Currently, the large, upstream watershed above the Dianvelli Valley is not managed. While this may create problems for downstream users, it is probably efficient in the sense that the costs of installing an effective system of flood control works would be prohibitive.

The dam and ancillary works constructed in the valley bottom to control water flows there may be efficient depending on the adequacy of the technical design of these structures in light of probable water flows. The criterion of equity is probably not yet met in the sense that many who have invested their labor to build the dam derive no benefits from it. If present beneficiaries help construct other works that improve conditions on the fields of those who do not now benefit, equity will be better served.

H. Conclusions

With NEF, Anacanaa embarked on an experimental program in surface water management similar to those the NGO is conducting elsewhere in Douentza Cercle. The technical issues involved in building a dam adequate to control the quality of water that normally flows through the Dianvelli Valley are now recognized as serious problems. The strategy of starting in the bottom lands, rather than at the top of the contributing micro-watersheds, may be questioned in retrospect. The answer is not yet clear because of uncertainties about how much water the large watershed upstream contributes to the flow in seasonal valley watercourses, particularly after flash floods.

It is possible that aggressive soil conservation measures on contributing micro-watersheds would reduce in-stream flows enough for the dam to function as envisaged. However, this result is not certain. NEF expects to modify the existing dam structure as an experiment by lowering the height of the dam at the midpoint so excess water will flow down the stream center, not overflow the dam wings creating new ravines in previously protected lands.

Another approach would involve continuing to construct dams at points along the Dianvelli seasonal watercourses. It is conceivable that if local people build enough dams, they would eventually succeed in regulating flows in the valley to the point where flash flooding would no longer pose a threat to valley fields adjacent to the Dianvelli watercourses. Such an effort would probably involve constructing several more dams. Presumably, it would also create the need for a special district to coordinate the placement, construction, and maintenance of the dams. It is by no means obvious that such an effort is desirable, or if it is, that the institutional innovation necessary to carry it off would be feasible. Nonetheless, it appears a worthwhile approach to explore.

I. Recommendations

1. Obtain professional engineering assistance to determine the technical parameters of the water control problems in the Dianvelli Valley and in the large watershed above the valley.

2. In the Dianvelli Valley, NEF staff should encourage the six communities to explore possibilities of collaboration within the context of a joint institution or special district for watershed governance and management. A possible base rule, in light of information provided by the headmen of Anacanaa and Anapin, would be for each community to commit to work on its own territory. This constitutional arrangement should include, among other things:

- an annual agreement on activities to be undertaken, publicly debated, and accepted by an assembly of village assemblies as the decision-making mechanism of the district;
- a resource mobilization mechanism allowing the district government to mobilize labor and to provide supplementary labor in other communities to handle watershed management problems that exceed the capacity of a local work force; and
- a mechanism for monitoring work progress, so that each community could be assured that the others were contributing their fair share to the effort.

The six villages might not be equally willing to participate because of differing degrees of exposure to flash flooding and difficulties of organizing labor exchanges within the community in a manner to provide benefits to those whose fields are not affected by the flood control program, for example. NEF should be prepared to work with these variations. The Administration should also be willing to accept locally different institutions as a condition for progress.

3. The NGO, together with the villagers, should undertake adaptive agricultural research to determine the most appropriate use of animal and semi-mechanized techniques to transport rocks from quarry to dam site.

IX. Conclusions and Recommendations

A. Introduction

This chapter presents conclusions and recommendations drawn from the six case studies. Both conclusions and recommendations relate most directly to Malian circumstances. They also address technical and institutional issues concerning RNRM and RNRG that occur more broadly throughout Sahelian countries.

B. Conclusions

The six sites described in this report are not presented as a cross-section of RNRM situations in contemporary Mali. Team members understand that rural communities in the country, as elsewhere in the Sahel, vary in their capacity to undertake collective action, facilitate private sector activities, coordinate RNRM and RNRG initiatives across several local jurisdictions or informal governments and resolve disputes. Indeed, almost all the case studies reveal problems and limitations affecting the ability of local governments to govern RNR adequately. At the same time, limitations in local capacities should not be seen as a valid argument for refusing to devolve some RNR governance and management authority to local communities. Such a refusal would amount to a rejection of the very considerable institutional and human resources available at various local levels in Mali.

These local institutional and human resources should be taken as the starting point of thinking about RNR management and governance in Mali and elsewhere in the Sahel. The study communities have demonstrated considerable ability to create working institutions for RNR management and governance. They have, over a period of years, consistently mobilized and managed the necessary labor, material and money to protect and enhance local RNR. They have successfully resolved conflicts concerning their renewable natural resources. They have shown willingness and ability to collaborate effectively on RNRM and RNRG problems with outsiders, whether other local communities, state agents, NGOs or foreign assistance personnel. In light of such capacities demonstrated by the study villages, but by a large number of other Malien rural communities as well, attention in the future should focus on (a) finding out what local capacities are and (b) trying to strengthen them through appropriate legislation, through technical assistance, and through circulation of ideas.

The overall goal, in an era of growing recognition of the limitations of the central state, should be to liberate and encourage local initiative in RNRG and RNRM. In addition to changes in formal rules, movement towards that goal will necessitate a new willingness on the part of state, NGO and foreign assistance agencies to recognize the existence of local potential, and to carefully adapt their programs to local strengths and capacities, as well as local weaknesses and limitations. It is no longer adequate to assume either that the "village will do it," or that "everything must be done for rural people." It is crucial to assist local people, if they feel they need help, to strengthen their own capacities for self-governance and self-management.

C. Recommendations

General recommendations are based primarily on the case studies. Team members' background knowledge about Malien and Sahelian conditions also affects the recommendations. No attempt has been made, however, to canvas all on-going projects. Some recommendations suggest policy changes, action approaches or applied research about RNR problems that are already underway in Mali or elsewhere in the Sahel. Recommendations are presented in three categories: technical recommendations, institutional recommendations, research propositions, and follow-on activities.

1. Technical Recommendations

These recommendations follow from team members' observations concerning production systems in several of the case studies. As the basis of the local economy, the relative organizational and technical efficiency of production systems fundamentally shape the capacity of rural people to sustain themselves on the land and generate a surplus of products for urban consumption or export. Anything that improves the functioning of a given production system is likely to enhance the ability of local people to undertake and finance public activities.

1. Technical research should be devised to support local efforts to heighten production system efficiency, where such efforts exist. Local farmers showed a good deal of technical initiative and inventiveness in several sites. Their efforts focused on innovations they considered useful in reinforcing the sustainability or efficiency of their production system. In Sanankoro Togola, for instance, a local farmer selectively bred sorghum to adapt it to the specific conditions of his field. In other places, for reasons team members were not able to clarify entirely during the limited time available, farmers failed to exploit obvious opportunities to enhance productivity, e.g., non-adoption of animal traction equipment in Yaguinébanda, a community with ample supplies of livestock.

Where less initiative is displayed, technical investigations should focus first on the impediments to production system efficiency that local people identify. Once these have been isolated, efforts can be started to overcome them. Efforts to extend the range of cash crops produced locally to buffer farmers against fluctuations in local, regional and international markets would be an appropriate focus.

2. Identify and seek to modify regulations that make it difficult for farmers to obtain quality inputs in a timely manner, and to sell their products in commercially attractive markets.

The geographic impediments to livestock marketing in Yélimané Cercle, where Yaguinébanda is located, discourage exploitation of pasture resources that may still be underutilized. The Office du Niger, by liberalizing rice marketing, has created strong incentives for farmers to produce more rice.

3. Assist farmers, rural producers and other private sector operators to process agricultural commodities so they retain a larger share of the value added. This can be done either through collective operations, organized by cooperatives, or by private individuals or firms.

In the Office du Niger irrigation scheme farmers have begun, with project assistance, to acquire small rice hullers. Using these machines to process rice local farmers have earned considerably more from their production than they otherwise would have. Villagers working in OAPF might do much by transporting wood products from the forest and marketing them in town. Some have already shown great interest in such activities, and should be encouraged.

2. Institutional Recommendations

Institutions can be viewed as instruments that facilitate people's effort to solve their problems. If an existing institutional arrangement does not measure up, opportunities may exist to realize gains in RNR management effort by modifying specific rules in an institutional framework. Conversely, if existing institutions, whether formal or informal, appear underutilized, gains may also be possible by relying more heavily upon them. Rules that may be appropriate candidates for modification fall into several areas, outlined below.

1. Local institutions should form the starting point of efforts to preserve and enhance RNR. Sahelian governments can make a strong contribution, as can donor-financed projects and programs and NGO operations, by reinforcing the positive aspects of local institutions. Such support can take several forms:

- review legislation concerning local organizations (traditional and modern governmental organizations, NGOs, etc.) with the goal of incrementally revising specific laws to reduce the costs to rural people of collective action designed to preserve or enrich RNR;
- create enabling legislation to authorize creation of special districts at local initiative to take responsibility for RNR management and governance;
- create enabling legislation to authorize local communities to tax themselves, through labor, in-kind and cash contributions, to finance RNRM and RNRG activities;
- support the growing willingness of state agencies to rely on existing institutions to govern and manage RNR, for instance, fishermen's associations to govern and manage fisheries, age grades to undertake pasture and watershed management activities, canal associations at various levels to coordinate irrigation water use and system maintenance, etc.;
- support research to explore and strengthen traditional organizational units of the sort noted above, but also to identify pre-colonial local units--village clusters, cantons and the like--that may provide institutional bases for RNR governance and management in the Malien and Sahelian countryside; and
- explore ways to strengthen the role of local judicial and conflict resolution mechanisms in clarifying disputed access and appropriation rights to RNR.

Many of these recommendations involve complex issues. They are proposed here as foci for action by the Government of Mali (and other Sahelian governments), donors and NGOs. The complexity of the issues will in many cases retard action. This is to be expected. Delays can prove productive on condition that they permit a widening and deepening of public debate and reflection on these issues. In recognition of the complexity, however, most of these same topics are proposed as applied research themes.

2. Land tenure rules and property rules concerning renewable natural resources, in addition to land, strongly influence management and governance efforts. Rules in this category include both formal legislation such as Sahelian national forestry codes and informal or traditional rules regulating access to and control over land, trees, pastures, water, etc.

The efforts of Sahelian governments to modify formal tenure rules to reduce the costs involved in managing and governing RNR should be supported on a continuing basis. Many donors and some

NGOs have, with Sahelian counterparts, invested considerable funds and effort in this sector. These efforts should be vigorously pursued so long as they respect the contributions that local leaders and local people can make in this sector.

3. Reinforce the new freedom of the press now authorized in Mali and several other Sahelian countries, and encourage publication of local language newspapers and other reading materials. They can serve as conduits for the circulation of information at the grass roots level on institutional and technical innovations in RNRG and RNRM, and their successes and failures. Making more information available about such issues will both help people recognize the complexities involved and will permit efficient sharing of experiences so that, over time, communities become better able to avoid institutional and technical traps in RNR management and governance.

4. Continue to support women's efforts to preserve and strengthen their rights and capacity to contribute to the economic and institutional development of their families and communities.

This issue raises many problems, and should be approached cautiously so as not to disrupt sharply local conceptions of the role of the sexes. On the other hand, women in at least four of the six study sites have made important efforts to improve the lot of their families while improving the operation of local production systems. Their efforts represent a tremendous resource in local economies and should be fostered.

5. Continue to liberalize private sector operating conditions to foster development of local economies, multiplication of ways to resolve RNR problems, and generation of resources that local communities can use to finance RNRM and RNRG activities.

3. Research Propositions

Research activities can be treated in three categories: technical, local institutional, and national institutional. Each is sketched out briefly below.

Applied Technical Research Themes

1. Organize a survey of villages in selected areas to identify farmers currently engaged in applied technical research, either in attempts to tailor externally-proposed technical packages to local conditions, or to develop their own solutions to local issues. Explore possibilities for supporting these efforts and disseminating information about them.

2. Build on existing local and external assistance efforts to identify additional areas where private sector operators, including farmers and cooperatives, can engage in crop processing to capture value added returns.

3. Support a small research operation in collaboration with fishermen downstream from the Manantali Dam designed to increase the productivity of river fisheries in light of the sharply modified water regime.

Applied Research on Local Institutional Themes

Some of the themes proposed here should be undertaken within the context of existing projects, programs and NGO activities. Others will examine entirely local efforts as foci of research.

1. Undertake a comparative survey, both of existing literature and field sites, of the role of contemporary local institutions in managing and governing RNR. This research should emphasize rule-making, conflict adjudication and resource mobilization aspects of RNRM and RNRG.

A substantial, partially annotated bibliography on this theme has been developed as part of this series of Club-financed activities, and another is underway. The RESADOC holdings at the Institut du Sahel, and materials in the libraries of Sahelian universities, national libraries, etc., should also be exploited. Library research should be followed up by field investigations, organized by resource types and designed to highlight the range of solutions local people and communities have developed in this sector.

Research on this issue should examine carefully the roles of all local institutions, e.g., the chiefdom, local council, age grades, *tons*, inter-village organizations, sectors, cantons and political organizations.

2. Develop a series of case studies on the role of pre-colonial local polities and communities in RNR management and governance. This research should emphasize rule-making, conflict adjudication and resource mobilization aspects of RNRM and RNRG.

The purpose of these studies would be to identify underutilized, or dormant, local institutions that might serve as building blocks for improved RNRM and RNRG in Mali, and in other Sahelian countries.

3. Examine selected contemporary and historical RNRM and RNRG cases to determine whether institutions have been adapted to the attributes of the target resources, considered as economic goods. In other words, are RNR that have the characteristics of private goods, public goods or common pool resources recognized as such? Are institutions appropriately structured to deal with the problems involved in managing each type of good? If not, why not, and what are the prospects for modifying institutions so that they are better adapted to their tasks and enable people to manage or govern RNR more efficiently?

Applied Research on National Institutional Themes

1. Examine reviews of legislation concerning local organizations (traditional and modern governmental organizations, NGOs, etc.), undertaken as part of this study, and similar materials produced by other applied research efforts to identify specific laws that could be incrementally revised to reduce the costs to rural people of collective action designed to preserve or enrich RNR.

2. Examine and, as necessary, revise or devise national enabling legislation to authorize creation of special districts with limited powers, geographic domains and scopes of activity, at local initiative, to take responsibility for RNR management and governance.

3. Examine and as necessary revise or devise national enabling legislation to authorize local communities to tax themselves, through labor, in-kind and cash contributions, to finance RNRM and RNRG activities.

4. Undertake a comparative applied research activity to reveal how state agencies in Mali and in other Sahelian countries rely on existing local institutions to govern and manage RNR.

Research should be organized by resource sector. Investigations should focus on the specific roles, powers, scopes and domains of local institutions supported by state agencies, and in what manner (action, frequency, cost, etc.) government representatives are called up to assist local RNRG and RNRM units.

5. Explore ways to strengthen the role of local judicial and conflict resolution mechanisms in clarifying disputed access and appropriation rights to RNR, through comparative research on methods local communities now use to resolve disputes.

Follow-on Activities

1. Results of applied research on these themes should be disseminated through various channels, including local-language newspapers, reviews and technical sheets.
2. The Club du Sahel, CILSS, Sahelian governments, donors and NGOs should explore possibilities for development of village-level and in-service training courses that would draw on the knowledge of local people and on research findings of the sort outlined above to increase rural people's capacity to deal with technical and institutional issues.
3. A Center for Public Choice and Governance should be organized under CILSS auspices, with a mandate to assist Sahelian governments, local communities and other actors with the analysis of institutional and governance problems in the domains of RNRM, RNRG and provision of public services at the local level in Sahelian countries.

Annex A: Typical Farm Model Partial Budget

A typical farm model of a 7 ha. rainfed farm in Sanankoro Togola has been used to develop a partial farm budget from the information obtained during village interviews. The purpose of making these calculations is to give the reader a notional order of magnitude for the potential revenue generated by a small farmer growing cash crops under a rainfed growing environment. Sanankoro Togola is located in one of the most stable rainfed production zones of Mali.

The total revenue for the typical farm was 560000 CFA. This net revenue amount was calculated from the sale of all crops above subsistence needs for which there is a known local cash market. In practice much of the surplus production is bartered (with the exception of cotton) but it is assumed that the bartered value was at least as high as the local market value. The model did not take into account any livestock production as this varies across families considerably.

The net income of 560,000 CFA is a modest estimate. Prices and yields have been discounted to portray a conservative picture of the receipts available to the typical small holder in a rainfed growing area. The willingness of villagers to use this income to pay for social services or increased technical assistance was talked about during interviews. In general most villagers questioned indicated that if the quality of services were good and met their expectation they would be willing to use scarce resources to pay for reliable social services or technical assistance.

TYPICAL FARM SANANKORO TOGOLA 7 HA.
CROPPING PATTERN AND PRODUCTION

	HECTARES PLANTED	NET REVENUE HECTARE CFA	TOTAL NET REVENUE CFA	YIELDS KGS/HA.
COTTON	3	207330.00	891990.00	3500
MAIZE	1	64550.00	64550.00	3000
GROUND NUTS	1	61250.00	61250.00	2500
COWPEA	0.2	5700.00	1140.00	700
MILLET	1	1376.00	1376.00	3000
SWEET POTATOS	0.2	207500.00	41500.00	5000
RICE UPLAND	1	82000.00	82000.00	2000
TOTAL AREA HARVESTED	7.4 HECTARE			
TOTAL NET REVENUE FOR AREA HARVESTED			CFA 1143806.00	

COTTON RAINFED 1 HA

INPUTS:	AMT.	UN. PRICE	CFA
LAND PREP (PR. OXEN)	2 DAYS	1000.00	2000.00
SEEDING	1 DAYS	1000.00	1000.00
SEED	60 KGS/HA	12.00	720.00
FERTILIZER			
ORGANIC	0	0.00	0.00
CHEMICAL			
PHOSPHATE	300 KGS	10.00	3000.00
UREA	100 KGS	12.50	1250.00
POTASH	0	0.00	0.00
HERBICIDE	2 LTS	600.00	1200.00
PESTICIDE	2 LTS	1000.00	2000.00
		SB. TOTAL	11170.00

LABOR/FAMILY:	M/D	CFA	CFA
LAND PREPARATION	2	500.00	1000.00
SEEDING	1	500.00	500.00
WEEDING	4	500.00	2000.00
FERTILIZER APPL.	2	500.00	1000.00
HERBICIDE APPL.	1	500.00	500.00
PESTICIDE APPL.	4	500.00	2000.00
EROSION CONTROL	4	500.00	2000.00
HARVEST	30	500.00	15000.00
THRESHING	0	500.00	0.00
		SB. TOTAL	24000.00

TOTAL ALL INPUTS 35170.00

EST. YIELD KGS/HA.	PRICE/KG (CFA)	GROSS REVENUE
3500.00	95	332500.00

Net Revenue 297330.00

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MILLET RAINFED 1 HA

INPUTS:	AMT.	UN. PRICE	CFA
LAND PREP (PR. OXEN)	0 DAYS	0.00	0.00
SEEDING	0 DAY	0.00	0.00
SEED	20 KGS/HA	45.00	900.00
FERTILIZER			
ORGANIC	5 CARTS	0.00	0.00
CHEMICAL			
PHOSPHATE	0 KGS	0.00	0.00
UREA	0 KGS	0.00	0.00
POTASH	0 KGS	0.00	0.00
HERBICIDE	0 LTS	0.00	0.00
PESTICIDE	0 LTS	0.00	0.00
		SB. TOTAL	900.00

LABOR/FAMILY:	M/D	CFA	CFA
LAND PREPARTATION	6	500.00	3000.00
SEEDING	2	500.00	1000.00
WEEDING	3	500.00	1500.00
FERTILIZER APPL.	1	500.00	500.00
HERBICIDE APPL.	0	500.00	0.00
PESTICIDE APPL.	0	500.00	0.00
EROSION CONTROL	0	500.00	0.00
HARVEST	6	500.00	3000.00
THRESHING	5	500.00	2500.00
		SB. TOTAL	11500.00

TOTAL ALL INPUTS 12400.00

EST. YIELD KGS/HA.	PRICE/KG	GROSS REVENUE
3000	50	150000.00
Net Revenue		137600.00

GROUND NUTS RAINFED 1HA

INPUTS:	AMT.	UN. PRICE	CFA
LAND PREP (PR.OXEN)	0 DAYS	0.00	0.00
SEEDING	0 DAY	0.00	0.00
SEED	70 KGS/HA	75.00	5250.00
FERTILIZER			
ORGANIC	0 CARTS	0	0.00
CHEMICAL			
PHOSPHATE	50 KGS	10.00	500.00
UREA	0 KHS	0.00	0.00
POTASH	0	0	0.00
HERBICIDE	0 LTS	0.00	0.00
PESTICIDE	0 LTS	0.00	0.00
		SB. TOTA	5750.00

LABOR/FAMILY:	M/D	CFA	CFA
LAND PREPARATION	2	500.00	1000.00
SEEDING	1	500.00	500.00
WEEDING	2	500.00	1000.00
FERTILIZER APPL.	1	500.00	500.00
HERBICIDE APPL.	0	500.00	0.00
PESTICIDE APPL.	0	500.00	0.00
EROSION CONTROL	0	500.00	0.00
LIFT-HARVEST-THRESH	60	500.00	30000.00
		SB. TOTA	33000.00

TOTAL ALL INPUTS 38750.00

EST.YIELD KGS/HA.	PRICE/KG	GROSS REVENUE
2500	40	100000.00
Net Revenue		61250.00

11/2

MAIZE RAINFED 1 HA

INPUTS:	AMT.	UN.PRICE	CFA
LAND PREP (PR. OXEN)	1 DAYS	1000.00	1000.00
SEEDING	1 DAY	500.00	500.00
SEED	10 KGS/HA	45.00	450.00
FERTILIZER			
ORGANIC	5 CARTS	500.00	2500.00
CHEMICAL			
PHOSPHATE	0 KGS	0.00	0.00
UREA	0 KGS	0.00	0.00
POTASH	0 KGS	0.00	0.00
HERBICIDE	0 LTS	0.00	0.00
PESTICIDE	0 LTS	0.00	0.00
		SB. TOTAL	4450.00

LABOR/FAMILY:	M/D	CFA	CFA
LAND PREPARATION	4	500.00	2000.00
SEEDING	1	500.00	500.00
WEEDING	3	500.00	1500.00
FERTILIZER APPL.	1	500.00	500.00
HERBICIDE APPL.	0	500.00	0.00
PESTICIDE APPL.	0	500.00	0.00
EROSION CONTRTOL	0	500.00	0.00
HARVEST	3	500.00	1500.00
THRESHING	0	500.00	0.00
		SB. TOTAL	6000.00

TOTAL ALL INPUTS 10450.00

EST.YIELD KGS/HA.	PRICE/KG	GROSS REVENUE
3000	25	75000.00
Net Revenue		64550.00

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COWPEA RAINFED 1 HA

INPUTS:	AMT.	UN. PRICE	CFA
LAND PREP (PR. OXEN)	1 DAYS	1000.00	1000.00
SEEDING	1 DAYS	1000.00	1000.00
SEED	40 KGS/HA	20.00	800.00
FERTILIZER			
ORGANIC		0.00	0.00
CHEMICAL		0.00	0.00
PHOSPHATE	50 KGS	10.00	500.00
UREA	0 KHS	0.00	0.00
POTASH	0	0.00	0.00
HERBICIDE	0 LTS	0.00	0.00
PESTICIDE	1 LTS	1000.00	0.00
		SB. TOTAL	3300.00

LABOR/FAMILY:	M/D	CFA	
LAND PREPARATION	5	500.00	2500.00
SEEDING	1	500.00	500.00
WEEDING	2	500.00	1000.00
FERTILIZER APPL.	1	500.00	500.00
HERBICIDE APPL.	0	500.00	0.00
PESTICIDE APPL.	1	500.00	500.00
EROSION CONTROL	0	500.00	0.00
HARVEST	3	500.00	1500.00
THRESHING	4	500.00	2000.00
		SB. TOTAL	8500.00

TOTAL ALL INPUTS 11800.00

EST. YIELD KGS/HA.	PRICE/KG	GROSS REVENUE
700	25	17500.00
Net Revenue	112350-35178	5700.00

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SWEET POTATO RAINFED 1HA
(IPOMEA BATATUS)

INPUTS:	AMT.	UN.PRICE	CFA
LAND PREP(PR.OXEN)	0 DAYS	1000.00	0.00
SEEDING	1 DAYS	1000.00	1000.00
SEED	500 KGS/HA	20.00	10000.00
FERTILIZER			
ORGANIC	0	0.00	0.00
CHEMICAL	0	0.00	0.00
PHOSPHATE	0 KGS	0.00	0.00
UREA	0 KHS	0.00	0.00
POT.	0	0.00	0.00
HERBICIDE	0 LTS	0.00	0.00
PESTICIDE	0 LTS	0.00	0.00
		SB. TOTAL	11000.00

LABOR/FAMILY:	M/D	CFA	CFA
LAND PREPRATION	5	500.00	2500.00
SEEDING	1	500.00	500.00
WEEDING	0	500.00	0.00
FERTILIZER APPL.	0	500.00	0.00
HERBICIDE APPL.	0	500.00	0.00
PESTICIDE APPL.	0	500.00	0.00
EROSION CONTROL	0	500.00	0.00
HARVEST	7	500.00	3500.00
THRESHING	0	500.00	0.00
		SB. TOTAL	6500.00

TOTAL ALL INPUTS 17500.00

EST.YIELD KGS/HA.	PRICE/KG	GROSS REVENUE
5000	45	225000.00
Net Revenue		207500.00

RICE UPLAND 1 HA

INPUTS:	AMT.	UN. PRICE	CFA
LAND PREP (PR. OXEN)	2 DAYS	1000.00	2000.00
SEEDING	1 DAYS	1000.00	1000.00
SEED	70 KGS/HA	65.00	4550.00
FERTILIZER			
ORGANIC	5 CARTS	0.00	0.00
CHEMICAL	0	0.00	0.00
PHOSPHATE	300 KGS	10.00	3000.00
UREA	100 KHS	12.50	1250.00
POTASH	0	0.00	0.00
HERBICIDE	2 LTS	600.00	1200.00
PESTICIDE	2 LTS	1000.00	2000.00
		SB. TOTAL	15000.00

LABOR/FAMILY:	M/D	CFA	CFA
LAND PREPRATION	2	500.00	1000.00
SEEDING	1	500.00	500.00
WEEDING	4	500.00	2000.00
FERTILIZER APPL.	2	500.00	1000.00
HERBICIDE APPL.	1	500.00	500.00
PESTICIDE APPL.	4	500.00	12500.00
EROSION CONTROL	0	500.00	0.00
HARVEST	15	500.00	7500.00
THRESHING	8	500.00	4000.00
		SB. TOTAL	29000.00

TOTAL ALL INPUTS 44000.00

EST. YIELD KGS/HA.	PRICE/KG	GROSS REVENUE
2000	63	126000.00
Net Revenue		82000.00

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