TENURE, TREE MANAGEMENT, AND MALI'S FOREST CODE : REPORT OF A SAMPLE SURVEY IN CENTRAL MALI

by

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EXECUTIVE SUMMARY

I. Research Objectives and Methodology

This is the third of a series of reports produced for the Land Tenure Center's research project on land and tree tenure in Mali's Fifth Region. The project objective is to identify tenure constraints to sustainable natural resource management at the farm level. The research, which is financed by the United States Agency for International Development, is part of the Village Reforestation Project (VRP) currently being implemented in conjunction with the Malian Forest Service (Eaux et Forêts).

From July through September 1990, a sample survey was conducted in twenty-one villages in Bandiagara, Fatoma, Konna, and Koro. Bandiagara and Fatoma were chosen as the main study sites since the VRP activities are concentrated in those areas. The Koro area was included because a forestry extension effort managed jointly by CARE and the Cantonnement Forestier of Koro has been active in the area since 1985. In the Konna study zone, no significant forestry projects have been implemented.

The sample survey was designed to (1) describe current tree management and tenure characteristics, (2) describe the relationship between traditional tenure and tree management practices, (3) determine if there is greater use of agroforestry techniques in villages targeted by the Village Reforestation Project than in villages that have not been targeted by the project, and (4) determine if tree management practices and villager perceptions of Eaux et Forêts differ in areas where Eaux et Forêts operates only as a regulatory agency and areas where agents carry out both regulatory and extension activities.

Within the villages, respondents were selected from a pool of individuals who can best be described as "landholders." For purposes of the study, we have defined a "landholder" as someone who exercises significant land-use decision-making powers over one or more parcels of land. Data from the pilot studies that preceded the sample survey indicated that landholders in the area fall into two major categories: primary landholders, and subholders. Primary landholders correspond to the heads of production units and make land-use decisions for land that is farmed in common by members of the production unit. Subholders work at least some land under the supervision of the primary landholder. In addition, they have autonomous decision-making powers over one or more parcels of land which they use for their own purposes.

A sample of 13 percent of the primary landholders was selected randomly from each of the sample villages. As part of the interview, primary holders were asked to identify the subholders associated with their production unit. We then randomly selected 25 percent of the subholders identified during the primary holder interviews for inclusion in the sample survey. Thus the subholders included in the survey constitute 3.3 percent of the theoretical population of subholders in the 21 villages.

A total of 201 respondents were included in the study, including 158 primary landholders and 43 subholders.

II. Sample Survey Results

A. Tree Management Practices

The sample survey results support the idea that villagers try to increase their access to tree products and services by planting and protecting trees. A large majority of landholders plant trees in their concessions. With the exception of landholders in Bandiagara, the survey respondents were more likely to plant trees in their compounds than in their fields. Less than 20 percent of the landholders in Fatoma, Konna, and Koro had planted trees in their fields, compared to 46.5 percent of the landholders in Bandiagara. Neem was by far the preferred species for compounds in all four study zones. The preferred species for field plantings varied by zone: neem was most common in Fatoma and Konna, while raffia palm and baobabs were most common in Bandiagara, and Acacia albida and Acacia raddiana were the preferred field species in Koro.

An analysis of the sample survey data supports the idea that farmers in the region deliberately allow certain species of trees to grow in their fields. In all four zones, more than half the landholders avoid killing certain tree species that regenerate in their fields. The exact percentages vary considerably, from a high of 100 percent in Koro to a low of 64.6 percent in Konna.

Acacia albida was the preferred species for natural regeneration in fields in all four zones. Rates of protection for Acacia albida among respondents who protected trees in fields ranged from 54.8 percent in Konna to a high of 95 percent in Fatoma. Balanites aegyptica was the next preferred species, being among the three most commonly protected species in Fatoma, Bandiagara, and Koro. Other species commonly protected include Acacia nilotica, Lannea microcarpa, and Sclerocarya birrea.

The majority of the survey respondents employ techniques to ensure the survival of their trees and to improve tree productivity. The main tree care techniques used by the respondents were watering, fertilizing, fencing, and pruning.

B. Tenure Characteristics of the Study Region

1. Land Tenure. Respondents obtain land through inheritance, gifts, borrowing arrangements, and state leases. The distribution of access types is roughly similar throughout the study zones: most people have access to at least one parcel of inherited land, and a substantial number of people borrow at least one parcel of land. The proportion of respondents with borrowed parcels ranged from less than one-third (31.3 percent) in Bandiagara to nearly one-half (47.4 percent) in Fatoma. The percentage of respondents who have access to land only through borrowing arrangements ranges from 18.2 percent in Bandiagara to 31.2 percent in Koro.

A smaller percentage of people have access to gift land. The percentage of people with gift land ranges from 9.2 percent in Konna to 24.6 percent in Fatoma. State leases are found only in the Fatoma and Konna areas, where, respectively, 12.3 percent and 9.2 percent of the landholders stated that they had state lease land. The only respondent with purchased land was located in the Fatoma study zone.

2. Tenure and Tree Management. The sample survey data indicate that tree-planting behavior differs according to the type of access a person has to land. The rate of tree planting on borrowed land and state lease land is significantly lower than on inherited and gift land. None of the respondents had planted trees on state lease land. Farmers with only borrowed land are much less likely to plant trees than farmers with only inherited land, whereas the incidence of tree protection is approximately the same for both categories. Tree protection rates are approximately the same for borrowed and inherited parcels but are significantly lower on gift land.

C. Villagers and the Forest Service

1. Agent-Villager Contacts. As a rule, villagers have only limited direct contact with Eaux et Forêts agents, whether in a regulatory or an extension capacity. Extension contacts were highest in Bandiagara, where approximately one-quarter of the landholders have received forestry advice or inputs. Technical advice contacts were lowest in Konna, where only 3.1 percent of the landholders had had extension contacts with forest agents. The incidence of fines and permits varied considerably among the study zone, being highest in Konna (33.8 percent) and lowest in Fatoma (7 percent).

2. Fines. Fines were imposed for illegal woodcutting (including mutilation), failure to have a wood stove, and illegal clearing. In most cases offenders were fined for cutting only branches rather than an entire tree. No offenders had been fined for cutting planted trees. About one-quarter had been fined for cutting or pruning trees that they had allowed to grow in their fields. Violaters cut trees in order to obtain forage, domestic firewood, corral construction materials, house construction materials, and commercial firewood and to clear new and old fields. Less than one-fifth of the woodcutting offenders had received a receipt for the fine they paid.

3. Permits. Respondents acquired use permits in order to obtain fencing materials (30.9 percent), construction wood or wood for crafts (30.9 percent), and firewood (35.3 percent) and to clear land (16.7 percent). Most of the woodcutting permits were issued for cutting in natural forests. Slightly less than half of the permit holders had received a permit on more than one occasion, and 15 percent of the permit holders pay for a permit on a yearly basis.

Permit purchases appear to be restricted to people who either make a living out of selling wood or cut large quantities of wood. Most of the

people who do not get permits stated that they do not sell wood, do not cut wood, or do not cut large amounts of wood.

4. Perceptions of the Usefulness of Forest Agents. Few villagers perceive Eaux et Forêts agents as working in their interest. When asked to describe the usefulness of Eaux et Forêts agents, many respondents stated either that they did not know or that the agents served no useful purpose. In Fatoma and Bandiagara, approximately one-third of the respondents felt that the agents were useful in controlling illegal use of forest products, compared to only 20.0 percent of the respondents in Konna and 4.6 percent in Koro. None of the respondents in Konna mentioned extension as a useful function of Eaux et Forêts agents. Only 7 percent of the respondents in Bandiagara and Fatoma mentioned extension, compared to 19.3 percent of the respondents in Koro.

D. Villager Perception of Rights to On-Farm Trees

In order to obtain information about villager perceptions of their rights to trees in their compounds and fields on a wide-scale basis, a follow-up survey was conducted of the sample survey respondents. Nearly all of the follow-up survey respondents believe that they risk a fine if they prune self-sown and planted trees, whether in their compounds or in their fields. About three-quarters of the respondents stated that they have trees in their fields which they wish to prune but do not do so for fear of being caught by Eaux et Forêts agents. The majority of those who wish to prune trees want to prune them in order to increase crop production or reduce pests.

Rights to cut trees are considered to be even more limited than pruning rights. Nearly all the villagers interviewed believe that they risk fines if they cut down trees in their compounds or in their fields. Forty-two percent of the farmers interviewed stated that they have trees in their fields which they wish to cut but fear being fined by Eaux et Forêts. The majority (79 percent) of those wishing to cut field trees want to cut them in order to obtain raw materials or firewood.

Farmers are clearly concerned about the impact trees have on crop production. All of the farmers interviewed felt that the negative effect of trees on crop production can be diminished by pruning the trees. Yet virtually none of the respondents feel that they have the right to prune trees without first getting authorization from the local forest agent.

E. Differences between VRP and Non-VRP Villages

The hypothesis that planting and protection would be greater in areas where Eaux et Forêts has an extension function, as well as a regulatory function, is only partially supported by the survey. Tree protection rates and field planting rates are significantly higher in the Fatoma area in villages targeted by VRP, where Eaux et Forêts agents carry out both extension and police activities. However, non-VRP villagers are equally likely to plant trees in compounds as their counterparts. In Bandiagara, tree planting and protection rates are similar in both VRP

and non-VRP areas. A possible explanation for such results is that in Bandiagara, many farmers already plant and protect trees. In Fatoma, where farmers are less likely to plant and protect trees to begin with, the project provides an impetus for farmers who ordinarily would not plant trees or protect them to do so.

The VRP does, however, appear to have had a positive effect on how villagers perceive Eaux et Forêts agents. VRP villagers are more likely to feel that agents serve a useful function, whether it be controlling illegal woodcutting or providing technical advice and seedlings. The efforts of the past eight years on the part of the agents in Bandiagara and Fatoma have thus helped to improve the opinion that villagers have of Eaux et Forêts.

Translating this more positive attitude into greater planting and protection of trees is another, more difficult task. The present mix of extension/enforcement does not appear to lead to significantly greater efforts in tree planting and protection than in areas where agents serve only a regulatory function. This holds true for both VRP and non-VRP villages in Fatoma and Bandiagara and for CARE/EF villages and CARE villages in Koro. A comparison of the villages in Konna with VRP villages in Fatoma shows that protection rates are higher in Fatoma, but that planting rates are the same. A likely explanation for the minor differences in planting and protection behavior in extension/enforcement areas and enforcement-only areas is that the fear of being fined continues to exist in extension/enforcement areas, even though the actual likelihood of being fined is lower. In fact, the follow-up survey data indicate that such is the case: few villagers anywhere believe that they can prune or cut trees on their land without first getting a permit or authorization from Eaux et Forêts.

III. Conclusion

In contrast to the customary rules which provide users of inherited and gift land strong rights to trees, the Malian Forest Code, as villagers perceive it, does not permit <u>any</u> farmer legally to prune and cut down trees without prior authorization from the State. Data collected during the sample survey indicate that villagers believe that they are likely to be fined for pruning or cutting both self-sown trees and trees they have planted. They are only slightly more likely to believe that they will not be fined for cutting or pruning trees in their compounds than for cutting or pruning trees in their fields. Interestingly, the area in which villagers are most likely to plant trees in fields (Bandiagara) is also the area where more villagers feel that they have the right to prune and cut trees they have planted.

The data indicate that the confidence of villagers in their ability to control the trees in their fields is limited at best. Villagers perceive that it is not in their interest to plant and protect a great many trees, since they cannot limit the negative effects such trees may have once they are large enough to warrant pruning or felling. The Forest

Code as currently written and applied thus provides clear disincentives for the widespread dissemination of intensive agroforestry techniques, which frequently presuppose that the land user controls the trees on his land.

Decreasing disincentives to widespread adoption of agroforestry will require changes both in the Forest Code and in the way in which it is applied. In particular, the Code needs to spell out clearly the rights that farmers have to cut and prune trees located on their land. In addition, rights to prune species that are protected--but which exist in abundance and are considered valuable field species (notably Acacia albida)--need to be transferred to farmers. A legal extension program, with the task of keeping both foresters and villagers informed of private rights to trees on fields, needs to be developed in conjunction with the agricultural and livestock agencies, as well as the political and administrative services. Finally, increased salaries for agents and the provision of normal operating expenses at the cantonnement and post levels are a necessary part of any legal reform.

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I. INTRODUCTION

This is the third report in a series of articles covering the Land Tenure Center's research activities on land and tree tenure issues in the Fifth Region of Mali. The research is being conducted as part of the Village Reforestation Project, an agroforestry project financed by USAID and implemented jointly by USAID and the Malian Forest Service (Eaux et Forêts) in the Cercles of Mopti and Bandiagara in Central Mali. This report summarizes the findings of a sample survey conducted during August, September, and October 1990, as well as the preliminary findings of a follow-up survey conducted in January 1991.

During the first phase of the research project (February to July 1990), a series of pilot studies were conducted in eleven villages in the Fifth Region to gather information about current tree management practices, customary land and tree tenure rules, villager perception of their rights to trees on- and off-farm according to the Malian Forest Code, and villager perception of Eaux et Forêts agents. The pilot studies indicated that trees are an important component of the production systems present in the region. Many villagers plant trees, and most encourage certain tree species to grow in their fields. The pilot studies showed that rights to trees on borrowed land are less extensive than for inherited and gift land. There was evidence that borrowers were less likely to plant trees on their land. The pilot study data also indicated that villagers believe that they have few rights to trees, other than fruit harvesting, under the Malian Forest Code. This belief holds true for all species of trees in household compounds, fields, and the natural forest. Finally, the pilot studies indicated that contacts between Eaux et Forêts agents and villagers are primarily regulatory in nature, with a few exceptions in those areas where Eaux et Forêts agents receive extension support from nongovernmental and foreign governmental organizations.

The purpose of the sample survey was to determine to what extent the findings of the pilot studies hold true for a wider, more representative selection of villagers in the study area. The sample survey and follow-up survey were designed to (1) describe current tree management and tenure

characteristics, (2) describe the relationship between traditional tenure and tree management practices, (3) determine if there is greater use of agroforestry techniques in villages targeted by the Village Reforestation Project than in villages that have not been targeted by the project, and (4) determine if tree management practices and villager perceptions of Eaux et Forêts differ in areas where Eaux et Forêts operates only as a regulatory agency and areas where Eaux et Forêts agents carry out both regulatory and extension activities.

II. DATA COLLECTION

A. Study Sites

The sample survey was conducted in four areas: Bandiagara, Fatoma, Konna, and Koro (see figure 1). Bandiagara and Fatoma were chosen as the main study sites since VRP activities are concentrated in those areas. Two major ecological zones of the Fifth Region, the Niger floodplain and the Bandiagara plateau, are represented by these study sites. Villages in the Cercle of Koro were included because of the existence of a long-term forest extension project funded by CARE. In addition, the Koro area represents another major ecological zone, the Seno plain, found in the Fifth Region. In Konna, the fourth study zone, no major forestry projects have been implemented. The Konna study zone encompasses both seasonally inundated and uninundated portions of the Niger floodplain.

In the Konna study zone, Eaux et Forêts activities are almost exclusively regulatory in nature. In the Bandiagara and Fatoma zones, Eaux et Forêts agents have a dual role, devoting significant amounts of time to both extension and enforcement. In Koro, agents working with the CARE agroforestry project devote 75 percent of their time to extension and 25 percent to enforcement. Agents unaffiliated with CARE concentrate primarily on police activities.

B. Village Selection

Study villages were selected from the Arrondissements of Konna, Bandiagara Centrale, and Fatoma and the Cercle of Koro. A list of villages and hamlets was first developed for each study zone. Settlements that are officially included with other villages, but which are historically, ethnically, or politically distinct from the official village to which they are attached, were treated as distinct villages. Since the average village size varies considerably among the four zones, the number of villages selected per zone also varied so that the sample sizes would be roughly equal in each zone. Six villages were selected in Bandiagara, eight in Fatoma, three in Konna, and four in Koro (see table 1).

In Bandiagara and Fatoma, half the villages were selected at random from villages participating in VRP activities and half were selected at random from nonparticipating villages. In Bandiagara, exclusively Peulh villages, which comprise only a small percentage of the villages in the Arrondissement Centrale as well as the town of Bandiagara, were not included in the population of villages to be selected. In the Fatoma and Konna study zones, predominately Bozo and Bambara villages were eliminated, as were the towns of Fatoma and Konna. The three sample villages in Konna were selected at random from the remaining villages in the

FIFTH REGION

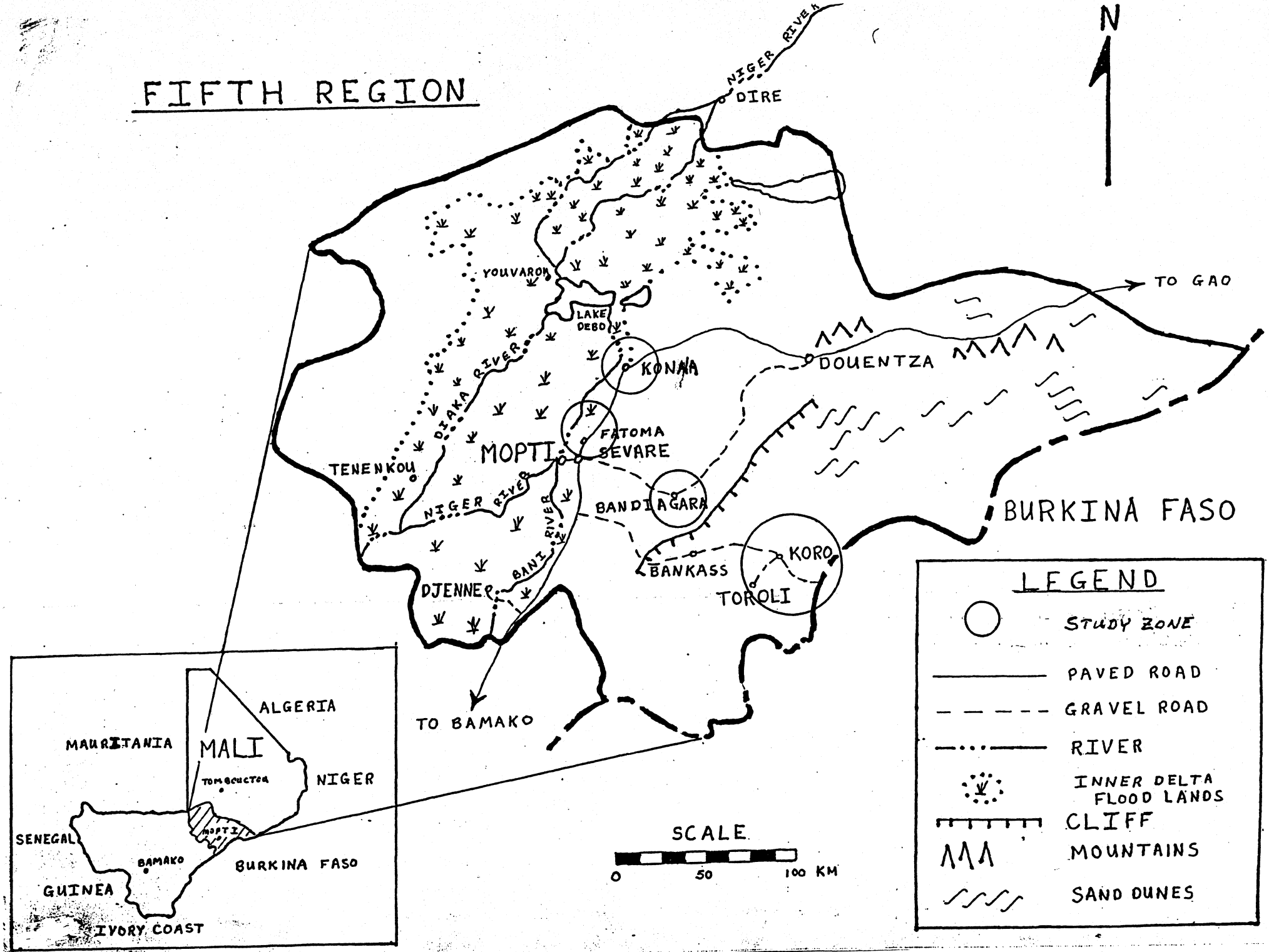

TABLE 1

Sample Survey Villages

BANDIAGARA	FATOMA	KORO	KONNA
Tougoume[a]	Badiongo[a]	Demoro[c]	Foussi
Doukombo[a]	Poutiouwel[a]	Danadougourou[c]	Time
Dandoli[a]	Moussawel[a]	Souan[b]	Takoutala
Golokou	Souma[a]	Mbana[b]	
Sokolo	Deguena		
Yawakanda	Ouro-Bainde		
	Diaborki		
	Mamourou		

a. Villages targeted by VRP/AIP.

b. Villages targeted by CARE agents.

c. Villages targeted by Eaux et Forêts agents working with CARE.

arrondissement. In Koro, the sample village list was restricted to villages targeted by the CARE agroforestry project. The CARE villages were divided into two strata: villages with forest service agents as extension agents, and villages with CARE agents as extension agents. Two villages were chosen at random from each category.

C. Selection of Respondents

Within the villages, respondents were selected from the pool of individuals who can best be described as "landholders." For purposes of the study, we have defined a "landholder" as someone who exercises significant land-use decision-making power over one or more parcels of land. The degree of control a landholder exercises over his or her land can vary considerably, depending on such characteristics as the landholder's position in the family and the type of access he or she has to the land.

Data from the pilot studies that preceded the sample survey indicated that landholders in the area fall into two major categories: primary landholders, and subholders. Primary landholders correspond to the heads

of production units. The primary landholder makes land-use decisions for land that is farmed in common by members of the production unit. In addition, he or she may make land-use decisions for land which he or she farms separately from the main production unit. In contrast, subholders work at least some land under the supervision of the primary landholder. They also have autonomous decision-making powers over one or more parcels of land which they use for their own purposes. Subholders sometimes rely on the head of their production unit for access to land but can also obtain access to land from outside the production unit.

Both primary landholders and subholders were included in the analysis. A list of primary landholders was established by conducting a census of heads of production units in each village in the study sample. A sample of 13 percent of the primary landholders was selected randomly from each of the sample villages. A 13 percent sample enabled us to have a minimum sample size of 35 primary holders in each of the 4 study zones while still staying within the project's financial and logistical means. As part of the interview, primary holders were asked to identify the subholders associated with their production unit. We then randomly selected 25 percent of the subholders identified during the primary holder interviews for inclusion in the sample survey. Thus the subholders included in the survey constitute 3.3 percent of the theoretical population of subholders in the 21 villages. A total of 201 respondents were included in the study, including 158 primary landholders and 43 subholders.

D. Research Topics

The initial survey instrument consisted of a series of close-ended questions. A few open-ended questions, primarily regarding fining and permitting activities, were also included. The instrument was organized into the following sections:

1) socioeconomic characteristics, including livestock ownership and use of trees for cut-and-carry fodder;
2) land-holding and land-use characteristics for each parcel managed by the respondent;
3) tree management practices, including planting, protection, and maintenance;
4) extension contacts with Eaux et Forêts agents;
5) permitting and fining activities;
6) perceptions of rights to trees; and
7) perceptions of Eaux et Forêts agents.

A follow-up survey instrument was subsequently developed to obtain more detailed information about perceived rights to trees in household compounds and fields and to determine the extent to which villagers

perceive the Forest Code as a disincentive to integrating trees with their crops.

Translating the instruments into all of the major languages and dialects of Dogon represented in the survey zones would have entailed more time and expense than was available. Consequently, the survey instruments were written in French. The enumerators, all natives of the study area, translated the questions into the appropriate local language. All members of the team were closely involved in the development of the instruments so that they would have a thorough understanding of the purpose of the questions. The team spent two weeks testing and revising the instruments so that the local language translations would be consistent for all enumerators.

The initial interviews were conducted from August 1st to September 13th, 1990. Fortunately, this period coincided with a lull in agricultural activities. We consequently encountered few problems contacting and interviewing the selected respondents. Verifications of anomalous data were conducted in October. The follow-up survey concerning natural regeneration and Forest Code disincentives to tree planting and protection of natural regeneration was carried out in January 1991. Approximately two-thirds of the original respondents were not included in the follow-up interview because they had left the village to find work or visit relatives in other areas. The data for both the initial and the follow-up questionnaire were entered onto a microcomputer and analyzed using the computer program, Statistical Package for Social Sciences.

E. Limitations of the Sample Survey Method for Conducting Tenure Research

While developing and implementing the sample survey, it became evident that a large-scale survey, consisting primarily of close-ended questions and administered by enumerators trained at the two-year technical-school level, has useful but limited applications for studying the complexities of land and tree tenure systems in Mali's Fifth Region. Collecting accurate information about land tenure and villager/forest-agent interactions presupposes that a certain degree of trust exists between the villager being questioned and the person doing the questioning, a degree of trust that is unlikely to develop during a 30-to-60-minute interview. Fortunately, one of our enumerators had previously worked in many of the sample villages and thus was able to smooth the way for the other enumerators.

Although the close-ended questionnaire format was adequate for gathering fairly basic information, we found that it was poorly suited for capturing the details that are so crucial to a complete understanding of the complexities of tenure and production systems. In particular, we noted that although we were able to record fairly easily what people do on a superficial level, it was much more difficult to obtain good information about why they behave in certain ways rather than in others. Illustrative examples and proverbs, which often provide additional insights

as to why people behave the way they do, also could not be recorded given the time constraints. Such examples, however, were gathered in previous work* conducted by the LTC in the Fifth Region and thus are not treated in this report.

However, the sample survey does enable one to determine what land access types predominate, the types of trees people plant and protect, the main techniques used to improve tree growth, and the broad outlines of the types of contacts rural people have with Eaux et Forêts agents in the Fifth Region. The data are thus quite useful for identifying general trends and for making statistically valid comparisons of the different study zones, comparisons which would not be possible with a less broad-based data collection effort.

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* See Rebecca J. McLain, Tenure and Tree Management on the Dogon Plateau: Three Case Studies in Bandiagara, Mali (Madison: Land Tenure Center, University of Wisconsin, March 1990), and Tenure and Agroforestry: Village and Household Studies in Central Mali (Madison: Land Tenure Center, University of Wisconsin, October 1990).

III. DATA ANALYSIS

Of the 201 respondents, 158 are primary landholders and 43 are subholders. However, only 25 percent of the possible subholders associated with the primary holders were interviewed. Consequently, analyses which compare landholders as a group were conducted by weighting the subholder respondents by a factor of 4. No weighting factor was used for analyses in which primary landholders and subholders were considered separately.

A. Socioeconomic Characteristics

1. Landholder Composition

As indicated in table 2, the ratio of primary landholders to subholders varies considerably among the four study zones. Most of the landholders in the Fatoma and Konna zones fall into the primary landholder category, whereas more than half of the landholders in Bandiagara and Koro are dependents of the production unit head. As will be shown later, subholders differ considerably from primary landholders in the type of access they tend to have to land and in their tree management behavior.

2. Ethnic Composition

The study zones vary greatly in their ethnic composition (see table 3). The sample villages in Bandiagara and Koro are ethnically homogeneous

TABLE 2

Distribution of Landholder Categories by Study Zone

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Primary landholders	37	(64.9)	35	(35.4)	45	(41.3)	41	(63.1)	158	(47.9)
Subholders	20	(35.1)	64	(64.6)	64	(58.7)	24	(36.9)	172	(52.1)
Total	57	(100.0)	99	(100.0)	109	(100.0)	65	(100.0)	330	(100.0)

Chi square = 20.77 Degrees of freedom = 3 Significance = .0001

TABLE 3

Ethnic Composition of the Study Zones

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Peulh	38	(66.7)	--		--		43	(66.2)	81	(24.6)
Dogon	7	(12.3)	99	(100.0)	108	(99.1)	--		214	(64.9)
Malinké	4	(7.0)	--		--		15	(23.1)	19	(5.8)
Other	8	(14.0)	--		1	(0.9)	7	(10.8)	16	(4.9)
Total	57	(100.0)	99	(100.0)	109	(100.0)	65	(100.1)	330	(100.0)

and consist almost exclusively of Dogons. In contrast, the villages in the Niger delta are much more diverse. Although Peulh speakers predominate in the sample villages in Fatoma and Konna, they are divided among several social classes. In addition, both Fatoma and Konna villages have substantial populations of Malinké speakers as well as a few Bozos, Somonos, Songhais, and Dogons.

3. Migration

In all four study zones, the vast majority of landholders are natives of the village in which they presently live (see table 4). Most of the

TABLE 4

In-Migration in the Study Zones

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Native	45	(78.9)	78	(78.8)	101	(92.7)	51	(78.5)	275	(83.3)
Immigrant	12	(21.1)	21	(21.2)	8	(7.3)	14	(21.5)	55	(16.7)
Total	57	(100.0)	99	(100.0)	109	(100.0)	65	(100.0)	330	(100.0)

Chi square = 10.20 Degrees of freedom = 3 Significance = .0169

TABLE 5

Average Number of Years Immigrants Have Been in Village

STUDY ZONE	MEAN	STANDARD DEVIATION	# OF CASES
Fatoma	30.1	20.4	12
Bandiagara	35.0	11.6	21
Koro	28.9	11.5	8
Konna	19.1	8.8	14
Combined	29.0	14.5	55

migrants have spent considerable time in their adopted villages (see table 5). The average length of time in residence for strangers was 30.8 years in Fatoma, 35.0 years in Bandiagara, 28.8 years in Koro, and 19.1 years in Konna.

Seasonal out-migration is high throughout the study region (table 6). The incidence of out-migration is highest in Bandiagara, where nearly half (47.5 percent) of the production units have members who migrate seasonally. Out-migration is also very high in Koro, where 37.6 percent of

TABLE 6

Incidence of Seasonal Out-Migration

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Seasonal migrants	11	(19.3)	47	(47.5)	41	(37.6)	17	(26.2)	116	(35.2)
No seasonal migrants	46	(80.7)	52	(52.5)	68	(62.4)	48	(73.8)	214	(64.8)
Total	57	(100.0)	99	(100.0)	109	(100.0)	65	(100.0)	330	(100.0)

Chi square = 15.48 Degrees of freedom = 3 Significance = .0015

the production units have members who migrate seasonally. In Fatoma and Konna, the out-migration rates are substantially lower (19.3 percent and 26.2 percent, respectively) but are still quite high.

4. Marital Status and Gender

Most landholders in the four zones are married (table 7). However, a higher proportion of respondents in the Fatoma area are widowed than in the other study zones, and a higher proportion of respondents in Koro are single.

The majority of landholders in the study zones are males (table 8). However, the relative frequency of men and women landholders varies by

TABLE 7

Marital Status of Survey Respondents

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Married	46	(80.7)	94	(94.9)	84	(77.1)	57	(87.7)	281	(85.2)
Single	2	(3.5)	4	(4.0)	17	(15.6)	4	(6.2)	27	(8.2)
Widowed	9	(15.8)	1	(1.0)	8	(7.3)	4	(6.2)	22	(6.7)
Total	57	(100.0)	99	(99.9)	109	(100.0)	65	(100.1)	330	(100.1)

Chi square = 25.35 Degrees of freedom = 6 Significance = .0003

TABLE 8

Gender of Landholders in the Study Region

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Female	23	(40.4)	20	(20.2)	33	(30.3)	25	(38.5)	101	(30.6)
Male	34	(59.6)	79	(79.8)	76	(69.7)	40	(61.5)	229	(69.4)
Total	57	(100.0)	99	(100.0)	109	(100.0)	65	(100.0)	330	(100.0)

Chi square = 9.49 Degrees of freedom = 3 Significance = .0235

TABLE 9

Gender Distribution by Landholder Category

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Primary landholders:										
Female	3	(8.1)	0	(0.0)	1	(2.2)	1	(2.4)	5	(3.2)
Male	34	(91.9)	35	(100.0)	44	(97.8)	40	(97.6)	153	(96.8)
Total	37	(100.0)	35	(100.0)	45	(100.0)	41	(100.0)	158	(100.0)
Subholders:										
Female	20	(100.0)	20	(31.3)	32	(50.0)	24	(100.0)	96	(55.8)
Male	0	(0.0)	44	(68.8)	32	(50.0)	0	(0.0)	76	(44.2)
Total	20	(100.0)	64	(100.1)	64	(100.0)	24	(100.0)	172	(100.0)

zone. Women landholders are more common in Fatoma and Konna (40.4 percent and 38.5 percent, respectively) than in either Koro (30.3 percent) or Bandiagara (20.2 percent). Women are much less likely to be primary landholders. In contrast, all of the subholders in Fatoma and Konna were women, and women comprised 50 percent of the subholders in Koro and 31.3 percent of the subholders in Bandiagara.

5. Age, Labor Availability, and Subholdings per Holding (tables 10-12)

The average age of landholders in the four study zones ranges from a low of 42.6 years in Koro to 48.3 years in Fatoma. The average number of workers available per production unit is greatest in Bandiagara (7.2 agricultural workers per production unit) and lowest in Fatoma (3.37 workers

TABLE 10

Average Age of Landholders

STUDY ZONE	MEAN	STANDARD DEVIATION	# OF CASES
Fatoma	48.4	13.7	57
Bandiagara	46.5	15.4	99
Koro	42.7	15.1	109
Konna	45.9	16.4	65
Combined	45.4	15.3	330

TABLE 11

Average Number of Workers per Production Unit (primary landholders)

STUDY ZONE	MEAN	STANDARD DEVIATION	# OF CASES
Fatoma	3.4	2.2	37
Bandiagara	7.2	4.5	35
Koro	5.6	2.7	45
Konna	4.7	3.4	41
Combined	5.2	3.5	158

TABLE 12

Average Number of Individuals in the Production Unit Who Work Land Apart

STUDY ZONE	MEAN	STANDARD DEVIATION	# OF CASES
Fatoma	0.8	1.7	37
Bandiagara	1.5	1.8	35
Koro	1.5	1.6	45
Konna	0.6	1.1	41
Combined	1.1	1.6	158

per production unit). The average number of subholders per production unit is 1.50 in Bandiagara, 1.46 in Koro, 0.78 in Fatoma, and only 0.58 in Konna.

6. Use of Hired Labor and Plow Ownership (tables 13 and 14)

Hired labor was used by more than one-quarter of the landholders in Fatoma, Konna, and Bandiagara but was used by only 14.7 percent of the landholders in Koro. Plow ownership was highest in Konna, where 26.2 percent of the landholders own plows, and lowest in Bandiagara, where only 3.0 percent of the landholders own plows. The low incidence of plow ownership in Bandiagara is most likely due to the area's steep and rocky soils which can be plowed only with great difficulty.

TABLE 13

Use of Hired Labor

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Hires labor	15	(26.3)	28	(28.3)	16	(14.7)	19	(29.2)	78	(23.6)
Does not hire labor	42	(73.7)	71	(71.7)	93	(85.3)	46	(70.8)	252	(76.4)
Total	57	(100.0)	99	(100.0)	109	(100.0)	65	(100.0)	330	(100.0)

Chi square = 7.38 Degrees of freedom = 3 Significance = .0606

TABLE 14

Plow Ownership among Survey Respondents

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Has a plow	9	(15.8)	3	(3.0)	20	(18.3)	17	(26.2)	49	(14.8)
Does not have a plow	48	(84.2)	96	(97.0)	89	(81.7)	48	(73.8)	281	(85.2)
Total	57	(100.0)	99	(100.0)	109	(100.0)	65	(100.0)	330	(100.0)

Chi square = 18.6 Degrees of freedom = 3 Significance = .0003

7. Major Economic Occupations

In Fatoma, Bandiagara, and Koro, the vast majority of respondents listed agriculture as their primary occupation (table 15). In contrast, only 48.4 percent of the respondents in Konna listed agriculture as their primary occupation. Agriculture is, nonetheless, an important occupation in Konna, being listed as a secondary occupation by 32.8 percent of the Konna respondents and a tertiary occupation by 18.8 percent of the respondents.

TABLE 15

Primary Occupations Cited by Survey Respondents*

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Agriculture	46	(86.8)	96	(99.0)	109	(100.0)	31	(48.4)	282	(87.3)
Livestock	1	(1.9)	0	(0.0)	0	(0.0)	11	(17.2)	12	(3.7)
Other	6	(11.3)	1	(1.0)	0	(0.0)	21	(32.8)	27	(8.7)
Total	53	(100.0)	97	(30.0)	109	(100.0)	64	(19.8)	323	(100.0)

* No response for seven cases.

8. Livestock Ownership

Livestock ownership varies by region (table 16). The highest rate of livestock ownership occurs in Konna, where 73.8 percent of the landholders had at least one animal. In contrast, 56.1 percent of the landholders in Fatoma, 48.5 percent in Bandiagara, and 47.7 percent in Koro own some livestock. Livestock production systems appear to differ significantly among the regions (table 17). In Konna, nearly one-third of the animal owners have cows, compared to only 15.4 percent in Koro, 9.7

TABLE 16

Livestock Ownership among Survey Respondents

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Owns animals	32	(56.1)	48	(48.5)	52	(47.7)	48	(73.8)	180	(54.5)
Does not own animals	25	(43.9)	51	(51.5)	57	(52.3)	17	(26.2)	150	(45.5)
Total	57	(100.0)	99	(100.0)	109	(100.0)	65	(100.0)	330	(100.0)

Chi square = 13.3 Degrees of freedom = 3 Significance = .0039

TABLE 17

Types of Animals Owned by Survey Respondents

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Owns cows	3	(9.4)	2	(4.2)	8	(15.4)	14	(29.2)	27	(15.0)
Does not own cows	29	(90.6)	46	(95.8)	44	(84.6)	34	(70.8)	153	(85.0)
Total	32	(100.0)	48	(100.0)	52	(100.0)	48	(100.0)	180	(100.0)
Chi square = 12.8	Degrees of freedom = 3				Significance = .0052					
Owns oxen	3	(9.4)	2	(4.2)	6	(11.5)	16	(33.3)	27	(15.0)
Does not own oxen	29	(90.6)	46	(95.8)	46	(88.5)	32	(66.7)	153	(85.0)
Total	32	(100.0)	48	(100.0)	52	(100.0)	48	(100.0)	180	(100.0)
Chi square = 18.4	Degrees of freedom = 3				Significance = .0004					
Owns ewes	13	(40.6)	22	(45.8)	34	(65.4)	11	(22.9)	80	(44.4)
Does not own ewes	19	(59.4)	26	(54.2)	18	(34.6)	37	(77.1)	100	(55.6)
Total	32	(100.0)	48	(100.0)	52	(100.0)	48	(100.0)	180	(100.0)
Chi square = 18.5	Degrees of freedom = 3				Signification = .0004					
Owns rams	8	(25.0)	17	(35.4)	26	(50.0)	9	(18.8)	60	(33.3)
Does not own rams	24	(75.0)	31	(64.6)	26	(50.0)	39	(81.3)	120	(66.7)
Total	32	(100.0)	48	(100.0)	52	(100.0)	48	(100.0)	180	(100.0)
Chi square = 12.2	Degrees of freedom = 3				Significance = .0068					
Owns goats	28	(87.5)	25	(52.1)	31	(59.6)	18	(37.5)	102	(56.7)
Does not own goats	4	(12.5)	23	(47.9)	21	(40.4)	30	(62.5)	78	(43.3)
Total	32	(100.0)	48	(100.0)	52	(100.0)	48	(100.0)	180	(100.0)
Chi square = 20.2	Degrees of freedom = 3				Significance = .0002					
Owns donkey	9	(28.1)	17	(35.4)	34	(65.4)	19	(39.6)	79	(43.9)
Does not own donkey	23	(71.9)	31	(64.6)	18	(34.6)	29	(60.4)	101	(56.1)
Total	32	(100.0)	48	(100.0)	52	(100.0)	48	(100.0)	180	(100.0)
Chi square = 14.7	Degrees of freedom = 3				Significance = .0020					

percent in Fatoma, and 4.2 percent in Bandiagara. Ox ownership frequencies are nearly identical to cow ownership frequencies. Konna landholders rely much less on small ruminants compared to their neighbors in Fatoma, Bandiagara, and Koro, where animal owners are very involved in small ruminant production. Goat ownership is particularly high in Fatoma, where 90.3 percent of livestock owners have at least one goat.

TABLE 18

Frequency of Respondents Who Use Tree Products for Fodder for Livestock Kept in the Village

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
For cows										
Yes	1	(50.0)	0	(0.0)	0	(0.0)	1	(11.1)	2	(12.5)
No	1	(50.0)	2	(100.0)	3	(100.0)	8	(88.9)	14	(87.5)
Total	2	(100.0)	2	(100.0)	3	(100.0)	9	(100.0)	16	(100.0)
				Significance = .3474						
For oxen										
Yes	1	(33.3)	0	(0.0)	4	(80.0)	1	(7.7)	6	(26.1)
No	2	(66.7)	2	(100.0)	1	(20.0)	12	(92.3)	17	(73.9)
Total	3	(100.0)	2	(100.0)	5	(100.0)	13	(100.0)	23	(100.0)
				Significance = .0141						
For ewes										
Yes	9	(69.2)	14	(63.6)	21	(63.6)	5	(50.0)	49	(62.8)
No	4	(30.8)	8	(36.4)	12	(36.4)	5	(50.0)	29	(37.2)
Total	13	(100.0)	32	(100.0)	33	(100.0)	10	(100.0)	78	(100.0)
				Significance = .8138						
For rams										
Yes	6	(75.0)	10	(58.8)	16	(64.0)	2	(22.2)	34	(57.6)
No	2	(25.0)	7	(41.2)	9	(36.0)	7	(77.8)	25	(42.4)
Total	8	(100.0)	17	(100.0)	25	(100.0)	9	(100.0)	59	(100.0)
				Significance = .1099						
For goats										
Yes	17	(63.0)	18	(72.0)	17	(56.7)	1	(6.7)	53	(54.6)
No	10	(37.0)	7	(28.0)	13	(43.3)	14	(93.3)	44	(45.4)
Total	27	(100.0)	25	(100.0)	30	(100.0)	15	(100.0)	97	(100.0)
				Significance = .0005						
For all animals										
Yes	18	(60.0)	25	(64.1)	34	(72.3)	8	(20.0)	85	(54.5)
No	12	(40.0)	14	(35.9)	13	(27.7)	32	(80.0)	71	(45.5)
Total	30	(100.0)	39	(100.0)	47	(100.0)	40	(100.0)	156	(100.0)
				Significance = .0000						

9. Use of Gathered Tree Products for Forage

The practice of collecting tree products for forage is widespread in Koro, Bandiagara, and Fatoma, where more than half of the livestock owners gather tree leaves or pods from fields and forests to feed their animals (table 18). In contrast, only 20 percent of the livestock owners in the Konna study zone collect tree products to feed to their animals. If only small ruminants are considered, the Konna landholders with livestock still make much less use of gathered tree products for feed than landholders in the neighboring study zones.

B. Tree Management Behavior

1. Frequency of Tree Planting and Protection

Approximately half of the respondents had planted trees in either their household compounds or fields (table 19). Although landholders in Bandiagara and Konna were slightly more likely to have planted trees than landholders in Fatoma and Koro, the differences are not statistically significant. With the exception of landholders in Bandiagara, respondents

TABLE 19

Incidence of Planting and Protection among Sample Survey Individuals*

# OF INDIVIDUALS WHO	FATOMA #	FATOMA %	BANDIAGARA #	BANDIAGARA %	KORO #	KORO %	KONNA #	KONNA %	TOTAL #	TOTAL %
	(n=57)		(n=99)		(n=109)		(n=65)		(n=330)	
Plant trees:										
Overall	28	(49.1)	56	(56.5)	46	(42.2)	36	(55.4)	166	(50.3)
				Significance = .1634						
In compounds	26	(45.6)	44	(44.4)	45	(41.3)	35	(53.8)	150	(45.4)
				Significance = .4484						
In fields	9	(15.8)	46	(46.5)	16	(14.7)	8	(12.3)	79	(23.9)
				Significance = .0000						
Allow trees to regenerate	40	(70.2)	83	(83.8)	109	(100.0)	42	(64.6)	274	(83.0)
				Significance = .0000						

* Weighted sample.

were more likely to plant trees in compounds than in fields. The differences in the percentage of landholders who plant trees in compounds among the four zones were not statistically significant. In contrast, the percentage of landholders who plant trees in fields does vary significantly according to study zone. More than 46 percent of the landholders in Bandiagara had planted trees in their fields, compared to less than 20 percent in the other three zones.

The bias toward planting in compounds is also evident if the data are analyzed on a parcel basis (table 20). Rates of planting on compounds ranged from a low of 71.1 percent in Fatoma to a high of 91.8 percent in Koro. Field planting rates were much lower, ranging from a low of 6.3 percent in Konna to a high of 38.3 percent in Bandiagara.

TABLE 20

Incidence of Planting and Protection by Parcels (sample survey)*

WHERE TREES HAVE BEEN PLANTED	FATOMA #	FATOMA %	BANDIAGARA #	BANDIAGARA %	KORO #	KORO %	KONNA #	KONNA %	TOTAL #	TOTAL %
All parcels[a]	37	(27.6) n=134	136	(46.4) n=293	67	(17.6) n=381	47	(23.0) n=204	287	(28.4) n=1012
				Significance = .0000						
Compounds[b]	27	(71.1) n=38	44	(83.0) n=53	45	(91.8) n=49	37	(84.1) n=44	153	(83.2) n=184
				Significance = .0844						
Fields[c]	10	(10.4) n=96	92	(38.3) n=240	22	(6.6) n=332	10	(6.3) n=160	134	(16.2) n=828
				Significance = .0000						
Parcels with regeneration[c]	63	(65.6) n=96	204	(85.0) n=240	324	(97.6) n=332	68	(42.5) n=160	659	(79.6) n=828
				Significance = .0000						

a. Does not include parcels worked by others or fallow fields.

b. Does not include compounds for subholders living with the main landholder.

c. Does not include fallow fields or land worked by others.

2. Reasons for Not Planting Trees

Most of the landholders had at least one parcel on which they planted no trees. Lack of labor and lack of water were the most commonly listed reasons for not planting trees (table 21). The belief that trees will decrease crop yields was cited as a reason for not planting trees by 15.1 percent of the survey respondents. However, there are differences among the four study zones: although lack of labor was the most frequently cited constraint in Fatoma and Koro, it was considered a constraint by only a few of the Konna respondents. Too much water was considered a constraint by nearly one-third of the respondents in Konna, many of whom farm rice fields on the inundated plain. Insufficient water, however, is also a major deterrent to tree planting in Konna, since one-quarter of the respondents cited lack of water as a reason for not planting trees. In the other three regions, lack of water was also mentioned by many villagers as a reason for not planting trees. Tenure-related reasons were cited by only a very small percentage of the respondents (3.7 percent).

TABLE 21

Reasons for Not Planting Trees (compounds and fields)*

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Lack labor	16	(29.6)	17	(23.6)	43	(40.2)	3	(4.6)	79	(26.5)
Women don't plant trees	8	(14.8)	-	(0.0)	12	(11.2)	4	(6.2)	24	(8.1)
Lack water	8	(14.8)	36	(50.0)	20	(18.7)	16	(24.6)	80	(26.9)
Disturbs crops	7	(13.0)	12	(16.7)	13	(12.1)	13	(20.0)	45	(15.1)
Poor soil	2	(3.7)	14	(19.4)	3	(2.8)	5	(7.7)	24	(8.1)
Not my land	3	(5.6)	-	(0.0)	3	(2.8)	5	(7.7)	11	(3.7)
Too much water (rice fields)	6	(1.1)	-	(0.0)	-	(0.0)	24	(36.9)	30	(10.1)
Don't know	7	(13.0)	1	(1.4)	5	(4.7)	8	(12.3)	21	(7.1)
Other	8	(14.8)	-	(0.0)	14	(13.1)	17	(26.2)	39	(13.1)

* Four missing responses; landholders who plant trees on all their parcels excluded from calculations; multiple responses possible.

3. Protection of Natural Regeneration

Nearly all landholders in the study allow some trees to regenerate in their fields (table 19). The percentage of landholders protecting trees in their fields ranged from 64.6 percent in Konna to 100 percent in Koro.

The most common reason cited for not protecting trees was that the trees would interfere with crop production (table 22). In the Konna study zone, a number of respondents did not allow trees to regenerate in their rice fields for fear that the trees would attract birds. Only one person mentioned land tenure as a reason for not protecting trees.

TABLE 22

Reasons for Not Protecting Natural Regeneration[a]

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
	(n=22)		(n=18)		(n=4)		(n=37[b])		(n=85)	
Disturbs crops	17	(77.3)	17	(94.4)	4	(100.0)	19	(51.4)	57	(67.1)
Attracts birds (rice fields)	1	(4.6)	1	(5.6)	-	(0.0)	10	(27.0)	12	(11.8)
No trees	3	(13.6)	-	(0.0)	-	(0.0)	4	(10.8)	7	(8.2)
Not my land	1	(4.6)	-	(0.0)	-	(0.0)	-	(0.0)	1	(1.2)
Too much work	1	(4.6)	-	(0.0)	-	(0.0)	1	(2.7)	2	(2.4)
Other	-	(0.0)	-	(0.0)	-	(0.0)	4	(10.8)	4	(4.7)

a. Landholders who protect trees on all fields not included in calculations.

b. Four cases of no response.

4. Diversity of Planted Species

The majority of tree planters reported having planted only one species of trees in their compounds (table 23). Planters in Bandiagara were least likely to have planted more than one species in their compounds, while planters in Konna were most likely to have planted several species. With the exception of tree planters in Koro, most respondents planted only one species of trees in their fields as well.

TABLE 23

Diversity of Species Planted in Compounds and Fields

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Compounds	**(n=26)**		**(n=44)**		**(n=45)**		**(n=35)**		**(n=150)**	
1 species	18	(69.2)	40	(90.9)	29	(64.4)	20	(57.1)	107	(71.3)
2 species	4	(15.4)	4	(9.1)	14	(31.1)	7	(20.0)	29	(19.3)
3 species	4	(15.4)	0	(0.0)	2	(4.4)	8	(22.9)	14	(9.3)
Fields	**(n=9)**		**(n=46)**		**(n=16)**		**(n=8)**		**(n=79)**	
1 species	6	(66.7)	30	(65.2)	7	(43.8)	5	(62.5)	48	(60.8)
2 species	1	(11.1)	7	(15.2)	5	(31.3)	3	(37.5)	16	(20.3)
3 species or more	2	(22.2)	9	(19.6)	4	(25.1)	0	(0.0)	4	(5.1)

5. Diversity of Protected Species

The majority of tree protectors protect more than one species in their fields (table 24). More than half of the tree protectors in Fatoma, Bandiagara, and Koro and exactly half of the protectors in Konna protect three or more species.

TABLE 24

Diversity of Species Protected in Fields

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
	(n=40)		**(n=83)**		**(n=109)**		**(n=42)**		**(n=274)**	
1 species	7	(17.5)	3	(3.6)	0	(0.0)	11	(26.2)	21	(7.7)
2 species	11	(27.5)	23	(27.7)	29	(26.6)	10	(23.8)	73	(26.6)
3 species	17	(42.5)	39	(47.0)	35	(32.1)	7	(16.7)	98	(35.8)
4 species or more	5	(12.5)	18	(21.7)	45	(41.3)	14	(33.3)	82	(29.9)

6. Tree Management by Landholder Category

If a comparison is made of tree-planting behavior for primary landholders and subholders, it is clear that the two groups differ considerably (table 25). In all four study zones, primary landholders are much more likely to plant trees than subholders. As a rule the difference is more striking for trees planted in fields than for trees planted in concessions, but in all cases primary holders were significantly more likely to plant trees. In contrast, the two landholder categories did not differ significantly in their tree protection behavior.

TABLE 25

Tree Planting and Tree Protection by Landholder Category

	PRIMARY HOLDERS				SUBHOLDERS				SIGNIF-ICANCE
	Yes		No		Yes		No		
	#	%	#	%	#	%	#	%	
Protects natural regeneration:									
Fatoma	28	(75.7)	9	(24.3)	12	(60.0)	8	(40.0)	.3517
Bandiagara	27	(77.1)	8	(22.9)	56	(87.5)	8	(12.5)	.2924
Koro	45	(100.0)	0	(0.0)	64	(100.0)	0	(0.0)	--
Konna	26	(63.4)	15	(36.6)	16	(66.7)	8	(33.3)	1.0000
Plants trees									
Fatoma	28	(75.7)	9	(24.3)	0	(0.0)	20	(100.0)	.0000
Bandiagara	32	(91.4)	3	(8.6)	24	(37.5)	40	(62.5)	.0000
Koro	42	(93.3)	3	(6.7)	4	(6.3)	60	(93.8)	.0000
Konna	35	(87.8)	5	(12.2)	0	(0.0)	24	(100.0)	.0000

7. Gender Differences in Planting and Protection Behavior

Planting behavior also differs significantly between men and women landholders. Women are much less likely to plant trees than men (table 26). Given that a much greater percentage of women are subholders, who tend to have fewer rights to trees than primary holders, it is not surprising that so few women plant trees. In contrast, the percentage of women who protect trees is nearly as great as the percentage of men who do so.

TABLE 26

Tree Planting and Protection According to Gender

	WOMEN				MEN				SIGNIF-ICANCE
	Yes		No		Yes		No		
	#	%	#	%	#	%	#	%	
Protects natural regeneration:									
Fatoma	14	(60.9)	9	(39.1)	26	(76.5)	8	(23.5)	.3330
Bandiagara	16	(80.0)	4	(20.0)	67	(84.8)	12	(15.2)	.8556
Koro	33	(100.0)	0	(0.0)	76	(100.0)	0	(0.0)	--
Konna	16	(64.0)	9	(36.0)	26	(65.0)	14	(35.0)	1.0000
Plants trees:									
Fatoma	2	(8.7)	21	(91.3)	26	(76.5)	8	(23.5)	.0000
Bandiagara	4	(20.0)	16	(80.0)	52	(65.8)	27	(34.2)	.0006
Koro	0	(0.0)	33	(100.0)	46	(60.5)	30	(39.5)	.0000
Konna	0	(0.0)	25	(100.0)	36	(90.0)	4	(10.0)	.0000

8. Species Most Commonly Planted and Protected (tables 27-30)

Species Planted in House Compounds. Azdirachta indica (neem), is by far the preferred species for compound plantings. Among the Koro and Bandiagara respondents who had planted trees in compounds, all had planted neem. In Konna, 94.3 percent of the compound planters had planted neem, while in Fatoma just over half (57.7 percent) of the compound planters had planted neem. The only other species planted in compounds in Bandiagara was Prosopis juliflora. The lack of species diversity in Bandiagara compounds is probably due to the fact that most house compounds in the Bandiagara plateau are located in rocky areas with little, if any, soil. In Koro, a substantial number of planters (22.2 percent) planted baobabs in their compounds but few planted other species. Mango trees were planted in compounds by 31.4 percent of the compound planters in Konna. A number of other species, mostly fruit varieties, were also planted. Prosopis juliflora was planted by 19.2 percent, eucalyptus by 15.4 percent, and mango trees by 15.4 percent of the planters in Fatoma.

Species Planted in Fields. The preferred field species varied by study zone. In Bandiagara, the preferred field species were local or exotic fruits. Borassus aethiopum (raffia palm) was planted by 52.2 percent of the field planters, followed closely by Adansonia digitata (45.7 percent). Most of the other field species planted in Bandiagara were exotic fruit species.

TABLE 27

Species of Trees Planted and Protected in Fatoma

SPECIES	NUMBER	PERCENT
Compounds (planters = 26)		
Azdirachta indica	15	57.7
Prosopis juliflora	5	19.2
Eucalyptus sp.	4	15.4
Mangifera indica	4	15.4
Vitex doniana	2	7.7
Unidentified species	2	7.7
Acacia nilotica	1	3.8
Hyphanae thebaica	1	3.8
Khaya senegalensis	1	3.8
Psidium guajava	1	3.8
Flamboyant	1	3.8
Fields (planters = 9)		
Azdirachta indica	5	55.6
Acacia albida	3	33.3
Borassus aethiopum	2	22.2
Mangifera indica	2	22.2
Tamarindus indica	2	22.2
Psidium guajava	1	11.1
Khaya senegalensis	1	11.1
Parkia biglobosa	1	11.1
Natural regeneration (protectors = 40)		
Acacia albida	38	95.0
Balanites aegyptica	15	37.5
Acacia nilotica	14	35.0
Sclerocarya birrea	6	15.0
Vitex doniana	6	15.0
Diospyros mespiliformis	5	12.5
Tamarindus indica	4	10.0
Adansonia digitata	3	7.5
Parkia biglobosa	2	5.0
Pilostigma reticulatum	2	5.0
Acacia raddiana	2	5.0
Azdirachta indica	1	2.5
Guiera senegalensis	1	2.5
Borassus aethiopum	1	2.5
Annona senegalensis	1	2.5
Zizyphus mauritania	1	2.5
Boscia senegalensis	1	2.5
Psidium guajava	1	2.5

TABLE 28

Tree Planting and Protection in Bandiagara

SPECIES	NUMBER	PERCENT
Compounds (planters = 44)		
Azdirachta indica	44	100.0
Prosopis juliflora	4	9.1
Fields (planters = 46)		
Borassus aethiopum	24	52.2
Adansonia digitata	21	45.7
Mangifera indica	10	21.7
Parkia biglobosa	4	8.7
Psidium guajava	4	8.7
Annona senegalensis	3	6.5
Carica papaya	2	4.3
Citrus sinensis	2	4.3
Parkinsonia aculeata	1	2.2
Azdirachta indica	1	2.2
Natural regeneration (protectors = 83)		
Acacia albida	68	81.9
Balanites aegyptica	28	33.7
Lannea microcarpa	26	31.3
Butyrosperum parkii	25	30.1
Sclerocarya birrea	23	27.7
Tamarindus indica	20	24.1
Combretum glutinosum	15	18.1
Parkia biglobosa	10	12.0
Landolphia	9	10.8
Borassus aethiopum	8	9.6
Zizyphus mauritania	5	6.0
Adansonia digitata	4	4.8
Combretum micranthum	1	1.2
Unidentified species	1	1.2

TABLE 29

Species Planted and Protected in Koro

SPECIES	NUMBER	PERCENT
Compounds (planters = 45)		
Azdirachta indica	45	100.0
Adansonia digitata	10	22.2
Carica papaya	3	6.7
Acacia albida	1	2.2
Balanites aegyptica	1	2.2
Borassus aethiopum	1	2.2
Parkinsonia aculeata	1	2.2
Tamarindus indica	1	2.2
Fields (planters = 16)		
Acacia albida	13	81.3
Acacia raddiana	8	50.0
Azdirachta indica	4	25.0
Butyrosperum parkii	1	6.3
Detarium microcarpa	1	6.3
Tamarindus indica	1	6.3
Unidentified species	2	12.5
Natural regeneration (protectors = 109)		
Acacia albida	92	84.4
Balanites aegyptica	72	66.1
Sclerocarya birrea	50	45.9
Adansonia digitata	34	31.2
Acacia raddiana	32	29.4
Tamarindus indica	31	28.4
Acacia nilotica	8	7.3
Combretum glutinosum	8	7.3
Butyrosperum parkii	8	7.3
Unidentified species	8	7.3
Zizyphus mauritania	7	6.4
Lannea microcarpa	3	2.8
Anogeissus leiocarpus	2	1.8
Acacia senegalensis	1	0.9
Detarium microcarpa	1	0.9
Pilostigma reticulatum	1	0.9
Acacia seyal	1	0.9

TABLE 30

Species of Trees Planted and Protected in Konna

SPECIES	NUMBER	PERCENT
Compounds (planters = 35)		
Azdirachta indica	35	94.3
Mangifera indica	11	31.4
Parkia biglobosa	3	8.6
Eucalyptus sp.	2	5.7
Khaya senegalensis	2	5.7
Phoenix dactiylifera	2	5.7
Parkinsonia aculeata	1	2.9
Tamarindus indica	1	2.9
Acacia nilotica	1	2.9
Prosopis juliflora	1	2.9
Psidium guajava	1	2.9
Gmelina	1	2.9
Ndubalewi	1	2.9
Champs (planters = 8)		
Azdirachta indica	3	37.5
Borassus aethiopum	2	25.0
Hyphanae thebaica	2	25.0
Parkia biglobosa	1	12.5
Mangifera indica	1	12.5
Euphorbia balsamifera	1	12.5
Ndubalewi	1	12.5
Natural regeneration (protectors = 42)		
Acacia albida	23	54.8
Sclerocarya birrea	15	35.7
Acacia nilotica	12	28.6
Tamarindus indica	11	26.2
Parkia biglobosa	10	23.8
Balanites aegyptica	8	19.0
Lannea microcarpa	6	14.3
Combretum micranthum	5	11.9
Adansonia digitata	5	11.9
Vitex doniana	4	9.5
Calotropis procera	4	9.5
Diospyros mespiliformis	4	9.5
Guiera senegalensis	4	9.5
Pilostigma reticulatum	2	4.8
Hyphanae thebaica	2	4.8
Borassus aethiopum	2	4.8
Capparis tomentosa	1	2.4
Zizyphus mauritania	1	2.4
Pterocarpus lucens	1	2.4

In contrast, field planters in Koro were more likely to plant acacia species than fruit species. Acacia albida was planted by most field planters (81.3 percent), followed by Acacia raddiana (50 percent). Neem were planted by 25.0 percent of the respondents who planted trees in fields.

Neem was the preferred species for field plantings in both Fatoma (55.6 percent) and Konna (37.5 percent). Acacia albida was the next preferred species in Fatoma, having been planted by 33.3 percent of the field planters. Raffia palm was planted by 25 percent of the field planters in Konna and 22.2 percent of the field planters in Fatoma. The other popular field species in both Fatoma and Konna were fruit species.

Species Allowed to Regenerate. In all four study zones, Acacia albida was the species most likely to be allowed to regenerate in fields. The percentage of farmers who avoided killing Acacia albida varied from a low of 54.8 percent in Konna, to 81.9 percent in Bandiagara, to 84.4 percent in Koro, and to a high of 95 percent in Fatoma. Fruit species were also frequently protected by the respondents. Other than Acacia albida, Balanites aegyptica was the species most likely to be protected in Bandiagara, Fatoma, and Koro. In Konna, Sclerocarya birrea was the second most commonly protected species. In Bandiagara, local fruit species such as Lannea microcarpa (31.3 percent), Butyrosperum parkii (30.1 percent), Sclerocarya birrea (27.1 percent), and Tamarindus indica (24.1 percent) were protected by many farmers. Sclerocarya birrea was commonly allowed to regenerate in Koro (45.9 percent), as was Adansonia digitata (31.2 percent), Acacia raddiana (29.4 percent), and Tamarindus indica (28.4 percent). In Fatoma, a number of tree protectors (35.0 percent) allowed Acacia nilotica to grow in their fields as well as a variety of local fruit and nonfruit species. Slightly more than one-quarter of the tree protectors in Konna allowed Acacia nilotica and Tamarindus indica to regenerate in their fields.

9. Methods Used to Grow Trees

Seedling transplantation was the method most commonly used to grow trees in Fatoma, Koro, and Konna (table 31). Direct seeding was also extensively used in Fatoma and Konna. In Bandiagara, direct seeding was the technique most commonly used to grow trees, though a large percentage of tree planters also transplanted seedlings. Few of the landholders reported growing trees from cuttings.

10. Tree Failures

The majority of tree planters stated that they had planted some trees that had subsequently died (figure 32). The most common reasons listed for tree failures included insect damage, lack of water, and poor soil. Animal damage was listed by only a relatively small percentage of respondents as a cause for tree deaths.

TABLE 31

Tree Propagation Methods

	FATOMA #	FATOMA %	BANDIAGARA #	BANDIAGARA %	KORO #	KORO %	KONNA #	KONNA %	TOTAL #	TOTAL %
	(n=28)		(n=56)		(n=46)		(n=36)		(n=166)	
Direct seeding	14	(50.0)	45	(80.4)	8	(17.4)	21	(58.3)	88	(53.0)
				Significance = .0000						
Transplanting	23	(82.1)	39	(69.6)	44	(95.7)	32	(88.9)	138	(83.1)
				Significance = .0041						
Cuttings	0	(0.0)	0	(0.0)	0	(0.0)	1	(2.8)	1	(0.6)
				Significance = .3039						

TABLE 32

Tree Failures

	FATOMA #	FATOMA %	BANDIAGARA #	BANDIAGARA %	KORO #	KORO %	KONNA #	KONNA %	TOTAL #	TOTAL %
	(n=28)		(n=56)		(n=46)		(n=36)		(n=166)	
Planted trees that failed	26	(92.9)	43	(76.8)	41	(89.1)	29	(80.6)	139	(83.7)
				Significance = .1757						
Reasons for failure:										
Insects	16	(57.1)	19	(33.9)	21	(45.7)	18	(50.0)	74	(44.6)
				Significance = .1863						
Lack water	6	(21.4)	15	(26.8)	14	(30.4)	6	(16.7)	41	(24.7)
				Significance = .5021						
Bad soil	7	(25.0)	18	(32.1)	7	(15.2)	5	(13.9)	37	(22.3)
				Significance = .1091						
Browsing	1	(3.6)	0	(0.0)	5	(10.9)	4	(11.1)	10	(6.0)
				Significance = .0591						

11. Tree Maintenance and Protection

The survey respondents were asked to list the techniques they use to make trees grow better. Although a majority of landholders employ some techniques to improve tree growth, the relative percentage of respondents using each technique varies substantially from region to region (table 33). Tree maintenance was the norm among landholders in Bandiagara, where 88.9 percent of the respondents listed at least one maintenance technique. Tree maintenance was also very common in Koro, where nearly three-quarters of the respondents listed tree maintenance techniques they use. In contrast, landholders in both Konna and Fatoma were less likely to make an active effort to improve tree growth. Only 50.1 percent of the respondents in Fatoma and 58.5 percent of the respondents in Konna employed tree maintenance techniques.

TABLE 33

Tree Maintenance Techniques Used by Sample Survey Respondents

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
	(n=57)		(n=99)		(n=109)		(n=65)		(n=330)	
Maintains trees	29	(50.9)	88	(88.9)	78	(71.6)	38	(58.5)	233	(70.6)
	Significance = .0000									
Techniques used:	(n=29)		(n=88)		(n=78)		(n=38)		(n=233)	
Pruning	15	(51.7)	33	(37.5)	56	(71.8)	11	(28.9)	115	(49.4)
	Significance = .0000									
Fencing	8	(27.6)	38	(43.2)	41	(52.6)	20	(52.6)	107	(45.9)
	Significance = .0080									
Watering	16	(55.2)	41	(46.6)	29	(37.2)	26	(68.4)	112	(48.1)
	Significance = .0712									
Fertilizing	6	(20.7)	27	(30.7)	2	(2.6)	12	(31.6)	47	(20.2)
	Significance = .0000									

The methods listed for encouraging trees to grow better included watering, trimming branches, fencing off trees from animals and children, and fertilizing. As might be expected, considerable differences in tree maintenance techniques occurred among the four zones. Watering was the

most common tree maintenance technique used in Fatoma, Bandiagara, and Konna. Fencing was used by over half of the tree maintainers in Konna and Koro but by only 27.6 percent of the respondents in Fatoma. Pruning was used by the majority of tree maintainers in Koro, Fatoma, and Bandiagara, but was was much less common in Konna. The addition of fertilizer was generally less commonly practiced than other maintenance techniques.

12. Use of Soil Conservation Techniques and Fertilizer

Landholders were asked to list the methods they use to prevent soil from washing away in their fields. Soil conservation techniques used by the farmers included rock walls, earthen walls, dead vegetation barriers, and soil mounds.

Farmers in Bandiagara (93.9 percent) were most likely to use erosion prevention techniques in their fields (table 34). A large percentage of farmers in Fatoma (75.6 percent) and Konna (69.2 percent) also used soil conservation techniques. In contrast, less than half of the landholders in Koro (48.6 percent) reported using soil erosion techniques. The use of organic fertilizer was quite high in all four zones. The percentage of landholders who use organic fertilizer was lowest in Koro (71.6 percent) and highest in Konna (90.8 percent).

TABLE 34

Use of Soil Conservation Techniques and Manuring

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
	(n=57)		(n=99)		(n=109)		(n=65)		(n=330)	
Uses soil conservation techniques:										
Yes	43	(75.4)	93	(93.9)	53	(48.6)	45	(69.2)	234	(70.9)
				Significance = .0000						
No	14	(24.6)	6	(6.1)	56	(51.4)	20	(30.8)	96	(29.1)
Manures fields:										
Yes	49	(86.0)	84	(84.8)	78	(71.6)	59	(90.8)	270	(81.8)
				Significance = .0059						
No	8	(14.0)	15	(15.2)	31	(28.4)	6	(9.2)	60	(18.2)

13. Perceptions of Use of Trees for Improving Fertility/ Stopping Erosion

The majority of landholders in all four study zones felt that trees can improve soil fertility (table 35). Respondents in Konna were least likely to believe that trees can help improve soil productivity. In addition, approximately 15 percent of the landholders in Konna were unsure of the beneficial effect of trees on soil fertility. In the other study zones, more than 90 percent of the landholders believe that trees can help improve soil productivity.

TABLE 35

Beliefs in the Soil Improvement and Erosion Prevention Utility of Trees

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
	(n=57)		(n=99)		(n=109)		(n=65)		(n=330)	
Trees increase productivity:										
Yes	55	(96.5)	95	(96.0)	100	(91.7)	53	(81.5)	303	(91.8)
No	0	(0.0)	4	(4.0)	5	(4.6)	2	(3.1)	11	(3.3)
Don't know	2	(3.5)	0	(0.0)	4	(3.7)	10	(15.4)	16	(4.8)
Trees decrease soil erosion:										
Yes	29	(50.9)	53	(53.5)	9	(8.3)	25	(38.5)	116	(35.2)
No	28	(49.1)	46	(46.5)	87	(79.8)	30	(46.2)	191	(57.9)
Don't know	0	(0.0)	0	(0.0)	13	(11.9)	10	(15.4)	23	(7.0)

The belief that trees are useful as an erosion prevention measure was much less widespread and varied considerably between the study zones. Approximately half of the respondents in Fatoma and Bandiagara felt that trees were useful for preventing erosion, compared to 38.5 percent of the respondents in Konna and only 8.3 percent in Koro.

14. Perceptions of Changes in the Wood Stock

In order to find out whether landholders feel that the local stock of wood has changed over time, respondents were asked whether the number of trees in near fields, far fields, and the forest had changed. The

responses show considerable variation according to location (tables 36-38). In general, landholders in Koro were much less likely to think that the number of trees had declined than landholders in the other three zones. The most striking difference in opinion as to the change in the quantity of trees occurred for fields close to the village. More than half of the respondents in Fatoma, Bandiagara, and Konna felt that the number of trees in close fields had decreased. In contrast, more than half of the respondents in Koro believed that the quantity of trees had increased over time in fields close to the village.

TABLE 36

Perceived Changes in Wood Stock in Fields Close to Village

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
	(n=57)		(n=99)		(n=109)		(n=65)		(n=330)	
Decrease	34	(59.6)	68	(68.7)	30	(27.5)	43	(66.2)	175	(53.0)
Increase	9	(15.8)	27	(27.3)	67	(61.5)	22	(33.8)	125	(37.9)
No change	13	(22.8)	0	(0.0)	10	(9.2)	0	(0.0)	23	(7.0)
Don't know	1	(1.8)	4	(4.0)	2	(1.8)	0	(0.0)	7	(2.1)

TABLE 37

Perceived Changes in Wood Stock in Distant Fields

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
	(n=57)		(n=99)		(n=109)		(n=65)		(n=330)	
Decrease	33	(57.9)	78	(78.8)	47	(43.1)	42	(64.6)	200	(60.6)
Increase	10	(17.5)	17	(17.2)	42	(38.5)	22	(33.8)	91	(27.6)
No change	13	(22.8)	0	(0.0)	10	(9.2)	1	(1.5)	24	(7.3)
Don't know	1	(1.8)	4	(4.0)	10	(9.2)	0	(0.0)	15	(4.5)

TABLE 38

Perceived Changes in Wood Stock in Forests

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
	(n=57)		(n=99)		(n=109)		(n=65)		(n=330)	
Decrease	36	(63.2)	85	(85.9)	49	(45.0)	41	(63.1)	211	(63.9)
Increase	6	(10.5)	10	(10.1)	38	(34.9)	22	(33.8)	76	(23.0)
No change	14	(24.6)	0	(0.0)	11	(10.1)	1	(1.5)	26	(7.9)
Don't know	1	(1.8)	4	(4.0)	11	(10.1)	1	(1.5)	17	(5.2)

Almost 80 percent of the respondents in Bandiagara believed that the number of trees in far fields had diminished over time, compared to 64.6 percent in Konna, 57.9 percent in Fatoma, and only 43.1 percent in Koro. About one-third of the landholders in Konna and Koro felt that the wood stock had increased in distant fields, while less than one-quarter of the respondents in Bandiagara and Fatoma felt that their stock of wood had increased in distant fields.

The landholders in Bandiagara were considerably more likely to feel that the wood stock in the forests had decreased than were their counterparts in the other three zones. Only 10.1 percent of the Bandiagarans felt that the number of trees in the forest had gone up over time. Although only about 10 percent of the Fatomans felt that the forest wood stock had increased, a substantial percentage (25 percent) felt that it had remained stable. In contrast, one-third of the respondents in Konna and Koro believed that the forest stock had increased over time.

C. Land Tenure Characteristics

1. Types of Access to Land

Four major types of land access were identified among the survey respondents: inheritances, borrowing arrangements, gifts, and state leases (table 39). Only one respondent reported having purchased a parcel of land, and none of the respondents sharecropped, pledged, or rented land from private individuals. The distribution of access types is roughly similar throughout the study zones: most people have access to at least

TABLE 39

Distribution of Access Types among Survey Respondents*

ACCESS TYPE (individuals)	FATOMA #	FATOMA %	BANDIAGARA #	BANDIAGARA %	KORO #	KORO %	KONNA #	KONNA %	TOTAL #	TOTAL %
	(n=57)		(n=99)		(n=109)		(n=65)		(n=330)	
Inherited	32	(56.1)	64	(64.6)	59	(54.1)	47	(72.3)	202	(61.2)
Borrowed	27	(47.4)	31	(31.3)	46	(42.2)	25	(38.5)	129	(39.1)
Gift	14	(24.6)	17	(17.2)	17	(15.6)	6	(9.2)	54	(16.4)
State lease	7	(12.3)	0	(0.0)	0	(0.0)	6	(9.2)	13	(3.9)
Purchase	1	(1.8)	0	(0.0)	0	(0.0)	0	(0.0)	1	(0.3)

* Weighted sample; multiple responses possible.

one parcel of inherited land, and a substantial number of people borrow at least one parcel of land. A smaller percentage of people have access to gift land. The percentage of people with gift land ranges from 9.2 percent in Konna to 24.6 percent in Fatoma. State leases are found only in the Fatoma and Konna areas, where 12.3 percent and 9.2 percent, respectively, of the landholders had state lease land. The only respondent with purchased land was located in the Fatoma study zone.

A fairly substantial proportion of the survey respondents work at least one borrowed parcel (table 40). The proportion of respondents with borrowed parcels ranged from less than one-third in Bandiagara (31.3 percent) to nearly half in Fatoma (47.4 percent). The percentage of respondents who have access to land only through borrowing arrangements ranges from 18.2 percent in Bandiagara to 31.2 percent in Koro. The differences among the zones were not statistically significant. The percentage of respondents with access to both borrowed and inherited, gift or state lease land was lowest in Koro (11.0 percent) and highest in Fatoma (19.3 percent). The percentage of respondents who had no borrowed land at all was highest in Bandiagara (68.7 percent) and lowest in Fatoma (52.6 percent). However, these differences are not statistically significant.

If the sample survey data are analyzed on a parcel basis, the results indicate that the majority of parcels are inherited (table 41). Borrowed parcels are next most common, followed by gifts or state leases. Only one parcel had been purchased.

TABLE 40

Number of Individuals with Certain Combinations of Access (sample survey)*

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
	(n=57)		(n=99)		(n=109)		(n=65)		(n=330)	
Borrowed land only	16	(28.1)	18	(18.2)	34	(31.2)	13	(20.0)	81	(24.5)
No borrowed land	30	(52.6)	68	(68.7)	63	(57.8)	40	(61.5)	201	(60.9)
				Significance = .1806						
Borrowed land and other access type	11	(19.3)	13	(13.1)	12	(11.0)	12	(18.5)	48	(14.5)

* Weighted sample.

TABLE 41

Distribution of Access Types (parcel basis) (sample survey)*

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
	(n=156)		(n=310)		(n=433)		(n=266)		(n=1165)	
Inherited	99	(63.5)	218	(70.3)	263	(60.7)	209	(78.6)	789	(67.7)
Borrowed	30	(19.2)	49	(15.8)	123	(28.4)	35	(13.2)	237	(20.3)
Gift	17	(10.9)	43	(13.9)	47	(10.9)	10	(3.8)	117	(10.0)
State lease	9	(5.8)	-	-	-	-	12	(4.5)	21	(1.8)
Purchase	1	(0.1)	-	-	-	-	-	-	1	(<0.1)

* Weighted sample.

2. Land Access Types by Landholder Category

If a comparison of land access types is made between primary landholders and subholders, it is clear that the latter are much less likely to farm land they have inherited (table 42). None of the subholders in the Fatoma area had inherited land, whereas 86.5 percent of the primary landholders farmed inherited land. Although more subholders had access to inherited land in Koro and Konna (31.3 percent and 33.3 percent, respectively), they were still much less likely to have inherited parcels than primary landholders in the same zones. Primary holders in all four zones were less likely to have borrowed land than subholders, but the difference was statistically significant only in Fatoma. The differences

TABLE 42

Landholder Category and Land Access Type

	PRIMARY HOLDERS				SUBHOLDERS				SIGNIF-ICANCE
	Yes		No		Yes		No		
	#	%	#	%	#	%	#	%	
Inherited/purchased									
Fatoma	32	(86.5)	5	(13.5)	0	(0.0)	20	(100.0)	.0000
Bandiagara	28	(80.0)	7	(20.0)	36	(56.3)	28	(43.8)	.0321
Koro	39	(86.7)	6	(13.3)	20	(31.3)	44	(68.8)	.0000
Konna	39	(95.1)	2	(4.9)	8	(33.3)	16	(66.7)	.0000
Borrowed									
Fatoma	11	(29.7)	26	(70.3)	16	(80.0)	4	(20.0)	.0008
Bandiagara	7	(20.0)	28	(80.0)	24	(37.5)	40	(62.5)	.1168
Koro	14	(31.1)	31	(68.9)	32	(50.0)	32	(50.0)	.0769
Konna	13	(31.7)	28	(68.3)	12	(50.0)	12	(50.0)	.2306
Gift									
Fatoma	10	(27.0)	27	(73.0)	4	(20.0)	16	(80.0)	.7904
Bandiagara	5	(14.3)	30	(85.7)	12	(18.8)	52	(81.3)	.7761
Koro	5	(11.1)	40	(88.9)	12	(18.8)	52	(81.3)	.4156
Konna	2	(4.9)	39	(95.1)	4	(16.7)	20	(83.3)	.2540
ORM									
Fatoma	7	(18.9)	30	(81.1)	0	(0.0)	20	(100.0)	.0981
Bandiagara	-	-	-	-	-	-	-	-	-
Koro	-	-	-	-	-	-	-	-	-
Konna	6	(14.6)	35	(85.4)	0	(0.0)	24	(100.0)	.1277

in the percentage of primary holders and subholders with access to gift land were not statistically significant for any of the zones. Only primary landholders had access to state lease land in Fatoma and Konna. Since all of the subholders in these two zones were women, who cannot legally register for state lease land, the lack of subholders with state lease land is understandable.

3. Tenure and Tree Planting and Protection Behavior

The sample survey data indicate that tree-planting behavior differs according to the type of access a person has to land (table 43). The rate of tree planting on borrowed land is significantly lower than for inherited and gift land. No farmers planted trees on state lease land. Tree protection rates are approximately the same for borrowed and inherited parcels but significantly less on gift land in all zones except Koro (table 44). The low rate of protection for gift land may be explained in part by the fact that land given as a definitive gift is likely to be land that is not already under cultivation. The new owner is thus likely to concentrate on clearing out unwanted trees rather than on allowing trees to regenerate.

TABLE 43

Incidence of Tree Planting for Different Land Access Categories (parcel basis)*

ACCESS TYPE	FATOMA		BANDIAGARA		KORO		KONNA	
	#	%	#	%	#	%	#	%
	(# and % of parcels with planted trees)							
Inherited/purchased	33 (40.2) n=82		105 (51.0) n=206		55 (25.8) n=213		41 (27.9) n=147	
Borrowed	0 (00.0) n=30		12 (26.1) n=46		4 (3.3) n=121		4 (11.4) n=35	
Gift	4 (25.0) n=16		19 (46.3) n=41		8 (17.0) n=47		2 (20.0) n=10	
State lease	0 (00.0) n=6		--- n=0		--- n=0		0 (00.0) n=12	
Significance level	.0001		.0093		.0000		.0410	

* Weighted sample; fallow fields and land given out not included.

TABLE 44

Incidence of Protection of Natural Regeneration by Land Access Categories (fields only)*

ACCESS TYPE	FATOMA # %	BANDIAGARA # %	KORO # %	KONNA # %	TOTAL # %
	(number and percentage of fields with planted trees)				
Inherited/ purchased	36 (73.5) n=49	154 (90.6) n=170	170 (100.0) n=170	48 (45.3) n=106	408 (82.4) n=495
Borrowed	22 (75.9) n=29	34 (82.9) n=41	111 (93.3) n=119	20 (58.8) n=34	187 (83.9) n=223
Gift	5 (41.7) n=12	16 (55.2) n=29	43 (100.0) n=43	0 (00.0) n=8	64 (69.6) n=92
State lease	0 (00.0) n=6	--- n=0	--- n=0	0 (00.0) n=12	0 (00.0) n=18
Significance	.0006	.0000	.0007	.0003	

* Weighted sample; fallow fields, compounds, and land given out not included.

D. Contacts with Eaux et Forêts

1. Purpose of Village Visits

Virtually all of the respondents reported that Eaux et Forêts agents pass through their villages periodically (table 45). In all four areas, the majority of respondents stated that the Eaux et Forêts agents come to their village in a regulatory capacity. A much smaller percentage of respondents cited extension, including technical advice about trees, environmental awareness campaigns, and explanations of the forest law, as the purpose of the village visits from forest agents. A larger percentage of respondents in Koro and Konna cited enforcement as the purpose of the agent visits than in Fatoma and Bandiagara. A higher percentage of respondents in Fatoma (25.5 percent) and Koro (18.3 percent) stated that agents had come to their villages in an extension capacity than was the case for Bandiagara (11.1 percent) and Konna (10 percent).

TABLE 45

Purpose of Forest Agent Visits*

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Agents visit village:										
Yes	47	(82.5)	99	(100.0)	109	(100.0)	60	(92.3)	315	(95.5)
No	4	(7.0)	---		---		---		4	(1.2)
Don't know	6	(10.5)	---		---		5	(7.7)	11	(3.3)
Visit's purpose:	**n=47**		**n=99**		**n=109**		**n=60**		**n=315**	
Enforcement	35	(74.5)	66	(66.7)	93	(85.3)	50	(83.3)	244	(77.5)
Extension	12	(25.5)	11	(11.1)	20	(18.3)	6	(10.0)	49	(15.6)
Don't know	7	(14.9)	24	(24.2)	1	(0.9)	7	(11.7)	39	(12.4)

* Multiple responses possible.

2. Extension Contacts

Individual contacts with agents in a technical advice capacity were highest in Bandiagara, where approximately one-quarter of the landholders have received advice about establishing nurseries, planting trees, protecting trees, and pruning trees (table 46). Technical advice contacts were lowest in Konna, where only 3.1 percent of the landholders have received advice on nurseries and planting, protecting, and pruning trees. About one-fifth of the landholders in Koro and Bandiagara have received seedlings, seeds, or other materials from Eaux et Forêts, compared to only 10.5 percent of the respondents in Fatoma and 6.2 percent in Konna.

3. Regulatory Contacts

The percentage of landholders who have had contacts with agents in a regulatory capacity was higher than the percentage of individuals who have had extension contacts. Nonetheless, relatively few landholders have had such contacts (table 47). Respondents in Fatoma were least likely to have had direct contact with agents for permitting or fining activities. Only 7 percent of the Fatoma landholders reported having

TABLE 46

Extension Contacts with Forest Agents

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Received advice from agents:										
Yes	8	(14.0)	29	(29.3)	16	(14.7)	2	(3.1)	55	(16.7)
				Significance = .0001						
No	49	(86.0)	70	(70.7)	93	(85.3)	63	(96.9)	275	(83.3)
Total	57	(100.0)	99	(100.0)	109	(100.0)	65	(100.0)	330	(100.0)
Received inputs from agents:										
Yes	6	(10.5)	20	(20.2)	19	(17.4)	4	(6.2)	49	(14.8)
				Significance = .0563						
No	51	(89.5)	79	(79.8)	90	(82.6)	61	(93.8)	281	(85.2)
Total	57	(100.0)	99	(100.0)	109	(100.0)	65	(100.0)	330	(100.0)

TABLE 47

Regulatory Contacts with Forest Agents

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
None	53	(93.0)	75	(75.8)	76	(69.7)	43	(66.2)	247	(74.8)
Fines only	2	(3.5)	0	(0.0)	3	(2.8)	10	(15.4)	15	(4.5)
Permits only	1	(1.8)	12	(12.1)	26	(23.9)	4	(6.2)	43	(13.0)
Fines and permits	1	(1.8)	12	(12.1)	4	(3.7)	8	(12.3)	25	(7.6)
Total	57	(100.1)	99	(100.0)	109	(100.1)	65	(100.1)	330	(100.0)

TABLE 48

Forest Violations
(combined totals from all four zones)

ACTIVITY/TYPE OF TREE	#	%
Reasons for violations:		
Cutting branches for fodder	9	(22.5)
Cutting branches for fencing	8	(20.0)
Cutting firewood (home)	5	(12.5)
Failure to have a wood stove	5	(12.5)
Cutting construction wood	4	(10.0)
Clearing new fields	4	(10.0)
Cutting firewood (sale)	3	(7.5)
Other	2	(5.0)
Total	40	(100.0)
Location of woodcutting violations:		
Offender's field	20	(57.1)
Someone else's field	1	(2.9)
Village forest	9	(25.7)
Other forest	5	(14.3)
Total	35	(100.0)
Type of tree:		
Dead trees	20	(57.1)
Live trees	13	(37.1)
Both	2	(5.7)
Total	35	(100.0)
Entire tree	9	(25.7)
Branches	25	(71.4)
Both	1	(2.9)
Total	35	(100.0)
Cut planted tree?		
Yes	0	(0.0)
No	35	(100.0)
Total	35	(100.0)
Tree farmer had protected?		
Yes	10	(28.6)
No	25	(71.4)
Total	35	(100.0)
Given receipt?		
Yes	6	(17.1)
No	29	(82.9)

paid for a permit or having paid a fine. In contrast, 24.2 percent of the Bandiagara respondents, 30.4 percent of the Koro respondents, and 33.8 percent of the Konna respondents had either purchased permits or paid a fine. Landholders in Fatoma are much less likely to purchase permits than their neighbors in Konna, Bandiagara, and Fatoma. The percentage of the total landholder population purchasing permits ranged from a low of 3.6 percent in the Fatoma study zone to a high of 27.6 percent in Koro. Relatively few of the landholders had been apprehended by forest agents for the illegal use of forest resources. Landholders in Fatoma and Koro were least likely to have been fined (5.3 percent and 6.5 percent, respectively). In Bandiagara, 12.1 percent of the respondents had been fined. Fining activity was highest in the Konna study zone, where slightly over one-quarter (27.7 percent) of the respondents had been fined.

4. Regulatory Activities

Fines. Fines were imposed for illegal cutting (including mutilation), failure to have a wood stove, and illegal clearing. The majority of the fines involved illegal cutting. In all four study zones, 50 percent or more of the woodcutting violations involved the cutting of dead wood (see table 48). Slightly more than half of the violations occurred in the offender's field. In most cases the offender was fined for cutting branches rather than an entire tree. No offenders had been fined for cutting planted trees. About one-quarter had been fined for cutting or pruning trees that they had allowed to grow in their fields. Violators cut trees in order to obtain forage, domestic firewood, corral construction materials, house construction materials, and commercial firewood and to clear new and old fields. Only one respondent reported being fined for cutting even though he had a valid permit. Less than one-fifth of the woodcutting offenders had received a receipt for the fine they paid.

Permits. Respondents acquired use permits in order to obtain fencing materials (30.9 percent), construction wood or wood for crafts (30.9 percent), and firewood (35.3 percent) and to clear land (16.7 percent). Most of the woodcutting permits were issued for cutting in natural forests. The single clearing permit issued was for clearing a fallow field.

The cost of the permits ranged from 250 CFA to 20,000 CFA, with the average cost being 3,809 CFA. Slightly less than half of the permit holders had obtained a permit on more than one occasion, and 15 percent of the permit holders pay for a permit on a yearly basis.

Permit purchases appear to be restricted to people who either make a living out of selling wood or cut large quantities of wood. Most of the people who do not get permits stated that they do not sell wood, do not cut wood, or do not cut large amounts of wood.

TABLE 49

Permit Activities

	#	%
Reasons for getting permits:		
Construction material	19	(27.9)
Firewood (home)	19	(27.9)
Animal corrals	16	(23.5)
Garden fencing	5	(7.4)
Firewood (sale)	5	(7.4)
Woodcraft materials	2	(2.9)
Clearing	1	(1.5)
Fishing	1	(1.5)
Location of tree:		
Permit holder's field	11	(16.2)
Village forest	27	(39.7)
Other forest	30	(44.1)
Reasons for not getting permits:		
Don't cut large amounts of wood	98	(38.0)
Don't cut wood	82	(31.8)
Don't sell wood	35	(13.6)
Don't know	29	(11.3)
Lack money for permit	14	(5.4)

E. Tree Poaching in Fields

Tree poaching, or the cutting of trees on private land without permission, is common in all of the study zones except Bandiagara (table 50). More than half of the respondents in Fatoma, Koro, and Konna reported having had trees cut in their fields without prior authorization. Tree poaching was highest in Koro, where 72.5 percent of the respondents stated that someone had cut trees in their fields without first getting permission. Tree theft was lowest in Bandiagara, where only 18.5 percent of the landholders stated that unauthorized tree cutting had occurred in their fields. In all four study zones, landholders were generally unable to catch the offenders. Of the seven cases where offenders were caught, five were settled on a friendly basis while two were settled by threatening the offender with further action. No cases were taken to the local forest agent or arrondissement authorities for settlement.

TABLE 50

Incidence of Tree Poaching in Fields

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Has anyone cut or pruned trees in your fields without your permission?										
Yes	36	(63.2)	18	(18.2)	79	(72.5)	38	(58.5)	171	(51.8)
				Significance = .0000						
No	21	(36.8)	81	(81.8)	30	(27.5)	27	(41.5)	159	(48.2)
Total	57	(100.0)	99	(100.0)	109	(100.0)	65	(100.0)	330	(100.0)
How did you settle the matter?										
Didn't catch offender	34	(94.4)	18	(100.0)	76	(96.2)	36	(94.7)	164	(95.9)
				Significance = .7550						
Amicable settlement	1	(2.8)		---	3	(3.8)	1	(2.6)	5	(2.9)
Settled under threat	1	(2.8)		---		---	1	(2.6)	2	(1.2)
Total	36	(100.0)	18	(100.0)	79	(100.0)	38	(99.9)	171	(100.0)

F. Perceptions of Eaux et Forêts

When asked to describe the usefulness of Eaux et Forêts agents, many respondents either stated that they didn't know or that the agents served no useful purpose (table 51). In Fatoma and Bandiagara, approximately one-third of the respondents felt that the agents were useful in controlling illegal use of forest products, compared to only 20.0 percent of the respondents in Konna and 4.6 percent in Koro. None of the respondents in Konna mentioned extension. Only 7 percent of the respondents in Bandiagara and Fatoma mentioned extension, compared to 19.3 percent of the respondents in Koro.

G. Perceptions of Rights to Cut Planted Trees

In order to obtain information about villager perceptions of their rights to trees in their compounds and fields on a wide-scale basis, a follow-up survey was conducted of the sample survey respondents. Only

TABLE 51

Villager Perceptions of Agent Usefulness

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
Don't know	31	(54.4)	53	(53.5)	38	(34.9)	22	(33.8)	144	(43.6)
				Significance = .0000						
No use	2	(3.5)	4	(4.0)	45	(41.3)	30	(46.2)	81	(24.5)
Protection	20	(35.1)	35	(35.4)	5	(4.6)	13	(20.0)	73	(22.1)
Extension	4	(7.0)	7	(7.1)	21	(19.3)	0	(0.0)	32	(9.7)
Improvements:										
Less enforcement	10	(17.5)	6	(6.1)	5	(4.6)	19	(29.2)	40	(12.2)
				Significance = .0000						
More extension	6	(10.5)	7	(7.1)	8	(7.3)	3	(4.6)	24	(7.3)
Don't know	41	(71.9)	84	(85.7)	76	(69.7)	42	(64.6)	243	(73.9)
Nothing	0	(0.0)	1	(1.0)	20	(18.3)	1	(1.5)	22	(6.7)

two-thirds of the original respondents were contacted during the follow-up survey, the others having gone to look for seasonal work or to take their herds into the inner delta. Consequently, the follow-up survey data cannot be used to make statistically valid comparisons. However, the data still provide evidence that many villagers in the study zones feel that they have only limited rights to the trees they plant or allow to regenerate on their land.

Farmers are clearly concerned about the impact trees have on crop production. The majority of farmers (89.8 percent) feel that having too many trees in a field results in decreased production (table 52). Farmers also felt that trees attract pests and make working in the fields more difficult. All of the farmers interviewed felt that the negative effect of trees on crop production can be diminished by pruning the trees. Yet virtually none of the respondents feel that they have the right to prune trees without first getting authorization from the local forest agent.

As indicated in table 53, nearly all of the follow-up survey respondents believe that they risk a fine if they trim trees either in their compounds or in their fields. Of the 247 cases used in the analysis, 188 (76.1 percent) stated that they have trees in their fields which they wish to prune but do not do so for fear of being caught by Eaux et Forêts

TABLE 52

Villager Perceptions of Negative Effects of Trees*

	YES	
A. How do trees interfere with crop production? (n=247)	**#**	**%**
1. Competition decreases yields	222	(89.8)
2. Trees get in the way of workers	16	(6.5)
3. Trees attract pests	9	(3.6)
4. Trees don't interfere with crops	6	(2.4)

	YES		NO	
B. If you prune trees, will they interfere less with crop production (n=247)	**#**	**%**	**#**	**%**
	247	(100.0)	0	(0.0)

* Multiple responses possible.

agents. The majority of those who wish to trim trees want to trim them in order to increase crop production or reduce pests. Approximately 14 percent wish to trim field trees in order to improve tree production. Only 6.4 percent want to trim the trees solely to obtain raw materials.

Nearly all the villagers interviewed believe that they risk fines if they cut down trees in their compounds or in their fields (96.4 percent and 100.0 percent, respectively). Of the farmers interviewed, 42 percent stated that they have trees in their fields which they wish to cut but fear being fined by Eaux et Forêts. The majority (79 percent) of those wishing to cut field trees want to cut the trees in order to obtain raw materials or firewood. One-quarter of the farmers feel that cutting the trees would improve their crop yields.

Although some villagers believe that they have the right to prune or cut down trees they have planted without getting a permit, the vast majority of villagers stated that they fear being fined if they cut or trim trees that they have planted.

The data obtained during the follow-up survey indicate that the perceived lack of rights to prune and cut down trees discourages villagers from planting or protecting more trees. In all four study zones, the majority of the respondents stated that they would plant and protect more trees if they could cut and prune the trees without being subject to a fine if caught by Eaux et Forêts agents (table 54).

TABLE 53

Villager Perceptions of their Rights to Trees (sample survey)*

	YES		NO		TOTAL	
	#	%	#	%	#	%
A. Agents fine people for pruning trees:						
-in compounds	225	(91.1)	22	(8.9)	247	(100.0)
-in fields	244	(98.8)	3	(1.2)	247	(100.0)
B. Agents fine people for cutting trees:						
-in compounds	238	(96.4)	9	(3.6)	247	(100.0)
-in fields	247	(100.0)	0	(0.0)	247	(100.0)
C. Agents fine people for pruning trees they have planted:						
-in compounds	225	(91.1)	22	(8.9)	247	(100.0)
-in fields	234	(94.7)	13	(5.3)	247	(100.0)
D. Agents fine people for cutting trees they have planted:						
-in compounds	226	(91.5)	21	(8.5)	247	(100.0)
-in fields	237	(96.0)	10	(4.0)	247	(100.0)
E. Has trees he wants to prune but is afraid of Eaux et Forêts agents	188	(76.1)	59	(23.9)	247	(100.0)
F. Has trees he wants to cut but is afraid of Eaux et Forêts agents	104	(42.1)	143	(57.9)	247	(100.0)

G. Reasons for wanting to prune trees: (n=188)	#	%	Reasons for wanting to cut trees: (n=104)	#	%
-Improve crop production	141	(75.0)	-Construction materials	50	(48.1)
-Control pests	29	(15.4)	-Improve crop production	27	(25.9)
-Improve tree production	27	(14.4)	-Firewood	27	(25.9)
-Obtain wood products	12	(6.4)			
Total	**	--	Total	104	(99.9)

* Partial sample; weighted for subholders.

** No totals calculated since multiple responses were recorded for some cases.

TABLE 54

Effect of Fear of Being Fined on Planting and Protection of Trees*

	YES		NO		TOTAL	
	#	%	#	%	#	%
A. Would you let more trees grow in your fields if you were not afraid to:						
-prune them? (n=244)	239	(98.0)	5	(2.0)	244	(100.0)
-cut them? (n=247)	241	(97.6)	6	(2.4)	247	(100.0)
B. Would you plant more trees in your fields if you were not afraid to:						
-prune them? (n=234)	232	(99.9)	2	(0.9)	234	(100.0)
-cut them? (n=237)	235	(99.2)	2	(0.8)	237	(100.0)

* Partial sample, weighted for subholders.

H. Comparison of VRP and Non-VRP Villages (Fatoma and Bandiagara)

As originally designed, the Village Reforestation Project was supposed to test ways in which Eaux et Forêts could evolve from a police force, enforcing tree use regulations, to an extension agency that could teach villagers how to improve and protect the region's natural resource base. The project's objectives were to increase farmer knowledge of tree planting and care techniques, to increase the frequency of tree planting, to increase villager awareness of the need for protecting and improving the environment, to provide villagers with a positive perception of forest agents, and to give them a better understanding of the basic provisions of the Forest Code.

A prerequisite to the AIP project was that forestry agents working in the project zone not fine people for infractions in that zone, and that they not wear their uniforms while conducting extension activities. The suspension of fining in the project zone was enforced until the end of the first phase in 1987, at which time agents resumed police activities. In the second phase of the project, agents carry out both police and extension activities in the project zone. At the present time agents generally do not wear uniforms when conducting extension activities but do wear them when carrying out police missions.

One goal of the present study is to determine whether the VRP has, in fact, met any of the objectives outlined in the original project documents. The sample survey, therefore, included respondents from villages targeted by VRP/AIP actions and villages not included in the VRP/AIP programs. The following section summarizes the results obtained by comparing VRP and non-VRP villages in Fatoma and Bandiagara. Earlier in this report, it was shown that tree-planting behavior for primary landholders and subholders varies significantly, with much lower rates of planting among subholders. To control for this factor, the analyses were conducted using only primary landholders.

1. Tree-Planting and Protection Behavior

A comparison of the rates of tree planting among primary holders in VRP villages and non-VRP villages indicates that overall planting rates are somewhat higher in VRP villages (86.4 percent versus 60.0 percent) in Fatoma but are not statistically significant at the .10 level (table 55). Rates of planting in household compounds, though higher in VRP villages, also did not vary significantly at the .10 level. However, the rate of tree planting in fields was significantly higher in VRP villages (36.4 percent versus 6.7 percent). Protection of natural regeneration was also significantly greater among respondents in VRP villages in Fatoma (100 percent versus 40 percent).

In contrast, overall planting rates, compound planting rates, field planting rates, and regeneration protection rates in Bandiagara did not differ significantly between VRP and non-VRP villages.

Use of techniques for improving tree survival and production did not differ significantly between VRP and non-VRP villages for either project zone (see table 56). As a rule, the use of specific tree maintenance techniques was slightly higher in VRP villages in Fatoma, though not at statistically significant levels. In Bandiagara, VRP villagers were less likely to fertilize their trees to improve growth, but the differences in the use of other tree maintenance techniques were not statistically significant at the .10 level.

2. Improved Wood Stoves

Respondents in VRP villages in Fatoma were much more likely to have wood stoves (77.3 percent versus 20.0 percent) than their counterparts in villages not targeted by VRP (table 57). Although the percentage of villagers who claimed to be able to construct and repair wood stoves was slightly greater in VRP villages, the differences were not statistically significant. In both cases, the rates were very low (less than 25 percent).

In Bandiagara, a higher percentage of villagers in VRP villages claimed to have functioning wood stoves than their counterparts in non-VRP villages. However, the difference was not statistically significant. As in Fatoma, the VRP villagers in Bandiagara were more likely to know how

TABLE 55

Tree-Planting and Protection Behavior in VRP and Non-VRP Villages

	PRV		NON-PRV		CHI-SQUARE	D.F.	SIGNIFICANCE
	#	%	#	%			
A. FATOMA							
Protects natural regeneration:							
Yes	22	(100.0)	6	(40.0)	14.34	1	.0002
No	0	(0.0)	9	(60.0)	17.44	1	
Plants trees:							
Yes	19	(86.4)	9	(60.0)	2.09	1	.1485
No	3	(13.6)	6	(40.0)	3.37	1	
Plants trees in fields:							
Yes	8	(36.4)	1	(6.7)	2.81	1	.0936
No	14	(63.6)	14	(93.3)	4.27	1	
Plants trees in concessions:							
Yes	17	(77.3)	9	(60.0)	0.58	1	.4459
No	5	(22.7)	6	(40.0)	1.27	1	
B. BANDIAGARA							
Protects natural regeneration:							
Yes	12	(70.6)	15	(83.3)	0.25	1	.6208
No	6	(35.3)	3	(16.7)	0.81	1	
Plants trees:							
Yes	16	(94.1)	16	(88.9)	0.00	1	1.0000
No	1	(5.9)	2	(11.1)	0.31	1	
Plants trees in fields:							
Yes	11	(64.7)	15	(83.3)	0.76	1	.3825
No	6	(35.3)	3	(16.7)	1.58	1	
Plants trees in concessions:							
Yes	14	(82.4)	14	(77.8)	0.00	1	1.0000
No	3	(17.6)	4	(22.2)	0.11	1	

TABLE 56

Use of Tree Maintenance Techniques in VRP and Non-VRP Villages

	PRV		NON-PRV		CHI-SQUARE	D.F.	SIGNIF-ICANCE
	#	%	#	%			
A. FATOMA							
Doesn't fence	17	(77.3)	12	(80.0)	0.00	1	1.0000
Fences trees	5	(22.7)	3	(20.0)			
Doesn't fertilize	17	(77.3)	14	(93.3)	0.72	1	.3970
Fertilizes	5	(22.7)	1	(6.7)			
Doesn't prune	13	(59.1)	13	(86.7)	2.06	1	.1511
Prunes trees	9	(40.9)	2	(13.3)			
Doesn't water	11	(50.0)	10	(66.7)	0.44	1	.5049
Waters trees	11	(50.0)	5	(33.3)			
B. BANDIAGARA							
Doesn't fence	13	(76.5)	8	(44.4)	2.52	1	.1123
Fences trees	4	(23.5)	10	(55.6)			
Doesn't fertilize	10	(58.8)	18	(100.0)	6.87	1	.0088
Fertilizes	7	(41.2)	0	(0.0)			
Doesn't prune	11	(64.7)	11	(61.1)	0.00	1	1.000
Prunes trees	6	(35.3)	7	(38.9)			
Doesn't water	8	(47.1)	6	(33.3)	0.23	1	.6289
Waters trees	9	(52.9)	12	(66.7)			

to construct and repair wood stoves, but again the differences were not significant. Although the percentage of villagers who said they could construct and repair wood stoves was greater in Bandiagara than in Fatoma, less than 50 percent claimed such knowledge.

3. Beliefs in the Utility of Trees for Soil Improvement and Erosion Prevention

A higher percentage of respondents in VRP villages than in non-VRP villages stated that trees help improve soil productivity; however, the difference between the two groups was not statistically significant.

TABLE 57

Knowledge of Repair and Construction of Wood Stoves

	PRV		NON-PRV		CHI-SQUARE	D.F.	SIGNIF-ICANCE
	#	%	#	%			
A. FATOMA							
Has wood stove:							
Yes	17	(77.3)	3	(20.0)	9.59	1	.0020
No	5	(22.7)	12	(80.0)	11.78	1	.0006
Can build stove	5	(22.7)	0	(0.0)	2.24	1	.1347
Can't build stove	17	(77.3)	100	(100.0)	3.94	1	.0471
Can repair stove	5	(22.7)	1	(6.7)	0.72	1	.3970
Can't repair stove	17	(77.3)	14	(93.3)	1.69	1	.1932
B. BANDIAGARA							
Has wood stove							
Yes	13	(81.3)	11	(61.1)	0.83	1	.3632
No	3	(18.8)	7	(38.9)	1.65	1	.1983
Can build stove	5	(31.3)	2	(11.1)	1.05	1	.3055
Can't build stove	11	(68.8)	16	(88.9)	2.10	1	.1472
Can repair stove	7	(43.8)	4	(22.2)	0.94	1	.3310
Can't repair stove	9	(56.3)	14	(77.8)	1.79	1	.1805

Similarly, a higher, but not significantly different, percentage of VRP villagers felt that trees helped decrease damage from water erosion.

In Bandiagara, all of the respondents felt that trees improve soil productivity. Respondents in both VRP and non-VRP villages were equally likely to feel that trees are useful in lessening water-caused soil erosion.

4. Relations with Eaux et Forêts

The percentage of villagers who mentioned that Eaux et Forêts agents come to their village in a police capacity was slightly lower in VRP villages in both Fatoma and Bandiagara, but the differences between the two

TABLE 58

Perceptions of the Role of Trees in Increasing Production and Reducing Erosion

	PRV #	PRV %	NON-PRV #	NON-PRV %	CHI-SQUARE	D.F.	SIGNIF-ICANCE
A. FATOMA							
Trees improve soil fertility?							
Yes	22	(100.0)	13	(86.7)			
No	0	(0.0)	2	(13.3)	1.04	1	.3075
Trees decrease soil erosion?							
Yes	14	(63.6)	7	(46.7)	0.47	1	.4933
No	8	(36.4)	8	(53.3)			
B. BANDIAGARA							
Trees improve soil fertility?							
Yes	17	(100.0)	18	(100.0)	--	-	--
No	0	(0.0)	0	(0.0)			
Trees decrease soil erosion?							
Yes	12	(70.6)	13	(72.2)	.00	1	1.00
No	5	(29.4)	5	(27.8)	.00	1	1.00

groups was not statistically significant. Although the percentage of villagers who stated that Eaux et Forêts agents come to their villages in an extension capacity was higher in VRP villages in both zones, again the differences were not statistically significant at the .10 level. (Note that some villagers stated that agents come in both capacities.)

At the individual level, villagers in VRP villagers were more likely to have received advice from Eaux et Forêts agents on planting, pruning, and protecting trees. In Bandiagara, VRP villagers were more likely to have received inputs, such as seeds and seedlings, than their non-VRP counterparts. In Fatoma, a higher percentage of VRP villagers received inputs than non-VRP villagers, but the difference was not statistically significant.

TABLE 59

Relations with Eaux et Forêts Agents in VRP and Non-VRP Villages

	PRV #	PRV %	NON-PRV #	NON-PRV %	CHI-SQUARE	D.F.	SIGNIF-ICANCE
A. FATOMA							
Reasons for agent visits to village:							
Enforcement:							
-Cited	14	(63.6)	13	(86.7)	1.37	1	.2413
-Not cited	8	(36.4)	2	(13.3)	2.39	1	.1214
Extension:							
-Cited	7	(31.8)	1	(6.7)	2.01	1	.1562
-Not cited	15	(68.2)	14	(93.3)	3.33	1	.0681
Extension contacts with agents:							
Technical advice							
-Yes	8	(36.4)	0	(0.0)	4.97	1	.0257
-No	14	(63.6)	15	(100.0)			
Inputs							
-Yes	5	(22.7)	1	(6.7)	0.72	1	.3970
-No	17	(77.3)	14	(93.3)			
Perception of usefulness of agents:							
No use	0	(0.0)	2	(13.3)			
Don't know	5	(22.7)	6	(40.0)	6.81	3	.0782
Protection	13	(59.1)	7	(46.7)			
Extension	4	(18.2)	0	(0.0)			
How can agents improve?							
Don't know	11	(50.0)	10	(66.7)			
Less enforcement	6	(27.3)	4	(26.7)	1.86	2	.3953
More extension	5	(22.7)	1	(6.7)			

[continued]

[Table 59, Relations with Eaux et Forêts Agents, cont.]

	PRV #	PRV %	NON-PRV #	NON-PRV %	CHI-SQUARE	D.F.	SIGNIF-ICANCE
B. BANDIAGARA							
Reasons for agent visits to village:							
Enforcement:							
-Cited	14	(82.4)	16	(88.9)	0.01	1	.9450
-Not cited	3	(17.6)	2	(11.1)	0.31	1	.5808
Extension:							
-Cited	3	(17.6)	0	(0.0)	1.587	1	.2077
-Not cited	14	(82.4)	18	(100.0)	3.474	1	.0623
Extension contacts with agents:							
Technical advice							
-Yes	5	(29.4)	0	(0.0)	4.00	1	.0453
-No	12	(70.6)	18	(100.0)			
Inputs							
-Yes	8	(47.1)	0	(0.0)	8.47	1	.0036
-No	9	(52.9)	18	(100.0)			
Perception of usefulness of agents:							
No use	3	(17.6)	1	(5.6)			
Don't know	5	(29.4)	12	(66.7)	6.95	3	.0735
Protection	6	(35.3)	5	(27.8)			
Extension	3	(17.6)	0	(0.0)			
How can agents improve?							
Don't know	11	(68.8)	17	(94.4)			
Less enforcement	1	(6.3)	1	(5.6)	5.186	3	.1587
More extension	3	(18.8)	0	(0.0)			
Nothing	1	(6.3)	0	(0.0)			

On the other hand, there are significant differences in how villagers in VRP and non-VRP villages view the purpose of Eaux et Forêts agents. When asked what purpose the Eaux et Forêts agents serve, respondents in the villages not targeted by VRP were more likely to say that they did not know what use the agents were. Although VRP villagers were more likely to mention forest control as a useful function of Eaux et Forêts, they were also more likely to mention extension. When asked how Eaux et Forêts agents could improve their work, VRP villagers were more likely to mention increased extension than non-VRP villagers.

5. Comparison between VRP and non-VRP Villages (overall comparison)

If the two project zones are combined, a comparison of VRP and non-VRP villages reveals that the frequency of natural regeneration protection is significantly higher in VRP villages (table 60). Field planting rates are nearly identical for both VRP and non-VRP villages. Although the percentage of VRP villagers who plant trees in compounds is slightly higher than for non-VRP villages, the difference is not statistically significant at the .10 level.

Respondents in VRP and non-VRP villages are equally likely to believe that trees can improve soil productivity and decrease water-caused erosion in fields. However, VRP villagers were much more likely to have a functioning wood stove than non-VRP villagers, and they were more likely to know how to construct improved wood stoves.

Perceptions of Eaux et Forêts also differed significantly between VRP villages and non-VRP villages. Over half (63.5 percent) of the non-VRP respondents either did not know what use the agents were or thought they were of no use at all. Slightly more than one-third (36.4 percent) of the respondents in villages not targeted by VRP felt that forest agents were useful in protecting the forest, and none mentioned that agents were useful for providing technical advice or inputs. In contrast, 48.7 percent of the VRP villagers thought that agents were useful for protecting the forest, 17.9 percent thought they were useful for providing technical advice or seedlings, while only one-third of them either did not know what use the agents were or thought they served no useful purpose.

I. Differences between Extension/Enforcement and Enforcement Only Villages

1. Village Reforestation Project and Non-Project Villages

One purpose of the study is to determine whether decreased emphasis on regulatory activities has a positive effect on people's willingness to plant and protect trees. Unfortunately, since agents continue to fine villagers in the VRP villages, it is impossible to compare planting and protection behavior in areas where there is enforcement with areas where there is no enforcement. However, a comparison can be made between those

TABLE 60

Comparisons between VRP and Non-VRP Villages
(combined figures for Bandiagara and Fatoma)

	PRV		NON-PRV		CHI-SQUARE	D.F.	SIGNIF-ICANCE
	#	%	#	%			
Protects natural regeneration:							
Yes	34	(87.2)	21	(63.6)	4.27	1	.0389
No	5	(12.8)	12	(36.4)			
Plants trees in fields:							
Yes	19	(48.7)	16	(48.5)	0.00	1	1.0000
No	20	(51.3)	17	(51.5)			
Plant trees in concessions:							
Yes	31	(79.5)	23	(69.7)	0.47	1	.4947
No	8	(20.5)	10	(30.3)			
Plants trees:							
Yes	35	(89.7)	25	(75.8)	1.61	1	.2043
No	4	(10.3)	8	(24.2)			
Trees improve soil fertility:							
Yes	39	(100.0)	31	(93.9)	0.71	1	.4011
No	0	(0.0)	2	(6.1)			
Trees increase erosion:							
Yes	26	(66.7)	20	(60,6)	0,83	1	,7739
No	13	(33.3)	13	(39,4)			
Has wood stove:							
Yes	30	(78.9)	14	(42.4)	8,51	1	,0035
No	8	(21.1)	19	(57.6)			
Can build stove:							
Yes	10	(26.3)	2	(6.1)	3.82	1	.0507
No	28	(73.7)	31	(93.9)			
Can fix stove:							
Yes	12	(31.6)	5	(15.2)	1.79	1	.1806
No	26	(68.4)	28	(84.8)			
Usefulness of forest agents:							
None	3	(7.7)	3	(9.1)	10.44	3	.0152
Don't know	10	(25.6)	18	(54.5)			
Protection	19	(48.7)	12	(36.4)			
Extension	7	(17.9)	0	(0.0)			
Ways to improve agents' work:							
Don't know	22	(57.9)	27	(81.8)	6.93	2	.0313
Less enforcement	7	(18.4)	5	(15.2)			
More extension	9	(23.7)	1	(3.0)			

areas where agents have predominantly a regulatory function (non-VRP villages) and those areas where agents have partly a regulatory and partly an extension function (VRP villages). To minimize differences due to increased access to technical advice, the comparison was restricted to those respondents who had received no advice in both VRP and non-VRP villages.

The analysis shows that although protection rates are higher among VRP villages, the difference is weak. A higher percentage of non-VRP villagers planted trees in fields, whereas a slightly higher percentage of VRP villagers planted in concessions. In both cases, the differences were not statistically significant. VRP villagers who had not received extension advice were, however, more likely to believe that Eaux et Forêts agents served a useful function, either as protectors of forest resources or as extension agents, than non-VRP villagers.

TABLE 61

Comparison of VRP and Non-VRP Villagers Who Received No Forestry Advice

	PRV		NON-PRV		CHI-SQUARE	D.F.	SIGNIF-ICANCE
	#	%	#	%			
Protects natural regeneration:							
Yes	22	(84.6)	21	(63.6)	2.2638	1	.1324
No	4	(15.4)	12	(36.4)			
Plants trees in fields:							
Yes	10	(38.5)	16	(48.5)	0.2558	1	.6130
No	16	(61.5)	17	(51.5)			
Plants trees in concessions:							
Yes	19	(73.1)	23	(69.7)	0.0000	1	1.0000
No	7	(26.9)	10	(30.3)			
Plants trees:							
Yes	22	(84.6)	25	(75.8)	0.2636	1	.6076
No	4	(15.4)	8	(24.2)			
Usefulness of forest agents:							
None	3	(11.5)	3	(9.1)	7.7065	3	.0525
Don't know	9	(34.6)	18	(54.5)			
Protection	9	(34.6)	12	(36.4)			
Extension	5	(19.2)	0	(0.0)			
Ways to improve agents:							
Don't know	17	(68.0)	27	(81.8)	3.1401	2	.2080
Less enforcement	4	(16.0)	5	(15.2)			
More extension	4	(16.0)	1	(3.0)			

2. Koro Villages with CARE Agents versus Villages with Eaux et Forêts Agents

The Koro villages also fall into two categories: those where Eaux et Forêts has strictly a police function, and those where Eaux et Forêts has both a police and an extension function. In those villages where Eaux et Forêts agents carry out only police functions, extension advice is provided to villagers by CARE agents. The levels of extension are thus roughly comparable for all the villages. A statistical comparison of tree-planting and protection behavior among the two types of villages reveals that tree-planting and protection behavior are nearly identical in both villages (table 62).

TABLE 62

Comparison of Koro Villages Targeted by Care Agents and Villages Targeted by Eaux et Forêts Agents

	CARE/EF		CARE		CHI-SQUARE	D.F.	SIGNIF-ICANCE
	#	%	#	%			
Protects natural regeneration:							
Yes	18	(100.0)	27	(100.0)	-	-	-
No	0	(0.0)	0	(0.0)			
Plants trees in fields:							
Yes	7	(38.9)	9	(33.3)	0.004	1	0.9493
No	11	(61.1)	18	(66.7)			
Plants trees in concessions:							
Yes	17	(94.4)	24	(88.9)	0.011	1	0.9148
No	1	(5.6)	3	(11.1)			
Plants trees:							
Yes	17	(94.4)	25	(92.6)	0.000	1	1.0000
No	1	(5.6)	2	(7.4)			

3. Villages in Konna versus VRP Villages in Fatoma

The Konna study zone also represents an area where forest agents operate almost exclusively as police agents, and can thus be compared with other areas where agents also have an extension function to see if there are any differences in tree-planting and protection behavior (table 63). To eliminate differences due to differences in ethnic composition (both Koro and Bandiagara are composed primarily of Dogons, whereas

TABLE 63

Comparisons of Villages in Fatoma and Konna Villages (respondents who received no extension advice or inputs)

	FATOMA/PRV #	FATOMA/PRV %	KONNA #	KONNA %	CHI-SQUARE	D.F.	SIGNIF-ICANCE
Protects natural regeneration:							
Yes	14	(100.0)	25	(64.1)	5.10	1	.0238
No	0	(0.0)	14	(35.9)			
Plants trees:							
Yes	11	(78.6)	34	(87.2)	0.11	1	.7364
No	3	(21.4)	5	(12.8)			
Plants trees in fields:							
Yes	3	(21.4)	7	(17.9)	0.00	1	1.0000
No	11	(78.6)	32	(82.1)			
Plants trees in concessions:							
Yes	10	(71.4)	33	(84.6)	0.47	1	.4942
No	4	(28.6)	6	(15.4)			

Fatoma and Konna are populated by a mixture of Peulhs, Rimaïbe, and Malinkés), the comparison was restricted to Fatoma respondents in VRP villages and Konna respondents. To control for the effect of extension, only respondents who had received no extension advice were included in the analysis.

The data indicate that the frequency of protection of natural regeneration is significantly higher among respondents in Fatoma villages targeted by VRP. However, differences in planting rates, in both compounds and fields, are not statistically significant.

4. Zonal Differences in Understanding of Rights to Trees

The belief that villagers have few rights to cut and debranch trees in their fields and compounds is predominant in all four study zones. There is a slightly greater tendency, however, for respondents in Konna and Koro to believe that they can trim naturally growing trees in their compounds, and Konna respondents are also slightly more likely to believe that they can cut naturally occurring trees in their compounds. Bandiagara respondents were slightly more likely to believe that they would not be fined for trimming or cutting trees they have planted in their fields and compounds. If a comparison is made between VRP and

TABLE 64

Zonal Differences in Beliefs about Rights to Trees

	FATOMA		BANDIAGARA		KORO		KONNA		TOTAL	
	#	%	#	%	#	%	#	%	#	%
A. Agents fine people for pruning trees in compounds:										
Yes	35	(87.5)	80	(98.8)	68	(89.5)	42	(84.0)	225	(91.1)
No	5	(12.5)	1	(1.2)	8	(10.5)	8	(16.0)	22	(8.9)
B. Agents fine people for pruning trees in fields:										
Yes	40	(100.0)	80	(98.8)	76	(100.0)	48	(96.0)	244	(98.8)
No	0	(0.0)	1	(1.2)	0	(0.0)	2	(4.0)	3	(1.2)
C. Agents fine people for cutting trees in compounds:										
Yes	37	(92.5)	81	(100.0)	76	(100.0)	44	(88.0)	238	(96.4)
No	3	(7.5)	0	(0.0)	0	(0.0)	6	(12.0)	9	(3.6)
D. Agents fine people for cutting trees in fields:										
Yes	40	(100.0)	81	(100.0)	76	(100.0)	50	(100.0)	247	(100.0)
No		-		-		-		-		-
E. Agents fine people for pruning trees they have planted in compounds:										
Yes	39	(97.5)	64	(79.0)	76	(100.0)	46	(92.0)	225	(91.1)
No	1	(2.5)	17	(21.0)		-	4	(8.0)	22	(8.9)
F. Agents fine people for pruning trees they have planted in fields:										
Yes	40	(100.0)	72	(88.9)	76	(100.0)	46	(92.0)	234	(94.7)
No		-	9	(11.1)		-	4	(8.0)	13	(5.3)
G. Agents fine people for cutting trees they have planted in compounds:										
Yes	39	(97.5)	64	(79.0)	76	(100.0)	47	(94.0)	226	(91.5)
No	1	(2.5)	17	(21.0)		-	3	(6.0)	21	(8.5)
H. Agents fine people for cutting trees they have planted in fields:										
Yes	40	(100.0)	72	(88.9)	76	(100.0)	49	(98.0)	237	(96.0)
No		-	9	(11.1)		-	1	(2.0)	10	(4.0)

non-VRP villages in Bandiagara, the data indicate that all of the respondents who believe they can trim and cut trees they have planted live in villages targeted by VRP. There appears to be little difference between VRP and non-VRP villagers' perceptions of their rights to cut and trim trees in the Fatoma study zone.

TABLE 65

Differences between VRP and Non-VRP Villagers' Beliefs about Rights to Trees They Have Planted

	BANDIAGARA				FATOMA			
	VRP		Non-VRP		VRP		Non-VRP	
	#	%	#	%	#	%	#	%
A. Agents fine people for pruning trees they have planted in compounds:								
Yes	35	(79.5)	37	(100.0)	32	(100.0)	8	(100.0)
No	9	(20.5)	-		-		-	
B. Agents fine people for pruning trees they have planted in fields:								
Yes	27	(61.4)	37	(100.0)	31	(96.9)	8	(100.0)
No	17	(38.6)	37	(100.0)	1	(3.1)	-	
C. Agents fine people for cutting trees they have planted in compounds:								
Yes	35	(79.5)	37	(100.0)	32	(100.0)	8	(100.0)
No	9	(20.5)	-		-		-	
D. Agents fine people for cutting trees they have planted in fields:								
Yes	27	(61.4)	37	(100.0)	31	(96.9)	8	(100.0)
No	17	(38.6)	-		1	(3.1)	-	

IV. CONCLUSION

The sample survey data indicate that trees are an important part of production systems in all four study zones. The vast majority of farmers avoid killing at least some species of trees that grow in their fields. Of those who do not protect regeneration, most feel that the trees interfere with crop production. The majority of farmers also plant some trees, mostly in their compounds where water is more readily available. In contrast, tree-planting activity in fields is quite low except among farmers in Bandiagara. Lack of water and labor were the main reasons cited for not planting trees. Only a few respondents gave tenure-related explanations as reasons for not planting trees.

Most of the villagers interviewed during the sample survey take an active role in improving the growth of their trees. Watering, fencing, pruning, and fertilizing are the most common techniques used. In all four zones, certain trees are commonly believed to improve soil fertility. Trees are also considered useful for preventing water-caused soil erosion, particularly in Bandiagara and Fatoma.

In order for farmers successfully to integrate trees into their crop and livestock production systems, they need to be able to control such things as the number of trees on their land, the types of trees, and the form of the trees. They also need to be able to use techniques for increasing tree production (fruits, wood, and the like), including pruning and cutting. Finally, they must have some assurance that they will be able to benefit from the trees in terms of either improved crop production or access to tree products that the farmer can use or sell.

To exercise maximum control over his trees, the farmer thus needs the following rights:

1) right to plant trees,
2) right to prune live trees,
3) right to cut down live trees,
4) right to cut down dead trees,
5) right to harvest fruits, bark, and so on,
6) right to exclude others from cutting, pruning, and harvesting fruit.

Previous work in the Fifth Region indicates that under traditional tenure rules prevalent in the region, rights to trees on cultivated fields and compounds are vested in the landowner, who may choose to cede all or some of the rights to others. Under customary tenure rules, farmers with inherited land exercise the most control over their trees. On inherited land, farmers usually have the right to plant, prune, and cut down trees as well as the right to harvest fruits, bark, and leaves. Restrictions on the cutting of live trees on private land, when they occur, are limited

to certain highly valued trees such as karité and nére. Farmers usually have the right to exclude others from harvesting fruits, though there is a tendency for them to apply those rights only for highly valued fruit trees or for large quantities. Holders of gift land also exercise considerable control over the trees on their land, since land givers generally cede cutting and planting rights with the land.

Borrowers, on the other hand, have much more limited rights to trees according to customary rules. Frequently they lack the right to plant or cut down trees without the owner's authorization. If allowed to plant trees, their choice of acceptable species may be limited. However, borrowers normally have the right to prune trees, except for major branches.

Thus, under customary tenure rules, the main tenure constraint to increasing participation in agroforestry projects lies with the segment of the population that cultivates borrowed land and whose rights to cut down and plant trees are limited. The sample survey data lend support to this thesis: a much lower percentage of borrowed parcels have had trees planted on them than either inherited or gift land. In addition, landholders with access only to borrowed land are much less likely to plant trees on their land than landholders with no borrowed land or both borrowed land and some other right for use. Certain categories of people are more likely to have borrowed land, notably women and subholders. These same population segments are also less likely to plant trees.

On the other hand, borrowers do have an incentive to protect some natural regeneration since they have the right to prune the trees and thus can minimize the tree's interference with their crops while also profiting from whatever fruits the tree may produce. The sample survey data indicate that, in fact, borrowers and users of inherited land are equally likely to protect trees on their land.

In contrast to the customary rules which provide users of inherited and gift land with strong rights to trees, the Malian Forest Code, as villagers perceive it, does not permit any farmer legally to prune and cut down trees without prior authorization from the state. Data collected during the sample survey indicate that on the whole, villagers believe that they are likely to be fined for pruning or cutting both natural regeneration and trees they have planted. They are only slightly more likely to believe that they will not be fined for cutting or pruning trees in their compounds rather than cutting or pruning trees in their fields. Interestingly, the area in which villagers are most likely to plant trees in fields (Bandiagara) is also the area where more villagers feel they have the right to trim and cut trees they have planted in both their compounds and their fields.

The hypothesis that planting and protection would be greater in areas where Eaux et Forêts has an extension function, as well as a regulatory function, is only partially supported by the survey. Tree protection rates and field planting rates are significantly higher in the Fatoma area in villages where Eaux et Forêts agents carry out both extension and

police activities. However, non-VRP villagers are equally likely to plant trees in compounds as their counterparts. In Bandiagara, tree-planting and protection rates are similar in both VRP and non-VRP areas. A possible explanation for such results is that in Bandiagara, many farmers already plant and protect trees. In Fatoma, where farmers are less likely to plant and protect trees to begin with, the project provides an impetus for farmers who ordinarily would not plant trees or protect them to do so.

The VRP does, however, appear to have had a positive effect on how villagers perceive Eaux et Forêts agents. VRP villagers are more likely to feel that agents serve a useful function, whether it be controlling illegal woodcutting or providing technical advice and seedlings. The efforts of the past eight years on the part of the agents in Bandiagara and Fatoma have thus helped to improve the opinion that villagers have of Eaux et Forêts.

Translating this more positive attitude into greater planting and protection of trees is another, more difficult, task. The present mix of extension/enforcement does not appear to lead to significantly greater efforts in tree planting and protection than in areas where agents serve only a regulatory function. This holds true for both VRP and non-VRP villages in Fatoma and Bandiagara and for CARE/EF villages and CARE villages in Koro. A comparison of the villages in Konna with VRP villages in Fatoma shows that protection rates are higher in Fatoma but that planting rates are the same. A likely explanation for the minor differences in planting and protection behavior in extension/enforcement areas and enforcement-only areas is that the fear of being fined continues to exist in extension/enforcement areas, even though the actual likelihood of being fined is lower. In fact, the follow-up survey data indicate that such is the case: few villagers anywhere believe that they can prune or cut trees on their land without first getting a permit or authorization from Eaux et Forêts.

The data indicate that the confidence of villagers in their ability to control the trees in their fields is limited at best. Villagers thus perceive that it is not in their interest to plant and protect a great many trees, since they cannot limit the negative effects such trees may have once they are large enough to warrant pruning or felling.

What Can Be Done?

Changing customary rights is a long process, and efforts to rectify injustices frequently create greater problems than anticipated. It is generally more efficient and less disruptive to adapt the agroforestry techniques to the cultural milieu rather than attempting to make massive societal changes. The key is to recognize that traditional tenure restrictions may inhibit the adoption of certain techniques, particularly among certain segments of the population, and to prepare for such eventualities.

A knowledge of the tenure status of the land belonging to villages and individuals participating in agroforestry programs is essential if conflicts are to be avoided in the long term. Project personnel should also identify the customary ways in which less secure landholders, notably borrowers, increase their rights to trees and incorporate these methods into their extension program. For example, several borrowers interviewed during the preliminary study had worked out agreements with the landowners to obtain planting rights and cutting rights for borrowed land. Similar agreements have been negotiated at the village level in cases where villages wishing to plant collective bosquets depend on another village for the right to use the land on which the proposed bosquet is to be located.

Extension programs need to incorporate such arrangements into their extension strategies, especially in those areas where the incidence of farmers using borrowed land is high. Technologies that provide benefits relatively quickly, or which require minimal investment of time and labor, should be the focus of extension activities directed at population segments, such as women and younger men, which have access primarily through borrowing arrangements.

Modern tree tenure rules, specifically the Forest Code, present even greater disincentives for villagers effectively to integrate trees into their production systems. A Malian forester once commented that the advantage of the Forest Code is that its imprecision gives agents room to interpret the law according to the situation. However, this vagueness also makes the code an inadequate tool for good resource management for a number of reasons:

1) Because the rights that farmers have to trees on their land are not clearly spelled out in the Forest Code, agents interpret the articles as best they can. Agents who are uncertain of whether certain articles apply to farmland as well as the natural forest tend to fine farmers for cutting any trees, including unprotected species, in their fields, regardless of whether the tree is dead or alive or whether it is destined for home or market use.

2) Certain provisions, notably the restrictions on the cutting and use of certain protected species, are counterproductive to agroforestry systems, since they discourage farmers from allowing too many trees to regenerate in their fields under the assumption that they will be unable to prune or cut those trees when they mature. The fact that the preferred field species, Acacia albida, is on the protected list aggravates the situation even further.

3) Villagers have a very poor understanding of the provisions of the code governing their rights to cut and prune trees which regenerate in their field or which they themselves have planted. Details of the code's provisions are lost in the multiple translations that are made during the meetings between Eaux et Forêts agents (who are rarely fluent in the languages common in the Fifth Region) and village leaders. Further simplifications are made as leaders explain the law to other villagers, with

emphasis being placed on what is not allowed rather than on what villagers can do.

Diminishing code-related constraints to widespread adoption of intensive agroforestry techniques requires that major changes be made in the way the Forest Code is written, applied, and disseminated:

1) The code needs to be revised so that the rights of farmers to prune and thin trees in fields and household compounds are clearly stated. The right to prune and thin trees on farms needs to be expanded to include species that are currently on the protected list but which exist in abundance in many areas. At the same time, provisions need to be included which would subject large-scale cutting and pruning activities on private land to review and supervision by forest agents in order to minimize or avoid cutting actions which carry substantial negative external effects.

2) On the extension side, appropriate pruning and thinning techniques need to be established for local species and the information disseminated on a much wider scale than at present. Technical service personnel, including forest, agricultural, and livestock agents, need additional training in appropriate pruning and thinning techniques for field trees.

3) Changing the law will be ineffective unless it is applied as intended. Misapplication of the law undeniably occurs at the present time--in part because of ignorance on the part of agents and villagers and in part because of the financial interest agents have in misapplying the law. The issue of ignorance of the law can be approached from two sides. On the one hand, agents need to be given a more thorough training in legal aspects of their work. Training should focus not only on actions that are forbidden but also on activities that are allowed under the code, particularly in fields and house compounds. Review sessions need to be conducted on a regular basis to ensure that agents remain up-to-date about the code's provisions and changes in its interpretation in the courts. Closer supervision of agents is also essential to ensure that the law is applied correctly.

Villager ignorance of their rights under the Forest Code is a key factor in the ability of agents to misapply the law. It is therefore important to increase understanding of the code at the village level. At present, the code is published only in French, a language few villagers understand. Translation of the code into the major local languages is a necessary first step to increasing villager awareness of their rights and responsibilities vis-à-vis the Forest Code. However, even if the code is available in local languages, few villagers know how to read. One solution to this problem is to incorporate the major provisions of the code, including actions that are allowed, into village literacy programs. At the same time, the administrative and technical authorities working in conjunction with Eaux et Forêts need to improve the ways in which they incorporate explanations of the code into their extension and public awareness campaigns.

A major obstacle to ensuring that farmers are accorded the rights due them in the Forest Code is the fact that agents receive a very inadequate salary and rely on income from fines to help pay for their operating costs. The low base pay and irregular salary payments for agents create a climate in which illegal fining is seen as a legitimate way for these enforcement officials to have an acceptable income on a regular basis. Many villagers accept the system because they end up paying lower amounts than they would if they were fined for genuine infractions at the rates specified in the code. In the long run, however, the villagers lose out since their rights to control trees on their land are severely restricted and the productivity of the land is diminished. The forest service, and the nation as a whole, also loses since the revenues that could, in theory, be available to pay for improvements in the Forest Service are turned over to private individuals. A restructuring of the way in which the Forest Service acquires and redistributes its revenues is thus another important precondition to revising the Forest Code and changing the manner in which it is applied.