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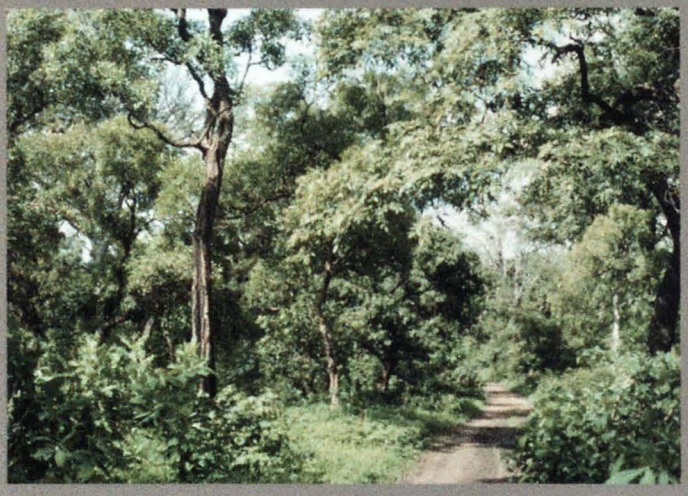
KANDIA: THREATENED FOREST, THREATENED LIVELIHOOD

A Study of Human-Environment Interaction in the Department of Velingara, Senegal



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A Study of Human-Environment Interaction in the Department of Velingara, Senegal

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CHAPTER I: INTRODUCTION

Many studies of rural Senegal paint a bleak picture of agriculture, the land, and the livelihoods of populations trying to make a living from these degrading resources. Rural people speak harshly of the difficulties in their lives and the daily challenge of providing food to their families through twelve months of the year. The tenor of conversation changes, however, when people reflect on their lives in the past and as old people think about conditions during their youth. Certainly, there are harsh memories....often of pestilence and uncontrollable maladies. But the dominant recollection is one of a productive resource base, few worries about food in most years, and an abundance of milk, grains, and fruits to satisfy the cravings of the village youth.

This pleasant picture is not a photograph from the distant past in Kandia. Rather it represents the current reality for many of the approximately 450 inhabitants of this Fulbe community in the Upper Casamance. The children of Kandia are chubby and clear skinned, many of them having virtually unlimited access to milk from the hefty cows that spend a portion of the year in the cool darkness of the forest that abuts the villages lands to the south. Granaries are full and many families continue to produce an agricultural surplus that is reinvested in cattle or small ruminants.

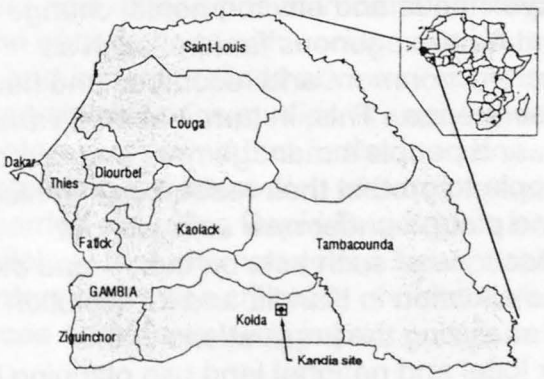


Figure 1. Location of case study in Senegal.

Kandia's relative prosperity derives from the population's continued success at integrating the productive elements of its livelihood system: notably crop and livestock production. Families who balance the production of cattle and crops have little problem feeding their families throughout the year and the more prosperous regularly produce a surplus for reinvestment. Those families who for one reason or another have not achieved this integration (do not own cattle, for example) are notably poorer than the rest of the village. They face a struggle to provide food throughout the year that is not unlike the challenges that typically confront villages further north as described in the first paragraph above.

There are clear signs, however, that the system that has been so effective in Kandia is currently under threat. If the integration of livestock and crops is the key element to their prosperity, it is equally clear that the livestock portion, in particular, depends on the continued health of the "Kandia" Forest. The forest plays a critical role in the life of Kandia's livestock, providing food and shelter during key periods of the year. Livestock raising will become a perilous undertaking if the forest is no longer there to provide these essential inputs. Without the livestock, agricultural production will suffer dramatic declines.

The forest of Kandia is a common property resource used by a large number of local villages, as well as immigrants and passers by from outside. The forest is currently under threat as cultivators from villages in the area seek to expand their fields onto its fertile soils. More serious than the absolute number of hectares being converted to farmland (this pressure is somewhat reduced by the relative remoteness of this zone), however, is the anarchic fashion in which this "development" is taking place. There is no plan that takes into consideration the needs of cattle, for example, much less the critical role of livestock in maintaining the overall health of the livelihood system. Hence, there is the imminent likelihood that the forest will be cut in two (greatly reducing its utility) as expanding fields from the villages of Kandia and Wolodou converge to cover the narrow channel that currently connects to two arms of the forest.

This study examines the interaction of human livelihoods and environmental change in and around the community of Kandia. It looks at how exogenous factors, such as changing rainfall patterns have affected the local environment and resources and how the residents have adapted their lives as a consequence. This, in turn, has had various effects on the environment, the resource base...and people's management and use of those resources. Which forces are pushing people to protect their resources? Which others create incentives for them to cut trees and plough under new soils without apparent consideration for the longer term implications of such acts on their -- and their descendants' -- well-being? After describing the situation in Kandia and its evolution over the past 50 years, the study concludes by analyzing the implications of this information both for the local population and for local and national land use planning in Senegal.

Context

This case study is one of several carried out as part the Long-term Environmental Monitoring in Senegal Project. Co-financed by USAID and the U.S. Geological Survey's EROS Data Center (EDC), and implemented by EDC and the *Centre de Suivi Ecologique* (CSE), this project has carried out extensive monitoring of natural resources and land use patterns in Senegal in order to better understand the complex dynamics of change in semi-arid tropics. The monitoring, as carried out by EROS staff and their Senegalese collaborators, has involved use of information collected by remote sensing (satellite and aerial photographs) as well as extensive field work including the collection of physical information about soils, vegetation, land use practices, and biodiversity at

over 600 sites in all parts of the country (Tappan and Wood, 1995). This information provides a remarkable record of changes in physical and land cover parameters over the last 30 years. Figure 2 presents a satellite image of the eastern Kolda Region covering the Department of Velingara. Images such as this one were used to study the changing land use patterns.

It is important to policy makers, development workers, and --ultimately -- to local populations, that changes in physical parameters be observed and recorded. This type of information has certain limitations, however. By itself, it does little to explain the complex causes that have led to observed changes in the environment and neither is it of much help in explaining the impact of these changes on local populations. Some of the observed changes can be directly linked to exogenous physical factors such as changes in rainfall quantity and patterns. But human interaction with the environment at the local level also clearly has an impact. And this impact is part of a circle of change where changes in resource availability (whether soil quality, tree density, or biodiversity) in turn have an impact on people and their livelihood strategies. As resource availability and human needs change, so do people's strategies toward resource use. The environment again changes forcing people to adapt new strategies....and so the circle continues.

For several years, the author and others have been working closely with EROS staff to consider how other types of information might be gathered that would begin to tie the physical observations with social analyses in order to better understand the issues of cause and impact outlined above. From these discussions, the EROS team decided to carry out several case studies in areas where preliminary analyses of the physical parameters suggested that further social research would be particularly illuminating in understanding the interaction of humans and their environment. The case studies were to be carried out using Rapid Rural Appraisal (RRA), a qualitative, participatory methodology that attempts to tap local people's indigenous knowledge. In this case, such information was critical to understanding their strategies for managing natural resources and the ensuing impact on the environment.

RRA is a method that helps outsiders establish a rapport with local populations and, through a highly intensive period of field research in a given site (generally a village and its territory), to explore interactions between multiple variables. The research team lives in the village during the research phase (typically from 5-8 days), uses a variety of tools and techniques to gather information, and works with diverse groups of people as well as individuals to better understand the range of experiences and perspectives that exist within a given community (see Figure 3). Each of these elements contributes to the team's ability to move beyond superficial explanations and to probe more deeply into the underlying strategies that individuals and communities use in their management of resources.

The approach taken by RRA studies (focusing on a single community and its surroundings but going into considerable depth) is very different from the remote

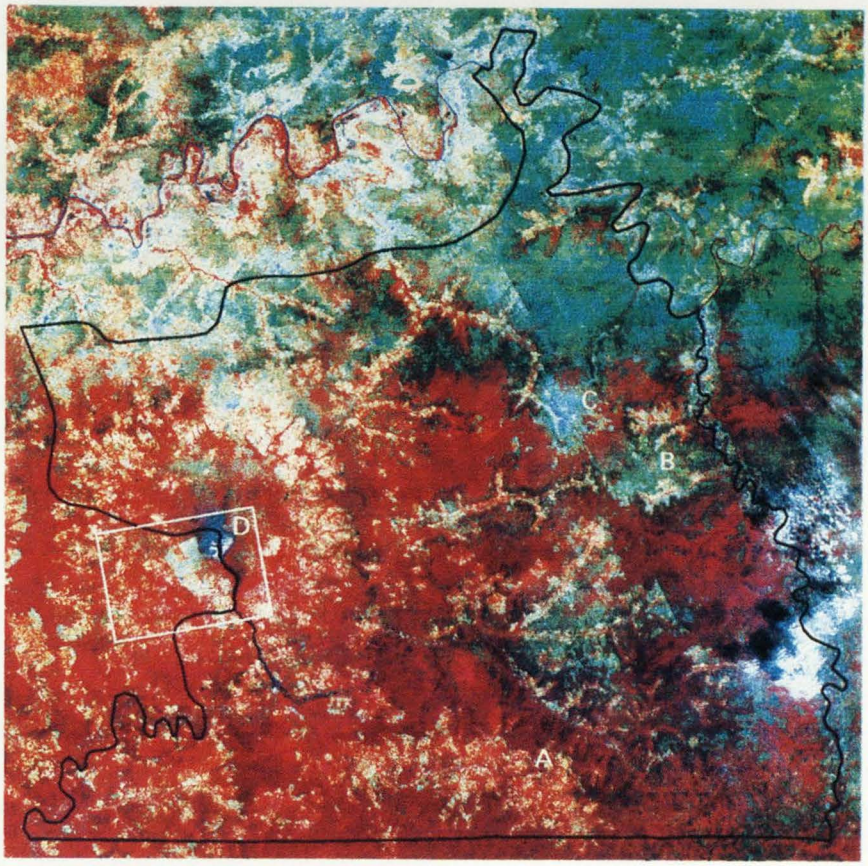


Figure 2. Satellite images were analyzed at the EROS Data Center to study and map land use and land cover changes over time in the Department of Velingara (boundary overlaid). This image was acquired by Landsat 5 on November 5, 1990. Forest or dense vegetation displayed as red (or dark gray if recently burned), whereas light areas typically represent cultivation or recently fallowed fields. Note the ring of agricultural activities around the Anambé Basin (D) and the agriculture in the south driven by immigration from Guinea Conakry and Guinea Bissau (A). The limited agriculture that exists in the east is driven largely by the influence of the rapidly growing religious center at Medina Gounas (C) and the increased efforts to expand cotton production (B).

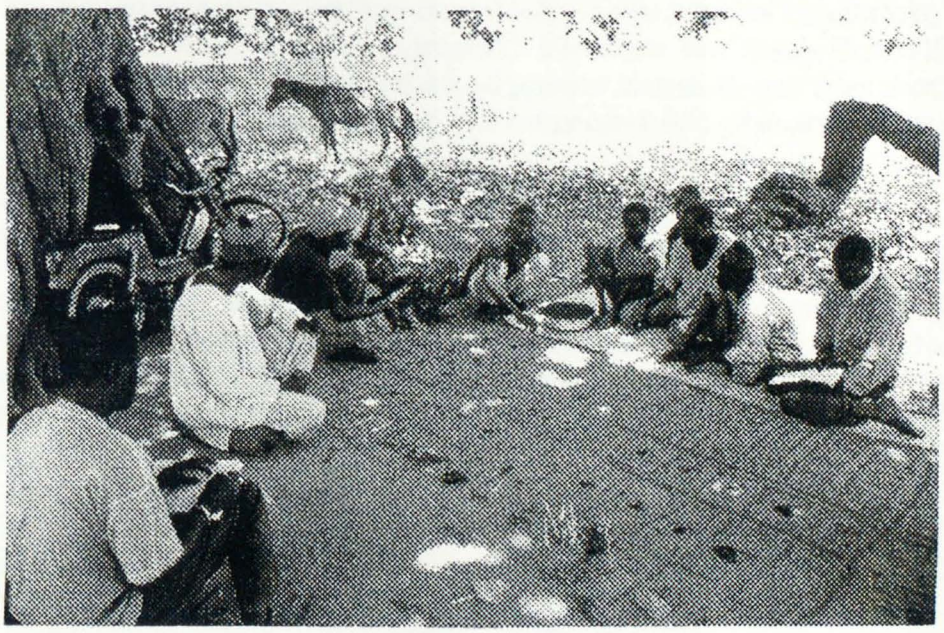


Figure 3. The RRA team observes a historical matrix exercise carried out by the Kandia villagers in which the natural resource and agricultural trends of the territory are assessed (see Figure 14).

sensing approach which tends to view the physical surface characteristics at local to regional scales but does not adequately capture the socioeconomic dimensions of a study area. This makes the marriage of the two methods particularly interesting since, while there should (if both methods are used accurately) be a certain limited amount of overlap in the information collected by the two (useful for cross-checking or "triangulating" in the lingo of RRA), for the most part the two methods will be collecting different kinds of information. In most simple terms, we might think of the remotely sensed information as telling us what is happening over a geographic area, whereas the RRA provides much greater information on the how and why by taking a closer look at a given site.

The advantage of combining the techniques will become evident from this study. In the first place, analysis of the spatial information (based primarily on satellite and aerial photos) can be used to focus on areas where (1) there are dramatic differences in land use, resulting in different resource patterns across a given ecological zone or (2) there are significant changes over time in the quality or quantity of resources as monitored by remote sensing. Both of these are indicators that there may be an interesting story of human-environment interaction to be explored further. In this way, the spatial information can be used to focus the intensive, site-specific RRA on areas where the most interesting information is likely to be obtained.

The purpose of these studies was multifold. The team was interested in gathering information on several salient issues concerning environmental change in Senegal. It is hoped that this information will illuminate some key issues that concern policy makers, donors, projects working in areas where these issues are relevant, and will ultimately serve the local populations who are in a daily struggle to maintain their livelihoods and the resources essential to their livelihoods. Of equal importance with the information gathered in the particular sites, however, is the demonstration of the utility of combining techniques that are quantitative and "top-down" with those that are qualitative, participatory, and "bottom-up" in their approach.[1] We hope that these illustrations will help others who are working on resource management issues to see how these complementary approaches might be used in their project and planning activities.

Methodology

The study in Kandia took place over seven days between February 3 and February 9, 1996 and used Rapid Rural Appraisal (RRA) to gather the information in the village. The team spent the entire week in the village, lodging with the family of the Chief, Koutchia Balde. The time in the field was divided between research activities with the villagers (including participatory maps, a transect, various semi-structured interviews, wealth ranking, and a historical profile and matrix), review of secondary materials

[1]For more examples of others who are working on combining these remote sensing and participatory research methods, see Cultural Survival Quarterly, Winter 1995.

including reports on the area and aerial and satellite photographs, and ongoing analysis of the information being gathered. Before leaving the village, an information and feedback session was held for all interested community members (approximately 35 men and women attended) to report back on the findings of the research and to solicit any additional reactions from the population on the preliminary conclusions of the study as presented in the meeting.

Site Selection

The selection of Kandia was made from a preliminary analysis of spatial information (satellite images in particular) which suggested that this area of Senegal is one that is undergoing rapid environmental change as indicated by historical analysis of land cover and land use patterns. Two members of the team then conducted a preliminary visit to the area to assess the suitability of various sites for conducting the case study. Criteria included: the interest of the local population in participating, the apparent interest of environmental issues in the area, the logistical appropriateness of the site, and whether it seemed to represent typical patterns of land use and environmental change in the area. Sites that were for some reason highly atypical due to their geographic situation or socio-economic factors were excluded from consideration.

Team Composition

The research team for this study was comprised of the following individuals:

Karen Schoonmaker Freudenberger, socio-economist (Team Leader)
Amadou Hadj, geographer/land use planner
Tamsir Ndiaye, hydro-geologist/geographer
Gray Tappan, geographer, specialist in remote sensing/GIS
Mamadou Hady Diao, translator/literacy trainer

We felt particularly fortunate to have a translator who was both highly skilled at his métier but who also knew the region well from personal experience and had considerable interest in the study and the research process. He was indispensable to the study. The team was also accompanied by a babysitter and the daughter of the team leader, both of whom contributed substantially to the ambiance of the study and our integration into village life.

Limitations of the Study

The team was generally very pleased with the process and the outcome of the study. The residents of Kandia expressed great interest in all the activities and participated with enthusiasm from beginning to end. Unfortunately, while women seemed interested in the proceedings, they tended to sit toward the back of most activities and to observe more than to participate. This bias was partly but not entirely compensated by several activities that were conducted exclusively with women.

There was a significant expectation bias that was particularly felt when we carried out various wealth ranking activities. It became clear that people were deliberately overestimating the degree of poverty in the village in order (they hoped) to attract more outside assistance. The team was able to compensate for this bias by carefully triangulating all information, and taking special pains to verify any information related to wealth and well-being using a variety of different techniques.

The team felt that it would have been useful to have had a team member with greater experience in livestock issues since these comprised a major part of the study.

This chapter concludes with a brief introduction to Kandia, its history, people, and environment.

A Profile of Kandia: its people and its environment

The population. Kandia is a village of 482 inhabitants located 15 kilometers west of Velingara in the arrondissement of Kounkané, the Department of Vélingara, and the Region of Kolda in the area popularly known as the Upper Casamance. The population is comprised principally of people from the Fulbe (Fouladou) ethnic group, a few Fulbes from the Fouta region and several Mandinka families. The cattle population, estimated at roughly 900 heads, now roughly doubles the human population. Established in approximately 1865, Kandia was the first village in the area and was settled during the time of the famous Fulbe warrior Moussa Molo who encouraged his followers to found villages that would help to secure his dominion. Unlike other villages that are dominated by a few families, Kandia has been settled progressively over the years by people of different origins and backgrounds, a fact that makes even more remarkable the sophisticated and unified approach to resource management that characterizes the village (to be addressed further below).

In the period since the installation of Kandia, other villages have been attracted to the area and between the 1930s and the 1970s there was a significant increase in both the number of villages and the total population of the area (see Figure 4, Historical Profile). The area experienced a "boom" period during the 60s and early 70s when the main road from Kolda to Velingara passed through Kandia and the village hosted a lively weekly market (*lumë*) that attracted people from throughout the region.

All this changed in 1980 when a more southerly route linking Kolda to Velingara via Kounkané was paved. The old dirt road rapidly lost business and fell into disrepair. The *lumë* ceased to exist and public transport stopped using the road to Kandia. It has, with time, become virtually impassable during the rainy season. This has had several effects on the village and its inhabitants. Psychologically, the residents who have known their village to be a central gathering place in the past, feel very much isolated in the current situation. While the distance to Velingara, a town of some 14,000 people (1988 census), is not great, the lack of public transportation makes access difficult. The principal weekly market for the region is now in Diawbé, 30 kilometers to the south.

Figure 4. Historical Profile
Kandia

c. 1865	Village of Kandia founded by Diatta Baldé, accompanied by Diedy Sabaly and Moussa Condiera; Crops cultivated: millet, rice, maize, groundnuts (very few)
	Neto was second village founded in the area
c. 1920	Diatta left for The Gambia
	The Mbaalo family joins Kandia
c. 1925	Beginning of major groundnut production; younger villagers begin season migration to peanut basis to work groundnut fields
1935	1st cattle vaccination campaign
	Samba Diallo family arrives from Fouta Djallon
1946	Beginning of period marked by major immigration to area and foundation of other villages: Sare Demba, Sare Fily, Sare Samba Coumbel, Sare Laly, Sare Samba Tenengue, Sare Mali, Sare Thierno (Founded 1975)
	Velingara Fair
1959	Kandia school opened by French
1960	Beginning of cotton extension service activities in the community Sow family joins the village, coming from Fouta Djallon
1960	Animal traction introduced in the village
1964	Beginning of long, gradual decline in rainfall
1965	Extension services by SATEC (rice) Extension services for groundnuts
	Coulibaly family joins village from Guinea Bissau
1970	Widespread adoption of animal traction Beginning of declines in maintenance and use of road through village
1975	Reduced rainfall causes reduction in cultivation of rice
1980	End of Kandia *lumë* (weekly market) SODEFITEX extension agents work on cotton with villagers Forest fire fighting committee created
1985	First orchards planted by villagers
1990	SODEFITEX expands extension work into livestock Fire fighting committee becomes inactive (lack of materials)

This historical profile was conducted with three men who had been designated by the villagers as being particularly knowledgeable about the history of the community. Two of the men came from the founding families, while the third was from a more recently arrived family. As they discussed the village history, landmark dates were written on cards which were then arranged chronologically.

These distances make it difficult to market produce from Kandia and fruit sellers have particularly suffered a loss in income as a result.

If the loss of the road has meant a reduction in economic activities and access for the village, it has also meant that population pressures and demand for resources have significantly declined. Immigration to the area has slowed and the creation of a new village is now a rare event, except in cases where existing residents move out to create satellite hamlets in areas where they will have more space for cattle and access to new and fertile lands for cultivation. There are fewer outsiders attempting to use resources (such as wood, charcoal, etc.) than in the past when Kandia was an important crossroad. This contrasts sharply with the area proximate to the paved road to the south which has experienced dramatic increases in population and severe land pressures. The differences in development rates along the old and new roads can be clearly seen in the two land use and land cover maps of the Department, Figure 5. The southern route exhibits a dramatic extension of agriculture along both sides of the road and, in comparison to 1973, an intensification of land use and reduction of fallows in many areas. While the Kandia area has experienced many of the same phenomena, they are much less acute than along the more population dense southern route.

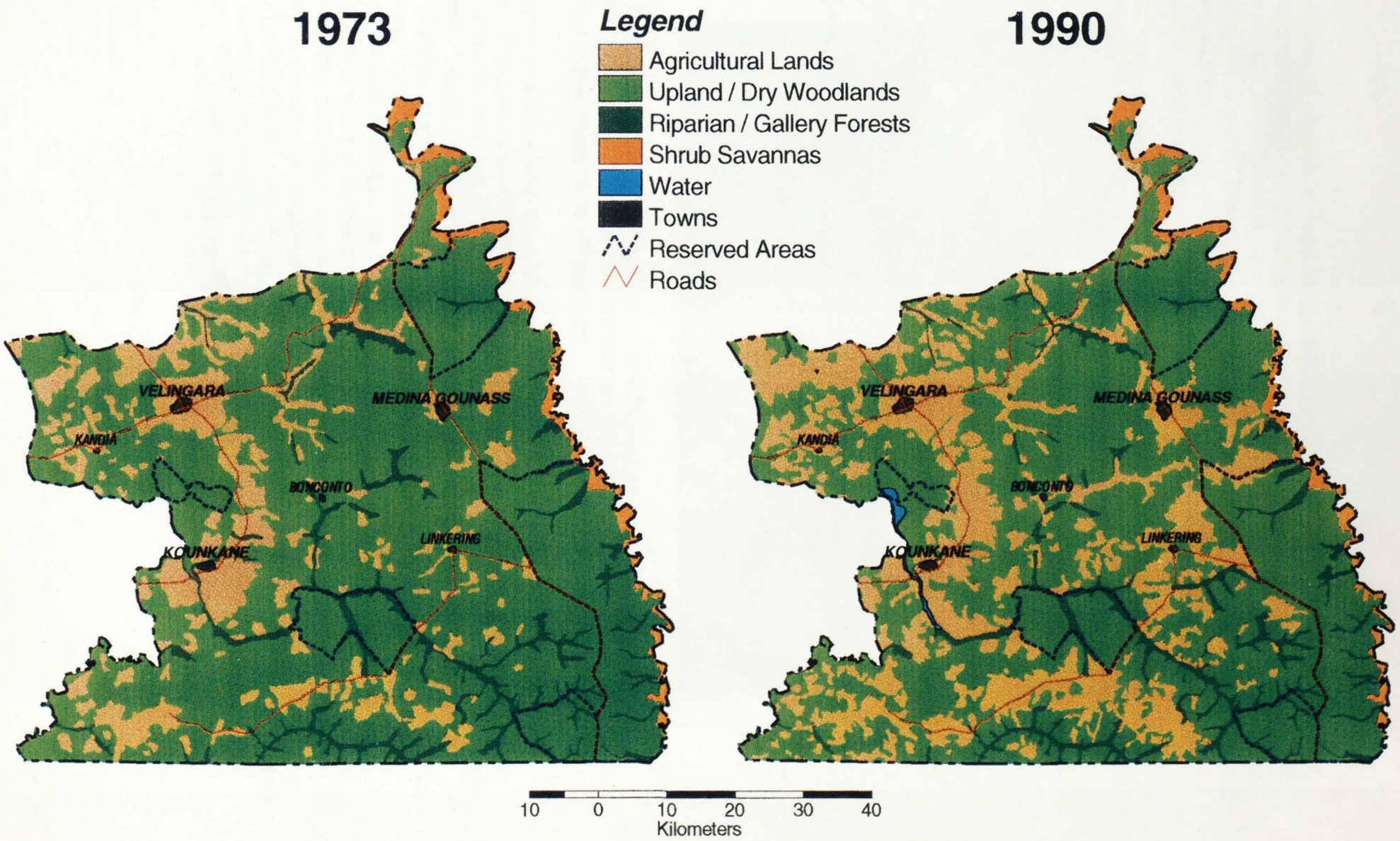
Another factor that has had a notable affect on the "community psyche" is their proximity to the Anambé rice project which lies approximately 25 km to the southwest. The Anambé valley was flooded in the early 1980's to permit intensive cultivation of lowland rice. When the project went in, most of the traditional land holders in the area lost their parcels to wealthier and more powerful interests. Many became laborers for the project. There are perpetual rumors in Kandia that the valley running through the southern part of their territory may be similarly developed by a project in the area. While the villagers are eager to see development of irrigation that might improve their livelihoods, they are equally concerned that they might lose their land if this were to happen. This contributes to a general sense of tenure insecurity in the area and has also led to some of the particular resource management practices now employed by the villagers as they seek to secure their claims to these lands.

The geographic setting. The area where Kandia is located lies in the Sudanian zone where rainfall now (since the 1970s) typically ranges from 800-1000 mm per year. This is significantly less than the period before 1964 when, for several decades, average annual rainfall was on the order of 1200 mm. The Department of Vélingara, at an elevation of about 40m about sea level, is characterized by a series of low, lateritic plateaux that are dissected by broad shallow valleys with intermittent drainage ways. The southern two thirds of the Department (where Kandia lies) drains toward the Anambé and Kayanga rivers, whereas the northern third drains north to the Gambia river.

The soils of the area are generally tropical ferruginous and are slightly leached with outcrops of laterite particularly along the edges of the plateaux. Soils are very shallow on the plateaux and somewhat deeper in the valleys. Vegetation (see Figure 5) in the

Figure 5.

LAND USE / LAND COVER
VELINGARA DEPARTMENT, SENEGAL



area is typical of Sudanian zone dry deciduous woodland. The valleys are characterized by semi-evergreen gallery forests. The diversity of trees, shrubs, and grasses is high. Throughout the area, there is a mix of tree species with no single tree dominating the canopy. The most common trees are: *Terminalia macroptera, Bombax costatum, Combretum glutinosum, Lannea acida, Acacia sieberiana, Khaya senegalensis,* and *Parkia biglobosa.*

Figure 6. Typical dry season aspect of the Sudanian zone dry deciduous woodland that forms the southern border of the Kandia territory. The tree cover generally ranges from 20 to 40 percent.

The territory of Kandia itself covers an area of approximately 12 km2, or about 1200 hectares. The population density in the territory is about 35 people per km2 which is somewhat higher than the overall density (21 people per km2) in the Rural Community as a whole. The territory is on the gentle slope of a broad valley. There is a small amount of plateau on the eastern edge of the territory; most of the territory is comprised of fields and fallow. The southern edge of the territory follows a valley that drains eventually into the Anambé. This valley formerly remained wet throughout the rainy season and was used to cultivate rice. Now most of the valley retains its humidity for only two months and only a very narrow band in the lowest part of the valley stays wet longer and is suitable for rice production. The valley now supports the only remaining woodland in the territory. While most of the territory is cleared deciduous dry woodland, there is a notable regrowth of the vegetation (secondary woodland) on the long-term fallows and the areas formerly cultivated in rice.

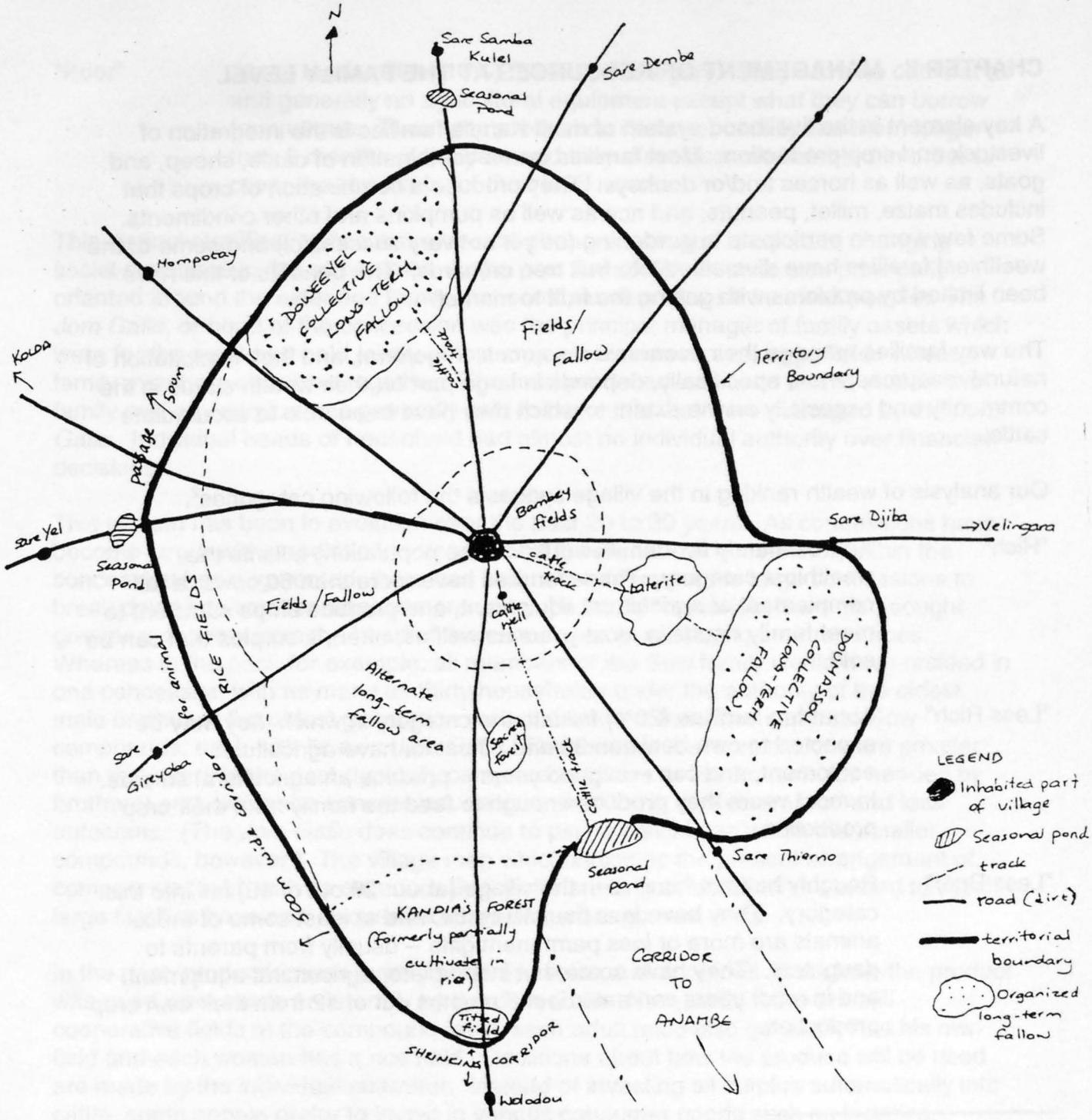
In addition to the wealth of tree species that can be observed on both fields and fallows, the visitor is struck by the tall savanna grasses that grow as tall as 1-2 meters on even one year fallows. These grasses are primarily *andropogon* and *pennisetum* species.

A good sense of the semi-natural woodland vegetation can be obtained in a visit to the wooded area that lies just outside Kandia's territorial limits to the west. This area has apparently never been cultivated (it serves now as an animal passageway between villages) and is very reminiscent of the vegetation found in the Niokolo Koba National Park in southeastern Senegal. Its condition may approach that of a fire-climax, a formation which is kept somewhat open by annual grass fires that sweep the understory. Human pressure appears to be minimal, with only some selected cutting of wood. Grazing of the understory may have somewhat more impact on the structure and composition of the woodland. Like much of the dry Sudanian zone woodlands of the region, it is relatively homogeneous in terms of floristic composition; it is difficult to subdivide the vegetation community into smaller units on the basis of species composition. Regionally, vegetation differences do occur in association with topography, particularly between the plateaus and the shallow valleys that dissect them.

There is one large seasonal watering hole that straddles the Kandia territory as well as several smaller seasonal ponds in valley depressions throughout the territory (see Territorial map, Figure 7).

Chapter II now turns to a description of how families in Kandia manage their resources at the household level. This, in turn, leads to a discussion of community level resource management strategies in Chapter III. Chapter IV concludes by analyzing the accumulated effect of household and community strategies on the Kandia environment and surrounding areas and what this implies for the continued well-being of the people who live there.

Figure 7. Map of Kandia Territory



This map of Kandia was originally drawn in the sand at the village meeting place by a large group of men from many different families. Several women were in attendance but did not participate actively in the preparation of the map. Discussion of the map became very heated over the territory boundaries at the southern edge of the village. This, in turn, led to a lively discussion of how much of the forest was cultivated in rice. Eventually, it became clear that the real issue was one of tenure insecurity over the forest lands and the villagers' attempts to solidify their claims to these lands. The cleared field at the very southern tip of the territory is part of a strategy to affirm the community's territorial boundaries. The village names reflect the names dictated to the team during the map exercise. Not all are consistent with the names on the land use/land cover maps of Kandia (Figures 11a, b, c), derived from the 1:200,000 scale topographic maps of the region.

CHAPTER II: MANAGEMENT OF RESOURCES AT THE FAMILY LEVEL

A key element in the livelihood system of most Kandia families is the integration of livestock and crop production. Most families own a combination of cattle, sheep, and goats, as well as horses and/or donkeys. They produce a combination of crops that includes maize, millet, peanuts, and rice as well as pumpkins and other condiments. Some few women participate in gardening (as yet not very successful) and some of the wealthiest families have diversified into fruit tree orchards. The benefits of this have been limited by problems with getting the fruit to market.

The way families manage their economic resources, in general, and their exploitation of natural resources, more specifically, depends in large part on their wealth status in the community and especially on the extent to which they have been able to accumulate cattle.

Our analysis of wealth ranking in the village suggests the following categories[2].

"Rich" Approximately five families (10% of the population) fall into the wealthiest category. These families have more than 50 cows, a full complement of agricultural equipment, and produce crops sufficient to meet family needs in most years as well as, often, a surplus that can be sold.

"Less Rich" About ten families (20%) fall into the category in which they may be expected to own between 20 and 30 cattle, have agricultural equipment, and can -- in good years -- produce an agricultural surplus. In most years they produce enough to feed the family from their crop production.

"Less Poor" Roughly half the families in the village (about 20 out of 45) fall into this category. They have less than 10 cattle, and at least some of these animals are more or less permanent gifts -- usually from parents to daughters. They have some, but incomplete, agricultural equipment and in most years can eat about 8 months out of 12 from their own crop production.

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[2]Note that up until the end the population continued to insist that our proportions were wrong and that roughly 50% of the population falls into the poorest category. This was supported by no firm evidence and was contradicted by individual interviews, personal observation, and other information provided by the population itself. We are quite confident that the estimates provided here are at least accurate orders of magnitude for the numbers of families in each group. There was never any dispute about the characteristics of the various groups.

"Poor" About ten families (10%) fall in this category. They have no cattle at all and generally no agricultural equipment except what they can borrow from others. Their crop production does not usually last them longer than 6 months of the year and they often become indebted in order to cover the remainder of their food needs.

This distinct stratification is a rather recent phenomenon and is linked to changing social structures in the community. In the past the social structure was principally oriented around the extended family that could number several hundred people. The *Jom Galle*, or head of the concession was the principal manager of family assets which were for the most part held jointly. Most crop production was on large fields where family members cultivated together. The food produced was used first to sustain the family and any surplus was generally sold to buy cattle that were managed by the *Jom Galle*. Individual heads of household had almost no individual authority over financial decisions.

This system has been in evolution over the past 20 to 30 years. As concessions have become larger with population increases and the number of households within the concession has augmented, there has been a tendency for the large concessions to break down into smaller management units. Heads of household have also sought greater autonomy from the head of the concession in managing their resources. Whereas in the past, for example, all members of the Sow family would have resided in one concession with as many as thirty households under the authority of the oldest male brother of the oldest generation, now there are at least five separate Sow compounds, each with its own *Jom Galle*. The result is that concessions are smaller than they were in the past (typically comprised of three to five households headed by brothers) and, within the concession, decision making is less centralized and less autocratic. (The *Jom Galle* does continue to play a critical role within the smaller compounds, however.) The village map which indicates the present arrangement of compounds (each with its own *Jom Galle)* offers telling evidence of the extent to which large families have now fractured into smaller management units.

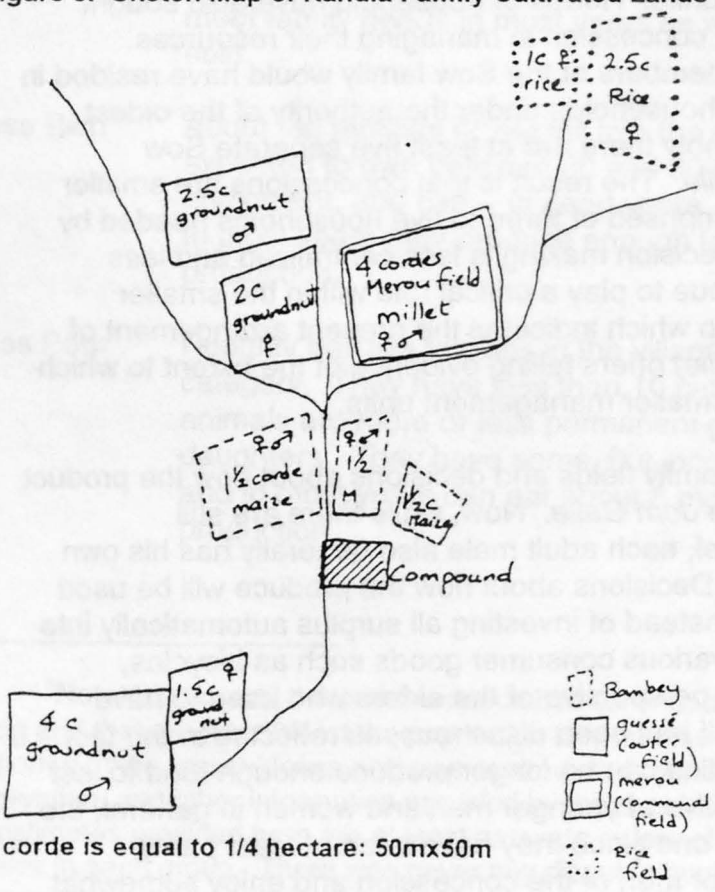
In the past, production was largely on family fields and decisions about how the product was used were made unilaterally by the *Jom Galle*. Now, while there are still cooperative fields at the compound level, each adult male also generally has his own field and each woman has a rice field. Decisions about how the produce will be used are made by the individual cultivator. Instead of investing all surplus automatically into cattle, some people prefer to invest in various consumer goods such as bicycles, radios, or "modern" housing. From the perspective of the elders who used to have much greater financial control, the result has been disastrous, as reflected in the fact that a significant number of village families can no longer produce enough food to last throughout the year. From the perspective of younger men and women in general, the evolution has generally been a positive one since they have been at least partly liberated from subservience to the senior men of the concession and enjoy somewhat greater autonomy in determining both their productive activities and how the output of

those activities will be used. Whether the change is desirable or not, it is indisputable that it has led to greater economic differentiation in the community which has, in turn, had an impact on resource management at the household level.

In the absence of sufficient harvests, poorer families depend more on forest products than do their wealthier neighbors. Among the products most often collected are various medicinal plants, honey, *nere (Parkia biglobosa)* which is transformed into condiments for cooking, and a diverse range of wild fruits. Often these fruits are transported to the Djawbé market for sale, though the distance to the market limits the revenue this provides. The honey is generally sold within the village to wealthier families.

The family sketch map (Figure 8) of fields in use indicates the extent to which families diversify their activities in various crops on lands scattered over holdings throughout the territory. This particular family is comprised of five adults and children of different ages. They have a full complement of animal traction equipment which facilitates their cultivating a total of approximately 1 ½ hectares of *bambey* (inner) fields, 3 ½ hectares of outer fields and a little less than one hectare of rice fields.

Figure 8. Sketch Map of Kandia Family Cultivated Lands



All families have fields in the *bambey*, which is directly contiguous to the inhabited part of the village, as well as in the farther fields. In addition, each woman has a small parcel in the low land forest that she uses principally for the production of rice. The management and productivity of these fields depend greatly on whether the cultivator is a cattle owner or not since cattle provide critical inputs of labor (traction) and manure.

The entire compound works together on the family's *bambey* fields, as well as on one portion of the outer fields. The communally cultivated part of the outer field is known as the *marou*. The *bambey* is generally planted in corn, while the *marou* field is allocated to millet. The products of both enter the family granary and

are used principally for food self-sufficiency. The corn from the *bambey* plays a critical role in food security because it is the first crop to be harvested and it feeds the family during the critical period when labor demands are high in harvesting the other crops, such as millet and peanuts. This is otherwise a time of high food insecurity since as many as half the families in the village have exhausted their granaries by this time. As we shall see below, yields on the *bambey* depend primarily on the extent to which it has been manured. The lack of manure for poor families is one of the principal weaknesses in the production system since they generally encounter food shortages during this critical time of the year. Any surplus from communal fields is managed by the *Jom Galle* who, as in the past, generally invests in cattle. Adults in the family will also have individual outer fields (both men and women can have these fields) where they most often cultivate groundnuts. The individual cultivator manages the harvest of these fields which may be partly eaten and partly sold to pay for various personal needs.

Most women cultivate, on average, 1-2 cordes (50mx50m) of rice. These fields are not explicitly manured, but because rice stubble is the crop residue that is most highly preferred by cattle, the animals do spend time grazing on the harvested rice and leave some deposit of manure and urine in their wake. Typically, women obtain yields of 300-400 kg of paddy from each corde. While this is a good yield, and contributes substantially to household food security, villagers continue to compare it to the quantities they used to harvest when the portion of the valley that flooded was considerably larger and most of the village population (both men and women) were involved in rice production. Unlike maize, which is consumed during a particular time of year, the rice is consumed gradually during the dry season, typically at a rhythm of one or two meals a week.

During the long dry season after the harvest, cattle are staked at night on the *bambey* fields to ensure consistent and sufficient manuring of these fields. Each animal is left for 10-15 (optimal) days at one spot before the herd is rotated onto another part of the field. Farmers estimate the ideal coverage as being 120 cows per corde for 15 days. Over the course of the dry season (6 months), then, a herd of 60 cattle can fertilize approximately 6 cordes of *bambey*, 30 cattle can fertilize 3 cordes of *bambey*, etc. A typical family would cultivate between 6-8 cordes but less than 1/3 of the families in the village own enough cattle to adequately manure areas this large. Others would reduce the coverage (keeping animals in one place for a shorter time), borrow animals from a wealthier family for a fee (usually a length of cord to tie the animal), or simply not manure their fields. Since the *bambeys* are in most cases cultivated continuously and without fallows, yields are highly dependent on returning organic matter to the soil.

Food security in a wealthy and poorer family

The Balde compound is in the wealthiest category and consists of 2 households. The first household is headed by the *Jom Galle* and includes his wife and children. The second is headed by his nephew and includes the nephew's wife and children. Other children of a brother who returned only after the harvest also live with the family. Last year the family cultivated 6 cordes of *bambey*, which in a good year produce 3 tons of grain. They have 4 cordes of *marou* field on which they cultivate millet and can, in a good season, harvest 2 ½ tons of millet. Two of the women cultivate rice on 3 ½ cordes, producing some 200 kg of paddy rice. In addition, three family members have individual peanut fields.

The family has 60 cows, as well as about 14 sheep and 4 goats. The cattle produce 15-25 liters of milk a day. A tiny portion of this milk is sold to buy salt for the cattle but the vast majority enters family consumption where it is consumed on demand by the children of the compound and is served with grains during meals. The cattle are staked first on the 6 cordes of bambey owned by the family. If they finish manuring these parcels before the end of the dry season they are loaned to relatives for the remainder of the season. Over the past ten years, the family has had to sell animals to buy grains on two occasions. In 1985, they sold three cows and 2 sheep to buy rice. In 1995, they were obliged to sell one sheep to carry them through the end of the rainy season before the maize ripened. In all the other years, they were able to produce sufficient grains to feed the family.

The Sabally family is in the third wealth category. The head of household has three wives, his mother, and several children residing under his tutelage. They have no animal traction equipment and cultivate only 1 corde of *bambey*, which produces enough maize to eat for a month, 1 hectare (4 cordes) of millet and 1 hectare of peanuts. The women cultivate 3 cordes of rice that produce approximately 200 kg of paddy. They have a few cows, probably animals conferred on the women by their fathers in a sort of "permanent loan" as well as some sheep and goats. While the area of *bambey* is small, the yield is reasonably good since the cattle are staked there during dry season nights. This family can eat for eight months from what they produce. For the remaining four months they cobble together a diverse packet of strategies that includes selling some of their small animals and chickens, borrowing money from the wealthy (later repaid with the receipts from the sale of peanuts), and doing various paid jobs for wealthier people in the village (e.g. fence or roof construction). They also have modest revenues from the sale of mangoes. Since they can never produce a surplus, they see little hope of either increasing their cattle herd (unless they receive more donations) or investing in animal traction.

The outer fields do not receive the same systematic manuring as the *bambey* but during the day the village cattle circulate freely on these fields, grazing on the stubble left after the harvest. Millet stalks and groundnut hay are purposefully left on the fields by the farmers in order to encourage the cattle to circulate in the fields. While the organic matter left behind is not great, it does have some importance and, unlike the *bambey* (where each cattle owner manures only his own fields) on the outer fields there is random distribution of manure on all fields regardless of the owner's wealth. Fertility

is also maintained on these outer fields by strict patterns of crop rotation (peanuts the first two years, followed typically by millet and, the following year, cotton.) Depending on yields, the cycle may be repeated (though with only one year of peanuts the second time) before the field is left in fallow for 3-6 years. Farmers also burn any remaining crop residues and fallen branches or dead trees and spread the ashes before each planting season to increase the nutrients in the field.

In addition to the contribution they make to crop production, animals also play a direct and critical role in household food security. Their role takes two forms: regular inputs (in the form of milk) into household consumption and savings that can be drawn down in years of bad harvest when crop production is insufficient to meet household needs. In most cases sheep and goats are sold to meet deficits but in particularly bad drought years a cow or bull will be sold.

Families with animal traction can generally cultivate nearly double the area of families who must rely on human labor alone. In some cases these latter families may borrow a pair of cattle when the owner has finished plowing but this means that they sow late, resulting in lower yields.

While families say that there is no limit to the amount of cattle that is desirable, in fact an examination of investment patterns of the wealthiest families suggest otherwise. At a certain point (a herd size of approximately 60), families begin to noticeably diversify their investments away from cattle. Some families have gone into fruit tree orchards (even though difficulties in selling the product mean that few have earned any significant profits), while others invest in such non-farm activities as transport, commerce, or housing. They may continue to accumulate cattle, but the rate in investment slows considerably once they reach this threshold.

The principal constraint to the accumulation of cattle, both at the community and household level is the provision of water. In this community, water poses a much more severe constraint than pasture. During the rainy season animals water at seasonal watering holes. While this poses no labor constraint, the absolute quantities of water are limited and the supplies are generally exhausted well before the end of the period when the animals depend on this water source. The entire village herd thus suffers toward the end of this period. This problem was less severe in the past when the rainy season typically lasted until at least November or early December by which time the crops had generally been harvested and animals could return to the village for watering. Now the rains more typically end in September and the ponds are dry by November.

The more significant disincentive to household investment in cattle is the labor required to water the cattle during the long dry season when the animals are watered at wells in the village. Most families use donkey traction to pull water from the wells that are 15-20 meters deep. Cattle owners report that cows drink from 30-50 liters of water per day, depending on their size. This requirement is divided between three waterings in the morning, afternoon and evening. A herd of 60 cattle thus requires somewhere between

2000 and 3000 liters of water a day: the equivalent of 100-150 buckets of water each day over a six month period.

The difference in men's and women's ownership patterns of animals is illuminated in the matrix Gender Roles in Food Security (Figure 9). Over the past 50 years, women report that their ownership of animals has generally decreased relative to men's, in part because men have more income generating activities that enable them to purchase animals and in part because the changing management system for household resources means that fewer animals are held collectively and thus women tend to receive fewer animals from the family at their time of marriage.

It is clear from this brief look at household livelihood strategies that the integration of crops and livestock is a goal of all families. Families who are too poor to own animals, either borrow them for specific purposes (traction or manuring of fields) or seek to create social relations through marriage or other means that will lead to their being "conferred" animals on a semi-permanent loan status. Families with and without livestock employ a range of strategies to benefit as much as they can from crop-livestock integration. These include intensive manuring of the *bambey* fields, and leaving crop residues on outer fields to attract animals.

Farmers are also acutely aware of the role that trees play in this production system. While there is variation in the tree density across the territory, in general farmers take considerable pains to leave a significant smattering of trees on outer fields. (The *bambeys* are cleared of all trees and bushes.) Most of the trees that are left on the fields are species that have some explicit value, either for fruits or fodder. Farmers take care to protect these trees from ploughing when they are small and then put up with the inconvenience of continuing to move heavy traction equipment around them once the trees have taken hold. They consider the trouble this causes to be well compensated by the benefits provided by the trees. The principal reason cited for cutting trees on fields was crop shading and because of this problem most trees that are not considered "useful" are removed...or banded. This kills the tree and removes the problem of canopy shading though in many cases the barren trunks are left standing in the field.

Having seen the importance farmers accord the integration of trees, livestock, and crops in their household livelihood strategies, the issue now arises to understand how these same concerns are managed at the community level in the territorial -- and extra-territorial -- management of resources. This is the subject of Chapter III.

Figure 9. Historical Matrix
Gender Roles in Food Security

	1945	1970	1986	Now
Extraction of	M 13	13	6	2
Forest Products	W 7	7	4	3
Contribution to family food	M 12	11	13	13
supply (normal)	W 8	9	7	7
Contrib. to family food	M 14	13	12	10
supply (hardship period)	W 6	7	8	10
Use of manure on	M 15	14	15	12
fields	W 5	6	5	8
Ownership of cattle	M 7	17	14	16
	W 13	7	6	4
Ownership of sheep	M 9	11	14	16
and goats	W 11	9	6	4

This matrix was carried out by a group of 6 women in an effort to distinguish between men's and women's contributions to household food security. In discussing each rubric, they noted the following explanations: men's exploitation of the forest has decreased more than women's because the products that men extracted (e.g. palm oil) have been more affected by droughts than have women's activities. While the tradition (line 2) is that men provide the basic food stuffs consumed by the family (much of it produced on family foods) when hardship strikes everyone contributes to the best of his/her ability. Regarding manure, men traditionally have manured their fields (and family fields) more intensively than have women. But, as cattle are increasingly left to circulate freely in the territory during the dry season, women's fields are now as likely to receive manure deposits as men. Men do have somewhat greater access to chemical fertilizers through extension services. Women's cattle ownership was greater than men in the past largely due to their inheritance of sizeable herds at marriage. As many families now produce smaller surpluses and thus have less to invest in cattle (and as investments take place at the level of the smaller family rather than the head of the entire concession), women tend to receive smaller herds at marriage. Men have more off-farm income generating possibilities (specifically seasonal migration) which permit them to increase their herds.

CHAPTER III: MANAGEMENT OF RESOURCES AT THE TERRITORIAL LEVEL

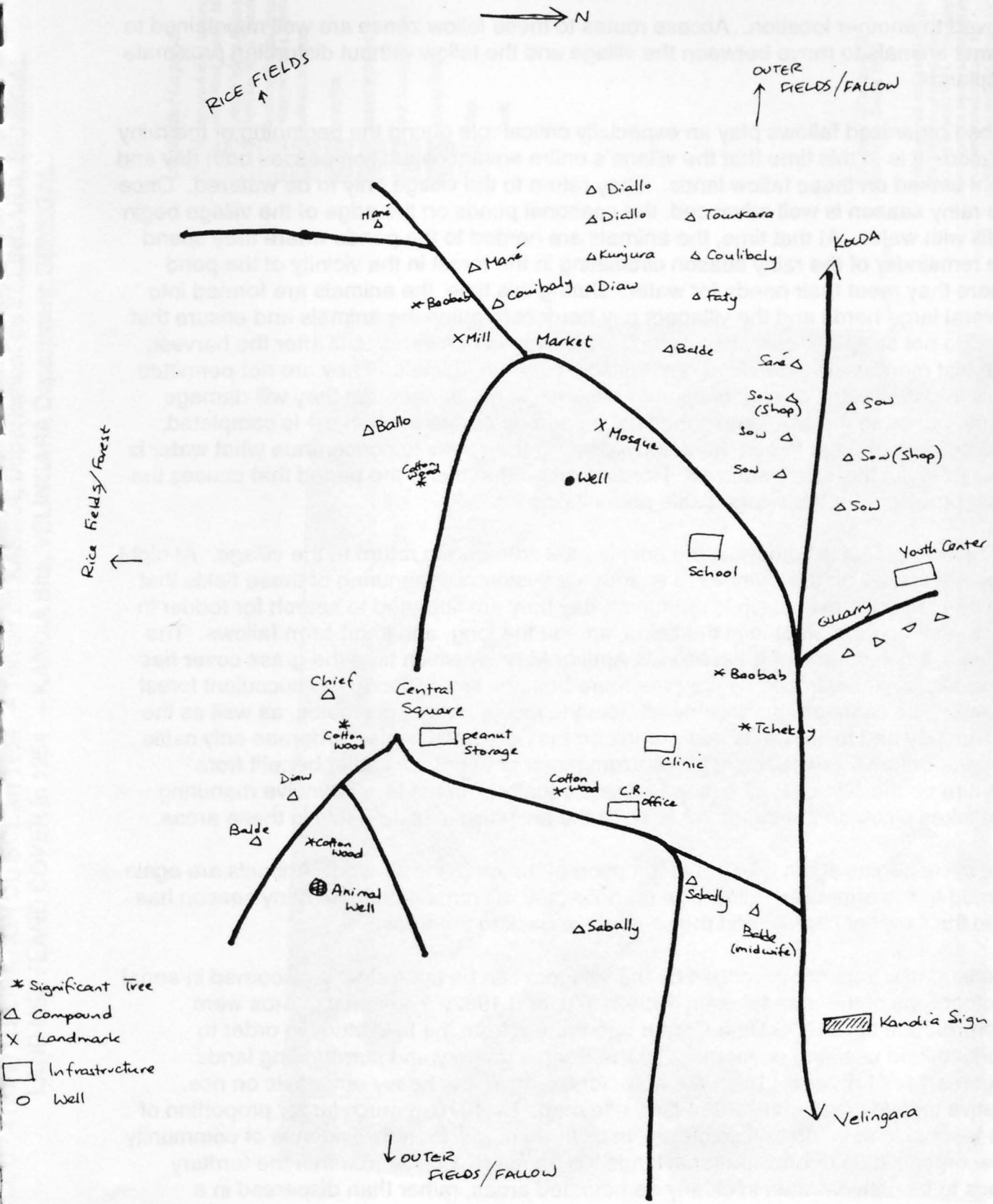
The territory of Kandia occupies about 1200 hectares of land. Land use in the area is divided among the inhabited parts of the village, including infrastructures such as the health center and school, the near fields which are largely cleared of trees (*bambey*), the outer fields (*guesse*) which are more heavily wooded and alternate use between crops, short-term fallow, and long-term fallow, the rice fields in the lowland parts of the forest, and a small portion of forest that falls within the lands Kandia defines as its own territory. The largest part of the forest, which is locally known as the "Kandia forest" actually lies outside the village's territorial boundaries, covering some 300 hectares in a band that circles the village from the southwest and continues on to the major forest of Anambé to the southeast (see sketch map of Kandia, Figure 7; see also Figure 10). There is also a small sacred forest within the territorial limits of the village. There are numerous passageways for people and cattle in the territory and 32 wells that serve the human and animal population.

The management of resources in the territory is in part the product of many individual and household decisions about how to use resources on their own and common lands. The predominant patterns observed were described in the preceding chapters. There are also, however, community-wide decisions that are made at higher levels that affect how these resources are used. Many of these decisions and practices are oriented toward ensuring that there is a balanced coexistence between the needs of livestock and those of crops which would otherwise come into conflict.

Field and Fallow

A critical mechanism for ensuring that livestock can be maintained without impinging on crop production is the maintenance of organized long-term fallows. In Kandia, at any given point in time, there are two zones that are designated as long-term (5-10 year) fallow. One zone serves the southwest quadrants of the village, while the other serves families which inhabit the north and east quadrants. The decision to establish a zone as long-term fallow is made by the heads of concessions in the affected zone. Once the decision is made, all farmers with land in designated area are expected to refrain from planting crops in the zone. Since almost all families have multiple fields scattered in different areas of the territory, they simply move their cultivation to a different set of fields. If any farmer lacks alternative options for cultivation, he or she generally has no problem making an informal arrangement to cultivate the lands of another family member or friend. Since land is not in shortage in Kandia, this appears in practice to pose little difficulty. While farmers are not categorically prohibited from cultivating in a fallow area, and some may be tempted back before the designated period is up due to the higher fertility of these well rested fields, they are entirely responsible for any damage to crops that animals may cause in the fallow area. Since the concentration of animals in the zone makes the likelihood of damage high, this acts as an effective disincentive to crop production in the designated zone. At the end of the 5-10 year fallow (decided in concertation depending on conditions of the fields), the fallow is

Figure 10. Map of the Inhabited Village of Kandia



This map was drawn on the ground (shortly after the research team's arrival in Kandia) by a group composed of 30 men and 20 women from the village.

moved to another location. Access routes to these fallow zones are well maintained to permit animals to move between the village and the fallow without disturbing proximate croplands.

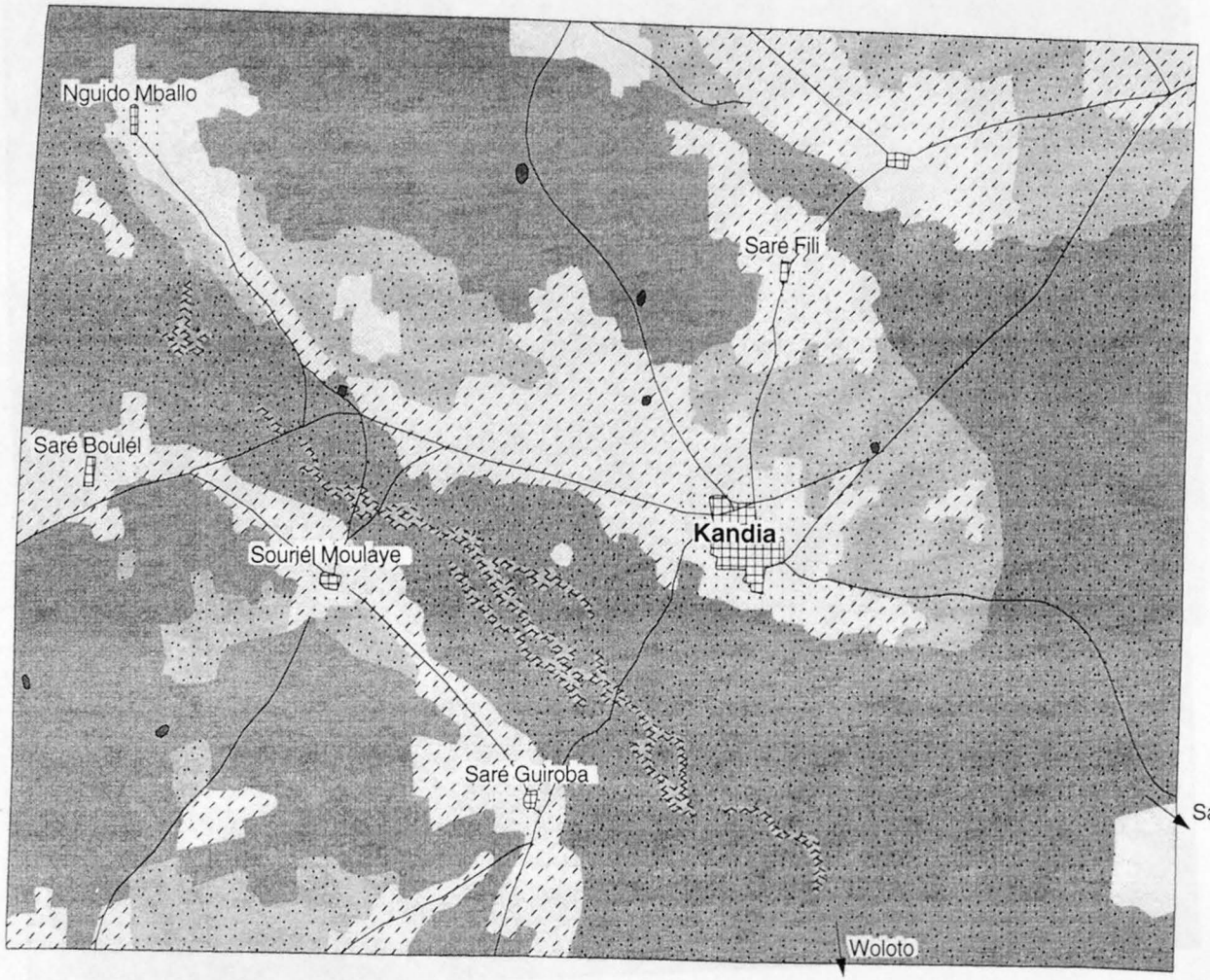
These organized fallows play an especially critical role during the beginning of the rainy season. It is at this time that the village's entire animal population passes both day and night staked on these fallow lands. They return to the village only to be watered. Once the rainy season is well advanced, the seasonal ponds on the edge of the village begin to fill with water. At that time, the animals are herded to the ponds where they spend the remainder of the rainy season circulating in the forest in the vicinity of the pond where they meet their needs for water. During this time, the animals are formed into several large herds and the villagers pay herders to guide the animals and ensure that they do not stray into cultivated zones. This system continues until after the harvest. The last months are periods of great difficulty for the animals. They are not permitted back into the village during this period because of the danger that they will damage crops, but often the seasonal ponds have dried up before the harvest is completed. The herders attempt to construct small dikes in the ponds to concentrate what water is available, but this rarely suffices. Herders report that this is the period that causes the most problems for the village cattle population.

Once the harvest is complete, the animals are liberated to return to the village. At night they are staked on the *bambey* to ensure the systematic manuring of these fields that will be planted in maize, while during the day they are liberated to search for fodder in the forest, on crop stubble in the fields, and on the long- and short-term fallows. The forest is a rich source of grasses until April or May, by which time the grass cover has generally been destroyed by fire (see more below). In addition to the succulent forest grasses, the cattle are particularly attracted to the stubble of rice fields, as well as the peanut hay and millet stalks that are left on the harvested fields. Whereas only cattle owners, or families who make some arrangements to borrow cattle, benefit from manure on the *bambey*, all families benefit equally from the less intensive manuring that takes place on the larger fields since the animals circulate freely in these areas.

The cycle begins again with the resumption of the cropping season. Animals are again herded to the organized fallow areas where they will remain until the rainy season has filled the seasonal ponds and they can move back to the forest.

The land use patterns described by the villagers can be quite clearly discerned in aerial photographs of the area taken in 1954, 1970, and 1982. The aerial photos were interpreted at the EROS Data Center upon return from the field study in order to produce land use/land cover maps of the Kandia territory and surrounding lands (Figures 11a, 11b, and 11c). We note, for example, the heavy emphasis on rice, relative to field crops in the 1954 land use map. By 1970, a much larger proportion of the territory is devoted to field crops. In all three maps, there is evidence of community level organization of how territorial lands will be used. Bushland within the territory tends to be concentrated in clearly demarcated areas, rather than dispersed in a

OCCUPATION / UTILISATION DU SOL en 1954 — Terroir de KANDIA, Département de VÉLINGARA, SÉNÉGAL
LAND USE / LAND COVER in 1954 — KANDIA Site, VELINGARA Department, SENEGAL



Légende / Legend

- Intensive Rainfed Agriculture with some fallow, "guesse" fields
- Extensive Rainfed Agriculture with significant fallow, "guesse" fields
- Continuous Rainfed Agriculture around village perimeters, "bambey" fields
- Bushland, old fields
- Paddy Rice
- Savanna Woodland
- Dense Savanna Woodland
- Seasonal Pond
- Village
- Roads

Projection: UTM, zone 28
Spheroid: Clarke 1880

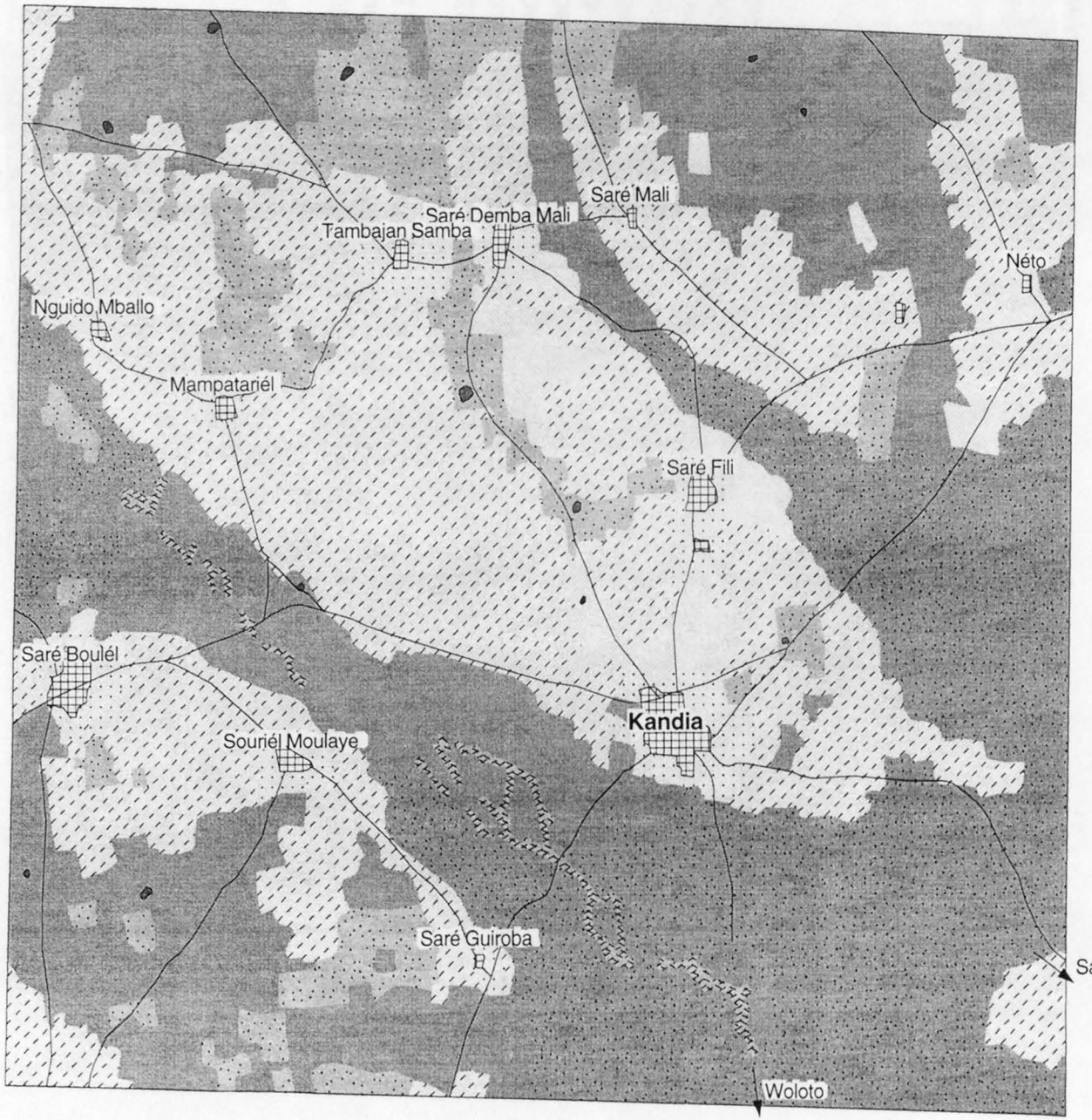
This map was prepared from an interpretation of aerial photographs taken in 1954. The aerial photographs were assembled into an uncontrolled mosaic. No attempt was made to correct for geometric distortions inherent in the aerial photographs.

Scale (nominal) = 1 : 40000

0.5 0 0.5 1 1.5 2 2.5 Kilometers

Figure 11a.

OCCUPATION / UTILISATION DU SOL en 1970 — Terroir de KANDIA, Département de VÉLINGARA, SÉNÉGAL
LAND USE / LAND COVER in 1970 — KANDIA Site, VELINGARA Department, SENEGAL



Légende / Legend

- Intensive Rainfed Agriculture with some fallow, "guesse" fields
- Extensive Rainfed Agriculture with significant fallow, "guesse" fields
- Continuous Rainfed Agriculture around village perimeters, "bambey" fields
- Bushland, old fields
- Paddy Rice
- Savanna Woodland
- Dense Savanna Woodland
- Seasonal Pond
- Village
- Roads

Projection: UTM, zone 28
Spheroid: Clarke 1880

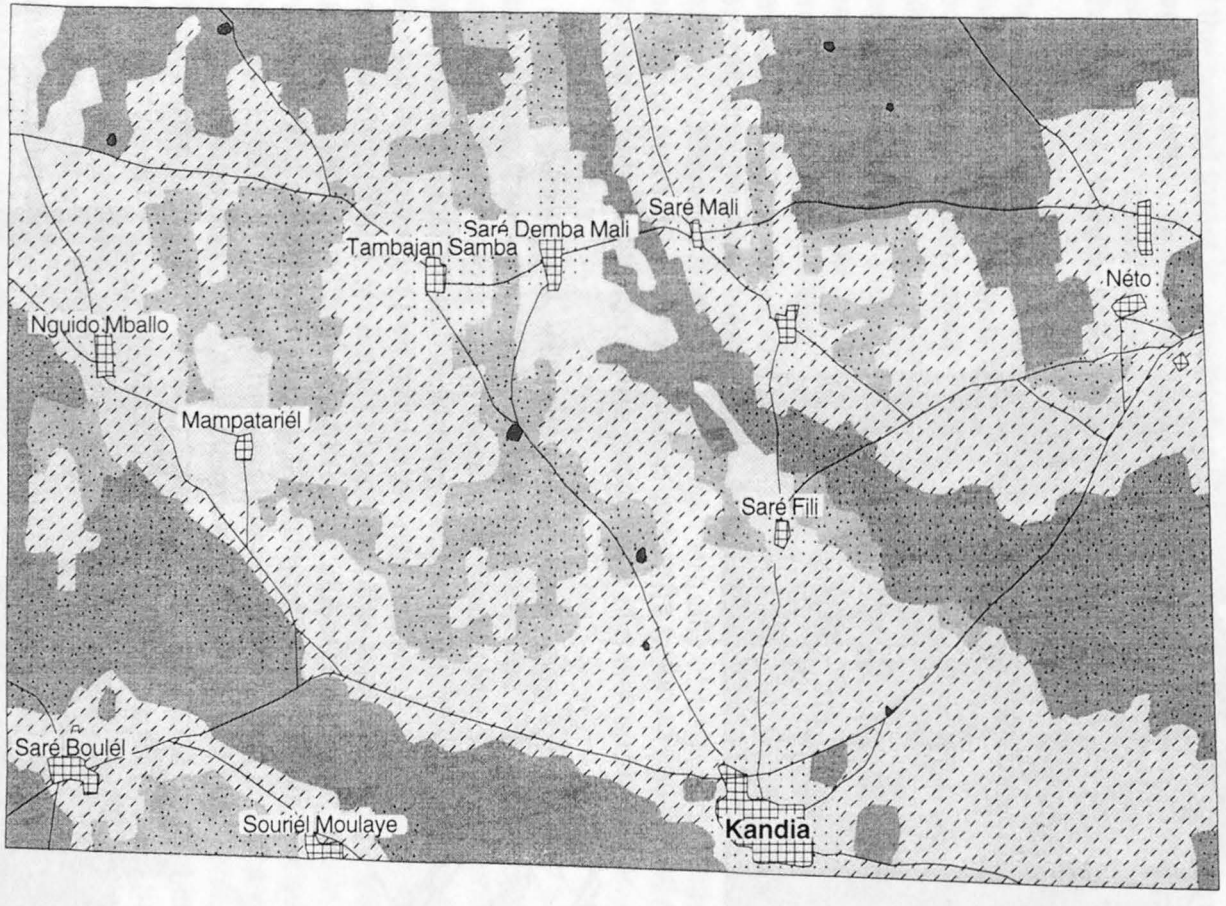
This map was prepared from an interpretation of aerial photographs taken in 1970. The aerial photographs were assembled into an uncontrolled mosaic. No attempt was made to correct for geometric distortions inherent in the aerial photographs.

Scale (nominal) = 1 : 40000

0.5 0 0.5 1 1.5 2 2.5 Kilometers

Figure 11b.

OCCUPATION / UTILISATION DU SOL en 1982 — Terroir de KANDIA, Département de VÉLINGARA, SÉNÉGAL
LAND USE / LAND COVER in 1982 — KANDIA Site, VELINGARA Department, SENEGAL



Légende / Legend

- Intensive Rainfed Agriculture with some fallow, "guesse" fields
- Extensive Rainfed Agriculture with significant fallow, "guesse" fields
- Continuous Rainfed Agriculture around village perimeters, "bambey" fields
- Bushland, old fields
- Paddy Rice
- Savanna Woodland
- Dense Savanna Woodland
- Seasonal Pond
- Village
- Roads

Projection: UTM, zone 28
Spheroid: Clarke 1880

This map was prepared from an interpretation of aerial photographs taken in 1982. The aerial photographs were assembled into an uncontrolled mosaic. No attempt was made to correct for geometric distortions inherent in the aerial photographs.

Scale (nominal) = 1 : 40000

0.5 0 0.5 1 1.5 2 2.5 Kilometers

Figure 11c.

Figure 12. Photo of youth harvesting bundles of grass.

Figure 13. Typical houses in Kandia, with the 'bambey' fields in the foreground.

haphazard way around the village. This suggests community decision making about where long-term fallows will be located. The fact that these denser bushlands often include a seasonal pond suggests that they are managed with the needs of cattle in mind.

The Forest

There are two forested areas within the territorial limits of Kandia as well as the so-called "forest of Kandia" that is a continuation of Kandia's own forest but lies largely outside the territory. Within the territory, there is a small sacred forest area that lies between the *bambey* fields and the *guesse*/forest to the south. Access to all products of the sacred forest is absolutely prohibited and neither humans nor animals are permitted entry. In the history of the village, this sacred patch has never been cultivated and is said to be occupied by spirits who resided there even before the first inhabitants of Kandia settled the zone.

The larger forested area lies at the boundary of the Kandia territory and adjoins the Kandia forest that extends beyond. Part of the forest is low lying land on clay soils that flood during the rainy season. These lands are used for the village rice fields that are cultivated by women. The rice is cultivated under the canopy of the forest and, aside from the clearing of stubble and bushy species, there is little difference in species composition between the area cultivated in rice and the rest of the low lying part of the forest. In the past (during the period 20-50 years ago), much larger areas of the forest were put into rice cultivation. At that time, with a longer and more abundant rainy season, considerably larger areas of the forest flooded. The entire village -- male and female -- cultivated rice, and millet was virtually abandoned. With reduction in rainfall and the compression of the flooded area, the crop became a women's crop and men devoted greater attention to the production of millet and groundnuts on *guesse* fields.

In discussing the forest, villagers are at great pains to insist that in the past the entire forest (within their territorial limits) was put into the production of rice. While it is certain that considerably larger areas were cultivated in the past than now, there is little evidence to suggest that the whole forest was cultivated. Instead, it appears that villagers' insistence on this point is related to their feelings of tenure insecurity in this forested area. They continue to hope that the area will benefit from a project that will build dams and return the area to rice production, as was done in the Anambé valley. They fear that only by convincing the authorities that they have cultivated the area can they lay claim to the land; otherwise they anticipate that under a project the lands would be expropriated and any future claims by villagers would be denied. As a result, the villagers take every opportunity of a public meeting to insist that in the past they did cultivate rice on every square meter of the forest that lies within their territory.

The sentiment of tenure insecurity in these forest areas has engendered other strategies intended to reinforce the villages claims and to more clearly demarcate their territorial boundaries. In at least one case, a farmer went to the far edge of the Kandia

territory and, at the outer edge of the forest, cleared a field for the production of millet on the territorial boundary. This was intended both to signal the edge of Kandia property to farmers seeking to expand their lands north from Woloudou and also to more clearly demarcate village lands in the case of future disputes in the valley. It is significant that this farmer sought -- and obtained -- official papers for his land holding from the Rural Community Council in order to further strengthen his claim. Had there not been an issue of tenure involved, this would have been an absurd placement of a field...far from the farmer's other lands and in an area that would be vulnerable to attacks by livestock, birds, and various other predators.

Rice production in the forest makes an important contribution to food security. The transformation of the forest into crop land for millet is at this point purely symbolic but it is indicative of some of the village's most pressing tenure concerns. The largest part of the forest, however, remains uncultivated at any given point in time and is used for the collection of various forest products and for pasture land for village cattle. Access to other products in the forest is essentially open to village residents and neighbors without restriction.

While the forested area is well used for fruit, medicinal plants, and fuel, there is little evidence that it is suffering from any substantial degradation due to these activities. In fact, at least cursory comparison of the sacred forest (from the outside, the team was unable to enter) and the "usable" forest revealed similar species types and density, with the exception of a more dense undergrowth of grasses and bushes in the sacred forest. The apparently sustainable use of forest resources can be explained in part by its lack of easy access by outsiders, meaning that most users are Kandia inhabitants or people from neighboring hamlets. Even these users exploit the forest principally for subsistence needs due to the fact that local markets are small and transport to larger markets has become such a problem.

Kandia has largely escaped the ravages of charcoal production which have been such a acute problem in many other areas of the Velingara/Kolda area. About 15 years ago, the village had an encounter with charcoal makers from outside who came to settle in the Kandia territory. The first year they produced charcoal without objection from the Kandia residents. The next year when they returned, however, the village mobilized. Having observed the damage that was taking place in their own forest and seen what had happened in other areas where the charcoal rnakers had spent time, the villagers decided that this was something that had to be stopped. In the terse explanation given by one elder: "We had nothing to gain; the forest had nothing to gain; our animals had much to lose." A delegation of villagers met the charcoal makers as soon as they were spotted in the village and told them in no uncertain terms that they were not welcome there. Ever since the village has maintained a lookout for charcoal makers attempting to settle in the area and has warned them away before they commenced cutting the forest.

The villagers feel that they have generally been lucky in their encounters with charcoal producers since the ones who have come to the territory have been fraudulent and had no papers authorizing their activity. They are aware of cases in the area where the charcoal makers come with paper signed from Dakar authorizing them to produce charcoal in a certain zone. It is much harder for villagers to exert their authority in such cases. Here again, at least in the recent past, Kandia has been spared much of the pressure from charcoalers because of its relative inaccessibility with the abandonment of the road.

Management of Fire in and around the Kandia Territory

Fire is a critical concern in Kandia. In order to understand its impact on the community and the source of their preoccupation with this topic, one must first understand the economic importance of the wild grasses and straw that grow in and around the village. Grass and straw has multiple uses. As one villager explained, "we sleep under straw (thatching), we sleep on straw (mattresses), we sleep inside straw (fences)." In addition, grasses provide critical inputs into the diet of both cows and small ruminants.

There are several species of grasses that are highly valued in the village. Two of the species grow primarily on the fallow fields (baludé [*andropogon pennisetum*] and léojéré). While these can be used for thatching, they are considerably inferior to species that grow in the forest and a roof that is constructed with these grasses will last only 3-4 years. In comparison, a roof constructed of the forest grasses (*nyantango*) can last as long as 20 years, while the other (*waba*) will last up to eight years. The *nyantango* grass grows where water is abundant and is rare now in the Kandia territory. Villagers go as far as the Anambé valley in search of these grasses, which sell for as much as 500 cfa[3] a bundle. This compares with 150 cfa for a bundle of *waba*, or 100 cfa for a bundle of *baludé* or *léojéré*, which are far more common in the territory.

Animals prefer, as their first choice, *waba* grasses, with the rare *nyantango* a close second. Both of these grasses, that grow in more low lying areas, maintain their humidity throughout the dry season. Only when these grasses are no longer available will animals turn to *baludé* or *léojéré* which begin to dry soon after the rainy season.

Given these diverse uses of grasses, it is not surprising that, from the perspective of Kandia villagers, there is "never enough straw." Another person commented that "the life of rural people depends on grasses." "But," he continued, "fire destroys grasses and unbalances the equilibrium in all aspects of life."

Fires are caused by numerous sources. Some of them come from the actions of local inhabitants and neighbors. Children use fire in hunting wild meat. Fire is used to smoke out bees when collecting honey. Despite rules to the contrary, people passing

[3]Approximately $1.00

through on bicycles throw out lit cigarettes. Women seeking wood use fire to fell dead trees. Any of these fires can quickly get out of control when a wind comes up sweeping them into areas of dry grass. Other fires come from outside the territory. Many originate on paved roads or from activities of charcoal makers that get out of hand. Customs officials use fire in their efforts to capture fraudulent traders crossing the border with The Gambia. These fires from afar are often more difficult to control, being larger and hotter by the time they reach Kandia.

While the villagers maintain a certain number of strategies to control fires in the territory, they feel impotent to control the extensive damage that results each year. The principal strategies employed by the village to control fire are (1) to discourage activities that provoke fires and (2) to construct fire breaks on the east side of the village which is most vulnerable to fires. While local fires do occasionally start and get out of control, the local population is keenly aware of the danger: from their early childhood villagers are exhorted to use fire carefully. The villagers clear a fire break approximately one kilometer from the inhabited part of the village on the eastern side to protect the fields and fallow lands (for grasses) from the most destructive fires which come from this direction.

For several years, Kandia participated in a Canadian funded project that provided fire fighting equipment to local village committees. The equipment included heat resistant boots, rakes, shovels, and water pumps. Residents of Kandia reported that this material was extremely useful and made their forest fighting efforts considerably more effective than they had been when they used only locally available materials such as tree branches. The materials provided by the project have now reached the end of their useful life, however, despite the residents' efforts to repair and maintain them. If there is a place to obtain replacements, the villagers are not aware of it. They say that while they probably would not buy all the equipment provided by the project, at least half of it was sufficiently useful that they would pay for it themselves were it available somewhere in the vicinity. Despite their reduced fire fighting capacity, the village is able to protect the one kilometer zone they have defined as essential.

While strategies to control fire in the farmland portion of the Kandia territory are at least modestly successful, their strategies to protect the forest are nonexistent. The result is that nearly every year the forest burns in its entirety by the end of the dry season. The villagers are quick to point out that fire does serve a useful role in the forest. From their perspective, the complete absence of fire would be as worrisome as is the current situation where the forest burns completely. The ideal situation, they say, would be for approximately half the forest to burn in any given year.

Villagers report that the impact of fire on the trees of the forest is small. Healthy trees rarely suffer from the passing of the fire and only those that are already severely weakened by disease or pests are killed by fires. The effects are more severe on the undergrowth and especially the grasses, however. Early fires (December) are less troublesome because the earth and grasses are still moist. *Waba* grasses, especially,

are fire resistant at this stage and, even if burned, will issue new, albeit weaker, shoots. If the fires come later in the season (April, May), they are much more problematic. Grasses do not regrow after these late fires and the forest loses its utility for grazing.

The benefits of fire are to be found particularly in growth patterns the following year. Villagers report that in areas that burned the year before, the grasses grow more quickly and in greater abundance than in areas that for some reason did not burn. The cattle appear to prefer grazing in areas that burned the previous year.

The tradeoff then is between losing current grazing resources when the forest burns but getting a more abundant regrowth the following year. In an ideal situation, the villagers say, they would be able to control fire, and would allow approximately half the forest to burn each year. The part that was burned would rotate annually with the unburned section since, in their evaluation, if one side were left unburned for several years in succession, the productivity of grasses would decline substantially.

In the past, the natural situation was considerably closer to the villagers' ideal scenario than it is now. This is because, with more abundant rainfall, much larger areas of the forest used to be flooded and stay humid throughout the dry season. These areas were little touched by fire. Even if the rest of the forest burned, as it regularly did, there was still a reserve of grasses left in the humid portion of the forest. Now, with the rains ending earlier, nearly the entire forest burns each year and by April it serves no further purpose for cattle. Villagers consider this to be a substantial problem but have no strategies to combat the annual tragedy. "Just as it rains each year," they say, "so will come the fires."

In discussions with the population, the root of the dilemma appears to be the difficulty of managing a common property resource that is used by all the surrounding villages and "belongs" to none of them. Whatever the reality, organizing multiple villages for a cause such as fire control is perceived to be impossible. When the idea of having patrols to identify fires and mobilize teams to fight them was proposed, it was summarily dismissed...."no one would take their turn." "People are prepared to save their fields and homes but they will leave the forest to the mercy of the fires."

Management of the Forest of Kandia

While the Forest of Kandia lies largely outside the territorial limits of the village, it plays a primordial role in the life of the community, and especially their ability to maintain their cattle herds. Since the forest lies entirely within the Rural Community of Kandia it is officially under the purview of the Rural Community Council which exercises, in particular, its right to allocate land within the forest to those who will "render it productive."

Villagers from both within the Rural Community and outsiders can make requests for land to the Council. While in the past the Council reports fairly large allocations of land, now it is rare that a single allocation exceeds 10 hectares. The number of requests is not high, especially in comparison to areas like the Rural Community of Diawbé, to the south and along the road. Over the last five years fewer than 50 hectares have been allocated in the forest of Kandia in most years. The problem is not so much the absolute quantities of land that are being converted from forest to cropland (since the areas are still small) but the lack of any overall plan that acknowledges the importance of the forest for livestock and other activities. The Community Council accords almost all requests that are made to it and refuses only if it is clear that the request will cause immediate conflicts because the land is either in an animal passageway or too close to a watering hole. In many cases, even these requests are not categorically refused, but the farmer is instructed to construct a fence around the property to avoid conflict with livestock.

The result is that land use patterns are haphazard and based on no overall plan that considers rational use of the remaining forest based on needs of livestock and crops. The impact of the small amount of forest that is being converted to cropland is considerably larger than would be suggested by the hectarage alone because of the haphazard development patterns. A few small scattered fields cause many more problems to livestock than one larger field, particularly if the latter is in a zone that has been designated for agriculture. Many of the requests for land from Kandia residents have been for land directly to the south of the village territory, on the side of Wolodou which is one of Kandia's closest neighbors. The result is that the narrow corridor of land between these two villages is shrinking and even the President of the Rural Community thinks it likely that the corridor will be filled in within 2-3 years. While a passageway of 200 meters is supposed to be left uncultivated, it is by no means sure that this distance will be respected. It is clear from the land use/land cover maps (Figures 11a, 11b, 11c) that former passageways to the north of Kandia (just north of Saré Fili) have become more constrained, and the vast areas of grazing lands are being increasingly occupied by fields. This has severely reduced the mobility of cattle between different grazing and watering areas.

The current situation poses two dangers. One is that the impact of the "development" that is taking place is disproportionate to the amount of land actually being converted into crops because of the lack of any rational land use plan for the forest area. From all evidence, while the Rural Community Council is deeply concerned to avoid situations that would cause immediate and acute conflict among populations, it expresses neither knowledge of nor concern for the longer term implications of its land allocation patterns for local livelihood systems. The second issue is more potential than actual, given the currently low levels of demand for land. Population and land pressures throughout southern Senegal are increasing, however, as rainfall and agricultural conditions in the north become ever more precarious. Without a strategic plan for the forest of Kandia, it is likely that continuing and perhaps accelerating demands for land will progressively

whittle away at the forest, reproducing land use patterns as they have occurred across the north of Senegal where forests have not been actively protected.

When confronted with this likely scenario, the residents of Kandia reacted with resigned concern. Concern because they see the danger to their livelihoods and know enough about farming systems in areas further north to realize that the threat to their own food security is not to be taken lightly. They are resigned because they do not see any mechanism by which the process can be stopped. The only "solution" they foresee is to become more like their semi-nomadic Fulbe cousins in the north who move their cattle great distances in search of adequate pastures and water. "There will always be somewhere to go; we Fulbe are used to moving great distances if we have to." For the moment, it is only the outsider who is wondering where that somewhere might be, and how long it will remain forested.

CHAPTER IV: ENVIRONMENTAL CHANGE IN THE KANDIA AREA

If we look back over the human and ecological history of Kandia over the past 50 years, there are several notable changes in the environment as observed by the villagers themselves (see Figure 14 Historical Matrix). While the size of the population has increased significantly over that period, the land area occupied by the "territory of Kandia" (the lands that the village considers as belonging to them) has diminished. This is due principally to the colonization of the area by new villages over the period between approximately 1930 and 1970. During this time about ten new villages moved into lands surrounding Kandia and many requested permission to occupy part of what was then the Kandia territory. Since, in the words of the chief, "this wasn't really to our liking, but in the tradition we could not refuse," the territory was gradually but regularly reduced over this period. These pressures have diminished considerably since 1970 when the road to the south was paved and Kandia became victim of increasing isolation.

With increases in the population and a reduction in land held by the village, the natural result was the cultivation of both more land in absolute terms, but also a greater proportion of the territory at any given point in time. This trend was exacerbated by the introduction of animal traction at the same time that the population was increasing. Since a family with a full set of animal traction equipment now cultivates almost twice as much land as one without any traction equipment, the impact on the total quantity of land cultivated has been significant.

Under these circumstances, one would expect a situation of rapidly declining soil fertility. And, in fact, farmers report that indeed they have suffered declines in productivity. As one put it, "After all, are your new clothes of the same quality as your old ones?" This issue showed up on the historical matrix as a dramatic decline in fertility which, however, contradicted many of the other conversations we had held with farmers. We finally concluded that the historical matrix confused fertility with productivity and farmers agreed that the report of declines from a relative fertility level of "20" in 1945 to "5" in the present was in fact largely due to reductions in rainfall and not to the quality of the soil. Most farmers report that while soil fertility has declined somewhat over the years, they consider the soils of their territory to be still highly productive in most places. This is due to the many practices described in the previous chapter that help to maintain fertility.

Even though population increases and reductions in the size of the territory have increased the population/land density, the ratio is still low compared to many parts of Senegal. With organized fallows of up to six years on large areas of the territory, and individual shorter fallows of 2-3 years, none but the *bambey* fields are subject to the perpetual cultivation that has become the norm in many more northerly villages. Fortheir part, the *bambey* fields remain fertile due to intensive infusions of cattle manure. Practices such as leaving the peanut hay and millet stalks on fields may not be specifically designed to maintain fertility (their principal purpose being to assure

Figure 14. Historical Matrix

Kandia territory

	1945	1970	1986	Now
Kandia population	5	10	15	30
Area of Kandia territory	20	15	10	8
Land area under cultivation	6	10	15	20
Land devoted to various crops	Millet 3 Rice 2 Maize 1	Millet 5 Rice 2 Maize 1 Groundnuts 2	Millet 7 Rice 1 Maize 2 Groundnuts 3 Cotton 2	Millet 10 Rice 1 Maize 3 Groundnuts 4 Cotton 2
Lands in fallow	8	12	17	25
Uncultivated forest	15	13	11	9
Number of cattle	2	4	10	15
Number of small ruminants	1	3	5	7
Soil fertility (productivity?) of large fields	20	10	7	5
Density of trees in fields	20	15	13	7
Density of trees in forest	30	16	15	13
Biodiversity of tree species	appx 100	60	50	48
Worries about tenure security	0	5	10	15

This historical matrix was carried out by a groups of about 12 men of different ages and from different families in the village. It was traced on the sand at the village square and our informants placed beans on each variable to represent trends over time. The only case in which the number of beans reflects precise quantification is in the biodiversity line where the villagers actually counted out the number of species they could remember during each time period (after 1945; the 100 beans in 1945 is an estimate based on remembering many more tree species then than what they actually counted for 1970). In all other cases, the number of beans has no special significance except to show the change in variables over time.

good quality animal fodder during the dry season) but the happy consequence is that these crop residues play an important role in reducing erosion and slowing soil degradation.

Increasing the land area under cultivation and maintaining fallows have necessarily put pressures on the forest. This is reflected in the historical matrix in the line "area of the forest remaining untouched by cultivation" which shows a gradual but quite slow transformation of the forested part of the Kandia territory into croplands. Much of the forest, however, remains intact. The forest outside Kandia, as noted above, is currently under pressure by both Kandia villagers seeking to expand their fields, and neighboring villagers. At least for the villagers of Kandia, it is important to note that the motivation to cut and cultivate the forest is due less to the need to put new or fertile lands into production than it is to concerns over tenure security and the perceived need to more clearly identify their ownership of the forest by cultivating on its outer edges and thereby demonstrating that these lands are being put to "productive use." Since perceptions in the area are strong that the forest is an unmanaged common property resource, there is also a strong sense that each village and each individual needs to get their "share" before someone else uses it up. There is very little consideration of what the combined impact of all these individual behaviors will be on the forest or its ability to sustain the pastoral side of the local economy.

Both tree density and biodiversity have declined over the past 50 years. Reduction in rainfall -- and the resulting drop in the water table -- has been probably the most significant factor in both cases since it has resulted in the loss of many of the hydrophytic species that were previously common in the zone. This is evident both from villagers' perceptions as reflected in the historical matrix and also from aerial photos that indicate a broad transformation of the dense woodlands into savanna woodlands, starting in the period between 1954 and 1970 and continuing between 1970 and 1982. Selective cutting of trees in fields to protect those that have some economic value has certainly changed the species mix on cultivated lands but regeneration of diverse species remains high on lands that are devoted to long-term fallow. In terms of impact on the local population, the most significant species decline has probably been in grasses, rather than trees.

The near complete disparition of *nyantango* grass and the reduced production of *waba* grasses has had a negative impact on (1) animal nutrition, (2) the amount of labor needed to maintain roofs, and (3) household incomes of poorer people who used to market these grasses and others who are now obliged to buy them. While the shortage of these grasses is caused largely by rainfall changes, it is also due to the frequency of fires that seasonally ravage the forest undergrowth. Fire is a resource management problem that has been partly, but far from fully, mastered by the local population. Current efforts are devoted to protecting croplands and fallow within the territory of the village. There is no effort to control fires within the adjacent forest, an activity that the villagers consider futile, again because of the common property characteristic of the

forest. They are aware of the negative consequences for both humans and animals, but feel impotent to take any effective actions.

In short, the villagers of Kandia employ a range of sophisticated resource management strategies within their territory that are designed to protect their local environment in order, ultimately, to protect their livelihoods. These strategies carefully balance the needs of crop production and animal raising to minimize conflict between these two productive activities and to maximize the benefits of combining the two production systems. The farmers of Kandia are, for the most part, relatively prosperous due to their success in managing resources in a way that permits the continued integration of these two systems.

The weakness in the system lies in the lack of effective management of resources outside the village's territorial boundaries. The forest of Kandia is an invaluable resource that serves not only the denizens of the zone, but transhuming herders from other parts of the country as well. It generates fodder for animals, harbors seasonal ponds that are essential for watering cattle, and permits mobility that is essential to the health of the pastoral system by providing access to further pastures and watering points. The residents of Kandia have no legal rights to regulate use of the forest and are convinced that it would be largely impossible to engage other neighboring villages to take concerted efforts to protect a resource that belongs to none and is used by all.

In addition to these constraints to good management, there are incentives that lead both communities and individuals to use the forest in ways that are inimical to good, sustainable management. Individuals, seeking the most productive recently cleared lands, would prefer to clear a patch of the forest than to return to and clear lands that have been in long-term fallow. Since there is at present virtually no control on the clearing of the forest for croplands, outsiders also may find it more convenient to surreptitiously clear the forest rather than negotiating use rights with existing communities. At the community level, villages attempting to protect their territorial boundaries (especially where the village forest runs directly into the communal forest) encourage the placement of fields in the communal forest to mark the outer limits of the territory and ensure that there is no confusion about the ownership of the forested area that falls within the territorial limits.

Legally, the management of the Kandia forest falls under the purview of the Rural Community Council. This group has the authority to allocate or deny requests for land in the forest which technically belongs to the State. In fact, there is no real "management" of the forest in the sense of having a rational plan for how its resources should be used and/or protected. Requests for land are generally granted unless the grant will engender some immediate and obvious conflict with other users. Many cultivators do not bother to get permission, but merely begin cultivating where and as they wish. The Council generally casts a blind eye on such activities unless, as above, they engender conflict. The result, as discussed in Chapter III are land use patterns

that, because of their incoherence and absence of a systematic plan, are potentially highly damaging to the pastoral system.

The relative prosperity of Kandia's livelihood, as well as many other communities in the area, depends as we have seen on the integration of crop and livestock production. The absence of livestock would mean not only the loss of milk, meat, and cash that result directly from this productive activity, but also the loss of critical inputs that contribute to the sustainability and productivity of the cropping system. The health of the livestock sector depends in turn not only on the resources of Kandia's territory, but also on the common property resources of the forest beyond. It is critical that both local populations and the State explicitly recognize these interdependencies.

The State can begin by acknowledging that extensive livestock production is productive use of resources and therefore is a value producing use of land ("*mise en valeur*"). This would at least legally reduce the existing bias that consistently favors the transformation of public lands into private cropland rather than its maintenance as communal pasture. Rural Councils throughout the country consider it part of their mandate to oversee the transformation of "unused" or "wasted" land into "value producing" cropland. It is essential that they be trained to recognize the multiple uses of common property resources and to appreciate the role of extensive livestock production in many rural livelihood systems. Once the principle is established that maintaining common property for extensive grazing is a legitimate and "value producing" use of lands, then the Community Councils will need to work more closely with the villages in their districts to identify the multiple demands on common property resources and to devise a plan that considers how the competing demands for resources can best be met. This planning process should begin in Rural Communities like Kandia where there are still resources to be protected. The greater the pressure on these resources, the more urgent it is to address these issues without delay.

Analysis of change in land use patterns over time, such as those being undertaken by EROS in collaboration with the *Centre de Suivi Ecologique* can be helpful in identifying the best opportunities to protect and begin more systematic and rational management of common property areas that are under threat. More intensive study of local livelihoods can then be undertaken using methodologies such as RRA and PRA to identify resource use patterns and needs in the communities that use these common property resources. Each of these leads logically into a planning process in which community users, in conjunction with the State authorities would devise the plan that would guide the development and protection of these endangered resources.

Without such a concerted effort, the forests of southern Senegal will soon become little more than memories of old-timers who will speak fondly of the days when their cattle roamed freely and their children grew plump from the consumption of milk and abundant grains. Kandia still has the chance to forestall the progressive pauperizing of its population. Let the opportunity not be wasted.

ANNEX
Program of RRA Field Work

Date	Activity	With whom
Saturday 2/3/96	Protocol Meeting	Chief, elders, villagers
	Participatory Village Map	30 men, 20 women
	Guided visit to village	Several village men and women
Sunday 2/4/96	Transect Walk (Team divided into 3 groups)	4 men, 2 women
	Analysis of transect information	
Monday 2/5/96	Historical Profile	3 men
	Wealth ranking	3 men from difft. wealth catetories
Tuesday 2/6/96	Territorial map	25 men, few women
	SSI* (household resources)	Wealthy family
	SSI (household resources)	Poorer family
	SSI (youth issues)	6 youth
Wednesday 2/7/96	Historical matrix	12 men, few women
	SSI (use of manure)	4 men
Thursday 2/8/96	SSI (management of fire)	5 men
	Gender matrix	9 women
	Visit to orchard/SSI	1 man
	SSI (organization of village)	1 man
	SSI (market)	3 men

Date	Activity	With whom
Friday 2/9/96	SSI (management of cattle)	1 man
	Village feedback	20 men, 15 women
	Visit to forest	1 man
Saturday 2/10/96	Visit women's garden	3 women
	SSI (land allocation, tenure)	Rural Council President

*SSI= Semi-structured interview

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