COMPETING USES OF LABOR IN RAINFED AND IRRIGATED AGRICULTURE IN THREE SONINKE VILLAGES

by
Monica Sella

This paper is one of a series which is being issued as preliminary documents for comment and discussion under the Land Tenure Center's contract with the United States Agency for International Development, Dakar, Senegal, as part of USAID's Project no. 685-0280, Irrigation and Water Management I. The author retains responsibility for errors and omissions

Bakel Discussion Paper Series No. 9
January 1989

Competing Uses of Labor in Rainfed and Irrigated Agriculture
in Three Soninké Villages

by

Monica Sella

I. INTRODUCTION

A. Background

This paper is the second of two papers which present the findings of a six month field research trip which was conducted as part of USAID's Irrigation and Water Management I Project in the Department of Bakel from January 1988 to July 1988. The first of the two papers (Sella 1988) addressed the land tenure issues which have arisen on several small-scale irrigated perimeters along the Senegal River. This paper focuses on the factors influencing farmers' decisions on the allocation of household labor between rainfed and irrigated farming activities.

Beginning in the middle 1970's, immediately following the period of severe drought in the Sahel, many African nations undertook heavy investments in river basin development in the hope of creating a more secure, stable, and productive agricultural system. The expectation was that irrigated agriculture, based on a system of double cropping and on the use of modern inputs, would meet both local and national needs by improving rural incomes and generating marketable surpluses. A decade and one-half later this expectation has not been fulfilled, and irrigation remains an activity with more potential than success.

This paper considers the experience of one ethnic group: the Soninké of the Department of Bakel. The Bakel Small Irrigated Perimeters (BSIP) project began in 1975 on the initiative of Diabé Sow, a Soninké migrant worker returned from France. The desire to establish a long-term local alternative to migration (given the threat of tightened immigration regulations to the sustained inflow of remittances from France), and to increase local subsistence food production and increase levels of disposable income, led Sow and others to recognize that irrigation with Senegal River water was a promising way to enable the Soninké to supplement their production from rainfed and flood-recession agriculture.

In the early stages of the development of the irrigated perimeters, which have been funded since 1977 by USAID, much hope was placed in the new initiative and plans for rapid expansion of irrigated areas were drawn up by the Senegalese Government. Today, a decade later, it is evident that the planned expansion did not take place, and, indeed, that some farmers -- though they continue to express enthusiasm about irrigation -- seem to give priority to rainfed cultivation rather than to their irrigation activities.

Table 1. on the following page, reveals that substantial portions of certain perimeters remain uncultivated each year.

TABLE 1

Irrigated Area Left Uncultivated
(hectares)

Year	Reason for Lack of Cultivation: Non-motivation/Debt	Non-functional Land Preparation
1984/85	119	60
1985/86	222	111
1986/87	223	148

Source: SAED 1987a and 1987b

SAED attributes this phenomenon to three principal factors: non-motivation, the failure of farmers to repay debt to SAED, and poor preparation of land for irrigation. Unfortunately for our purposes, non-motivation (which is not explained) and lack of debt repayment are not presented separately.

Additional SAED statistics, shown in Table 2, present a similar picture on a village by village basis for the dry season of October-December 1986, as well as for the rainy season of July-September 1987. Double-cropping is clearly not universally practiced, and even in the rainy season, the principal one for the cultivation of rice, maize and sorghum, several perimeters have substantial percentages of their area uncultivated.

TABLE 2

Percentage of Irrigated Area Left Uncultivated

Perimeter	Oct-Dec 1986	July-Sept 1987
Gandé	71	10
Galladé	87	30
Mouderi I		6
Mouderi II		33
Diawara A & B	12	
Tuabou		47
Collangal Gpt		27
Collangal Mil.	60	
Collangal Marabout		90
Collangal Ferme	60	33
Gassambilakhe A & B	34	20
Ballou I	11	32
Aroundou		13
Yafera A & B	37	61

Source: SAED 1987b

B. Research Themes

Clearly the irrigation infrastructure developed at great cost is not being used to anywhere near its potential. It is not sufficient to ascribe underutilization to non-motivation and failure to repay debts; it is important to understand why farmers do not use the irrigation facilities available to them. One of the reasons which farmers frequently give is that they do not have sufficient labor available to them both to irrigate and to conduct their traditional dryland and flood-recession farming operations. In order to investigate this explanation, the research activity described here posed the following questions:

1) *Do compounds with members who participate in irrigation have certain characteristics that distinguish them from other compounds that do not?*

2) *How do farmers who do irrigate decide on the allocation of labor between dryland and irrigated agriculture?*

These two questions seemed to be particularly appropriate given that not all farmers in the region irrigate -- indeed, the majority do not -- and given that those farmers who have adopted irrigation have adopted it as a supplement to, and not a substitute for, rainfed farming. Furthermore, these two questions seemed to be pertinent to an understanding of the dynamics of irrigation given the two major constraints with which local farmers must contend: first, labor tends to be the scarce factor of production due to continued large-scale outmigration of Soninké men from the region and due to the overlapping of the agricultural calendars of irrigation and rainfed farming; and second, most irrigated parcels are not large enough to cover the subsistence needs of the compound, let alone to meet market demand.

The focus of the research is also important because of the government's intention to expand the irrigated area by increasing the size of plots available to each farmer. Analysis of farmers' strategies for allocating their labor between irrigated and rainfed fields should reveal whether larger parcels are viable. If farmers devote attention to their rainfed fields because their irrigated parcels are not large enough, then an increase in the size of irrigated parcels would induce a shift of labor from rainfed to irrigated farming, because with larger parcels farmers could meet household food requirements and perhaps a marketable surplus entirely from irrigation.

If, on the other hand, farmers' continued devotion to rainfed fields is due to marketing considerations, to risk considerations, to cost considerations, or to household land tenure considerations, then an increase in parcel size might not be enough to ensure that farmers focus their activities on irrigation.

The information collected during the field research period is most useful in trying to answer the second of the two research questions. Thus, this paper limits itself to discussing the findings related to that question. It should be noted, however, that the first question has already been treated, to some degree, in Sella (1988) and Bloch (1988). Moreover, it will receive some attention in the work of David Miller,

another member of the Land Tenure Center research team, whose work addresses the question of whether land, labor, and other farm-related productive resources continue to be mediated through agnatic kin groups, or whether access to these resources today is via a new set of political and economic institutions such as the Rural Communities, emerging local political parties, SAED, etc.

C. Methodology

The field research was conducted over a period of five months, between February and June 1988. Most of the villagers' responses are the product of informal interviews and therefore are qualitative rather than quantitative in nature. The author asked all the questions and was assisted by an interpreter, a local Soninké man.

The interviews, for the most part, took place in two villages, Tuabou and Mouderi, although some information was also collected in Manael. The original intention had been to study all three villages equally; unfortunately, the village of Manael chose not to take part in the research. The reason for Manael's refusal to participate has been attributed to its reluctance to violate the decision of the Federation not to collaborate with outside researchers.

The selection of Tuabou and Mouderi was based on various criteria. Tuabou was chosen because it was the village hosting the author and also the seat of the royal Bathily family. Also, it served as a good example of an unsuccessful perimeter. Mouderi was chosen because the other field researcher, David Miller, was conducting his research there; the idea was to coordinate activities by applying different methodological approaches in the same setting. Mouderi also has a number of successful perimeters, a nice contrast to Tuabou, and it was not closely tied to the Federation.

Two sets of interviews were carried out. The first set was conducted during the month of March in the villages of Tuabou and Manael. In each village permission was asked to interview three families, or kas, one of small size, one of medium size, and one of large size. The actual number of people in each ka is not known, though the question was asked: in Soninké culture, revealing the number of individuals is perceived to carry with it some sort of risk. The questions focused on four main issues: risk, marketing, decision-making, and labor allocation. For examples of the sorts of questions asked, see Appendix I.

The second set of interviews was conducted during the month of June in Tuabou and Mouderi. Based on the results of the first set, a less structured apporoach appeared likely to yield better information. Thus, no fixed set of questions was drawn up, but rather a general theme was adopted in conversation with villagers.

A total of sixteen villagers were interviewed, including both men and women from different castes. In addition, the presidents of three perimeters were interviewed as was the head of the rural development agency (SAED) responsible for the implementation of the perimeters. Statistical information concerning the perimeters was taken from monthly and annual SAED reports.

D. Overview of the Organization of Production among the Soninké

1) The Production/Consumption Unit

A key element for an understanding of the limits a labor-intensive irrigation system will encounter is knowledge of the organization of production of its intended beneficiaries. Among the Soninké, the organization of production centers around the kore, or production/consumption unit. It is both the work group and the group within which food is distributed. It consists of the men who make up the work group, their wives and their children. This is a relatively recent development, the result of a gradual segmentation of the patrilineage, and thus the simplification of the production and consumption relationships within the ka (used variously to denote the extended family, the residential unit of family members, and the restricted residental unit within a territorial ka). Still, one should not overlook the role that the lineage continues to play in the organization of productive activities. Miller's research will hopefully shed light on the extent to which the lineage today takes part in mobilizing labor to ease bottlenecks in the farming cycle, in spreading risk by farming a wide variety of land types, in protecting members against shortages in production, and in maintaining rights to land when members migrate. Thus, whereas it is true that production and consumption relations are tightest within the kore, it seems also to be true that they extend beyond the kore to the lineage.

At the level of the kore, each man must contribute to the subsistence needs of all the members. The current custom is for the eldest kore male, the kagumme, who manages the collective kore field, or te xoore, to provide maize or sorghum from the te xoore for all members five days per week. The remaining two days of the week are the responsibility of the younger men. The work is organized in the following manner. In the morning all the men of the kore work on the te xoore, in the afternoon the younger men are free to work on their individual fields or saluma.

Women also maintain certain well-defined responsibilities. A woman is given several parcels by her husband at the time of marriage when she leaves her home to enter his. She and her daughters cultivate these plots and she retains exclusive rights over their produce. It is not uncommon to find women who farm one or two rice fields, an indigo field, and several peanut fields. As long as a son remains uncircumcised, his mother provides him with food and clothing. Once he is circumcised, the responsibility shifts to the father. The son, in turn, gives to his mother the harvest from his saluma until that time when he builds himself a granary, usually at the time of marriage. A daughter is under the care of her mother until she marries. (Pollet and Winter, p. 406).

The point is that although integration of economic activities takes place among members of the kore and members of the more encompassing lineage, each kore member must meet his/her responsibilites by undertaking a set of seperate farming activities, a series of segmented farming activities, if you will, which take place within a well-established timetable.

2) The Agricultural Year

There are four principal seasons throughout the year: Kandaara, the period running from May to mid-July when the Soninké prepare for the growing season by clearing and burning fields; Xaaxo, or rainy season, the period running from mid-July to October, during which the rainfed fields are planted, weeded, guarded, and prepared for the harvest; Mulle, or cool season, from mid-November to February when the rainy season crops are harvested, flood plains are planted, and when house construction and renovation begins; and finally Kineye, the hot season, from March to June, when men work on the construction of homes and wells, and women weave and dye cloth.

The Soninké agricultural calendar for rainfed, flood recession, and irrigation activities is shown in Figure 1. The segmented nature of farming activities as well as the particular timetable during which they occur can be easily seen. It is also evident that farmers face critical labor-short periods at various points throughout the year.

This situation might be somewhat mitigated if farmers had at their disposal labor-saving tools and implements. In fact, however, the vast majority of farmers use the most basic of hand tools: the daba and fanti for hoeing, the sowuta and jiabbade for sowing, the coupe coupe for weeding, the gobane for harvesting, and only rarely animal traction for plowing.

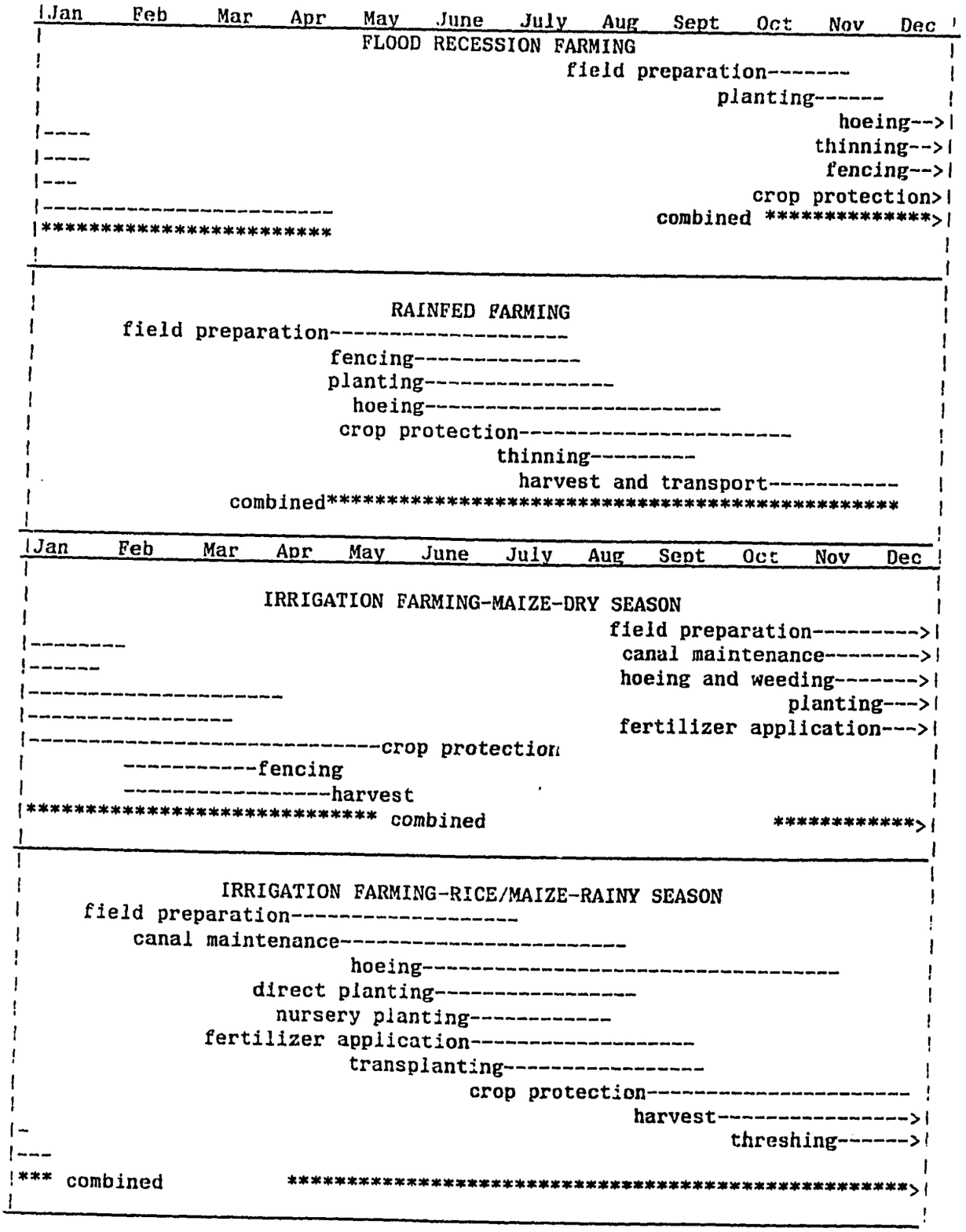
II. RESEARCH FINDINGS

A. Production for Subsistence vs. for the Market

A not surprising discovery in the field was the overwhelming emphasis among farmers on production for subsistence rather than for the market. It seems that farmers in the region are committed to a strategy of food security. A 1985 USAID report claims that 'farmers are irrigating to eat and not to sell.' Except for some of the larger perimeters, irrigation has become one more means of subsistence (USAID 1985: G-7). This is true both for rainfed staple crops and for irrigated crops such as rice, sorghum, and maize. The situation is somewhat different as far as fruit and vegetable crops are concerned. Farmers' interest in fruits and dry-season vegetable crops such as bananas, onions, tomatoes, cabbage, squash, eggplant, etc. both for home consumption and sale is increasing. However, as will be pointed out shortly, efforts to produce these for the market run up against some of the same constraints as do attempts to market staple crops.

The fact that farmers are farming primarily to meet local food needs is important because it certainly influences the decision they take on the allocation of their labor time between their rainfed and irrigated fields. In other words, if farmers cannot expect to bring their crop to market, it is likely that they will do whatever possible to meet compound consumption needs from the less costly, and in some respects, less risky, rainfed production.

FIGURE 1
AGRICULTURAL CALENDAR IN BAKEL



1) The Market Outlet Constraint

Table 3 reveals the importance of irrigated sorghum, a non-market crop, for the 1987 rainy season, especially in the villages downstream from Bakel. While rice yields are always higher than those of sorghum, rice is a more expensive crop to grow in terms of inputs, water needs and, especially, labor time per hectare.

TABLE 3
1987 RAINY SEASON YIELDS
(tons per hectare)

Village	Sorghum	Rice	Maize
Gande	0.483		
Galade	1.033		
Mouderi I	3.866	4.833	
Mouderi II	1.850	5.833	
Diawara II	2.750	4.850	
Yellingara	2.533		
Manael	1.816		
Collangal Groupt.		4.375	
Collangal Mil.		5.900	
Collangal Youth		6.283	
Kounghany	2.800		2.600
Golmy	3.750		1.500
Yafera		2.750	2.700
Aroundou	1.130	5.550	1.500
Ballou I		5.300	3.033
Ballou II		5.230	2.930

Source: SAED 1987b.

The emphasis on production for subsistence can be attributed to numerous factors. Low rainfall and the limited production levels associated with it have forced many farmers to keep most sorghum, millet and maize for home consumption. But there are also other constraints at play which affect farmers' marketing behavior. These include: lack of transport, transport costs, lack of market outlets, inadequate on-farm storage, and the limited capacity of private traders to buy coarse grains in large amounts given the government's regulatory role in the marketing of these cereals.

A USAID agricultural engineer very familiar with the Bakel region offered a slightly different explanation of the market constraint. Green corn is a very lucrative crop, selling for 50 FCFA per ear. There is a large market for green corn, but if it is grown during the rainy season, it is harvested at a time when the markets are flooded with green corn from the Casamance. The situation is little better for vegetables. Vegetables are grown cheapest near Dakar. Thus, farmers growing vegetables in Bakel are not in a very good position to compete with vegetable farmers close to the main population centers.

Some farmers do produce vegetables for sale locally, but the market is very restricted given that their customers, for the most part, are

other farmers. One man from Tuabou sells his cabbage in Diawara. He pays a local woman 200-250 FCFA to sell approximately 25 cabbages in the Diawara market. Each cabbage sells for about 25 FCFA. There is no market in Tuabou because the villagers of Tuabou have little money. So produce grown in Tuabou is sold in Bakel and Diawara. Sometimes women come from Diawara, buy vegetables in Tuabou, return to Diawara, and sell them there. But they earn little because they must pay their carfare.

In Mouderi, the president of the Rural Community recently introduced onion farming. According to him, next year many farmers will grow onions and the market will be glutted. He claims, however, that he will get a jump on the situation by growing onions in the dry season. This problems is not particular to Mouderi. A young woman from Tuabou in April of this year sent her onions to Dembankané, the Soninké village furthest down river from Bakel, to be sold by her sister. When asked why she did not sell the onions in Bakel, her response was that there were simply too many being sold.

2) The Size of Parcel Constraint

The marketing constraint is not the only one which innibits the production of surpluses for the market. The very small size of irrigated plots handicaps efficient farming activities. According to SAED figures, the average size of an irrigated parcel per member of a producer group is 0.27 ha. The average size per inhabitant in the region is 0.035 ha. Parcels are too small to meet family or compound subsistence requirements. As a result, farmers are obliged to continue working on rainfed fields. This reduces the efficiency of irrigation because farmers have to finish planting their rainfed crops before beginning to work on the perimeter. In some places, farmers direct broadcast rice on their irrigated parcel, leave it there to go to their rainfed fields, and come back to their parcel after having planted their rainfed fields. By that time, late August or early September, weeds in the rice fields are almost fully grown, making it very difficult for farmers to weed without pulling out rice seedlings along with the weeds. When this happens, the rice must be replanted. Some farmers address this problem by using costly herbicides.

Plans are currently under way to expand irrigation in the Department of Bakel. Approximately 1,200 additional hectares will be prepared for irrigation, thus bringing the total number of irrigated hectares up to 3,060 ha. If the number of producer group members were to remain at the current level, roughly 6900 members, the expansion would allow for an average parcel size of 0.45 ha., which is still relatively small, but which approaches the minimum size recommended by SAED in the Middle Valley.

B. Risk in Irrigated Farming

It is not uncommon knowledge that new agricultural activities or techniques may present farmers with risk given the unfamiliarity of the practice being introduced. Irrigated farming is no different. The Bakel Small Irrigated Perimeters are vulnerable to shortfalls in rainfall -- all perimeters are somewhat dependent on rainfall for soil preparation prior to planting, and pumping costs are much lower in good rainfall years --

and to technical mishaps such as the breakdown of pumps. Therefore, because farmers who irrigate must contend both with weather variations and with technical mishaps, irrigation farming may be risky even when compared to rainfed farming. Especially if they anticipate a good rainfall year, farmers may respond to perceived risk by diverting labor to their dryland parcels instead of concentrating labor efforts on the perimeters which, even with rainfall, present a certain degree of uncertainty given the possibility of technical breakdowns.

1) Uncertainty in Irrigated Farming

The list of technical and organizational factors which contribute to the riskiness of irrigation farming includes the following:

a) Perimeters are poorly designed and construc ·d. Canals on some perimeters sit below field level, and ı 1988 several perimeters were flooded by sudden downpours.

b) Perimeters are equipped with inappropriate equipment, and there is little in the way of maintenance or replacement.

c) The supply of inputs essential to successful irrigation cultivation is unreliable and becoming increasingly costly. According to Diemer and van der Laan, the production of fertilizer at the national level often cannot meet country-wide needs, and imported fertilizer is usually insufficient to bridge the gap between domestic supply and demand (Diemer and van der Laan 1987, p.73). Also, it is argued that the decrease in fertilizer subsidies (price of fertilizer increased from 25 FCFA to 110 FCFA) in the early 1980's caused a dramatic decline in fertilizer utilization by farmers and substantially reduced rice yields. (Le 1988).

d) Extension services are inadequate.

e) Farmers often lack the necessary managerial skills to coordinate irrigation activities successfully.

One indication of the degree to which these factors affect production levels is demonstrated in Table 4. It presents average yields in kilograms for the lowest and highest quartiles on several perimeters (not in Bakel). The disparity in yields is striking both within and among the various perimeters, revealing the risk inherent in irrigation farming.

The riskiness of irrigation farming is augmented further by the small size of irrigated parcels. That is, plots are quite small so the potential benefits are quite small. Yet the costs involved in irrigating are not trivial for most farmers (ranging from 2000 FCFA to 20,000 FCFA), so potential losses in terms of sunken investments may be quite high.

An illustration from Mouderi is pertinent here. A woman there maintains a parcel on the women's perimeter on which she grows maize, onions, tomatoes, and okra. In addition, during the rainy season, she has six other fields on which she farms rice, peanuts, indigo, and okra.

When asked which field she prefers, she replied definitely that she prefers her irrigated parcel. She is considered quite successful. A visit a few weeks later at her home in Mouderi brought bad news. All the maize on the women's perimeter had died because the motorpump was unable to pump enough water onto the parcels once the water level in the river had dropped too far down (this occurred during the dry season). The loss for her and the other women was great; the cost of irrigating, including fuel, fertilizer, dues, and pumpist, for each woman is approximately 7500 FCFA, not a paltry sum.

When farmers in Tuabou and Manael were asked which problems they encounter while farming their irrigated plots, one family from Tuabou replied that the perimeter is poorly leveled. At one point, all family members worked on the perimeter and not on rainfed land. But last season the perimeter did not function well at all and the family lost a lot. They were unable to repay their portion of debt to SAED. As a result they have abandoned the perimeter and returned to their rainfed fields.

Another family from Tuabou explained that in 1987 Tuabou's producer group tried using two motorpumps instead of just one. But even with two motorpumps, because the land is so poorly leveled, water did not reach some areas of the perimeter. In Manael, the situation is similar. The president of the producer group explained that the canals are poorly constructed and the perimeter itself is a bit too far from the river. It takes about one hour for the water to arrive to the plots after the pump has been started. This means that a lot of fuel is consumed.

TABLE 4
RANGE IN IRRIGATED CROP YIELDS
WITHIN AND AMONG PERIMETERS

Perimeter	Season*	Crop	Ave. of lower quartile yields	Ave. of higher quartile yields
Abdalla	R '81	rice	297	481
Abdalla	D '82	rice	163	357
Mamaji	R '80	rice	693	1407
Mamaji	D '81	maize	226	456
Mamaji	R '81	rice	827	1396
Alana	R '80	rice	227	781
Alana	D '81	maize	124	380
Alana	R '81	rice	473	985

* R and D denote the rainy and dry seasons respectively.

Source: Diemer and van der Laan 1987, p. 72.

2) Uncertainty of Credit Availability

Recently, moreover, a new element of risk has appeared, and that is the difficulty of acquiring credit for the purchase of inputs. According to a SAED report, credit remains the only source of cash for farmers

to purcha[illegible] diesel f[illegible], spare parts, fertilizer, herbi[illegible] etc.) (SA[illegible] or [illegible] farm[illegible] [illegible]ace the unavailability of [illegible] purchase necessary inputs, then the risk of irrigating increases and [illegible] returns decrease. Without the correct applications of fertilizer and pesticides, yields are considerably lower while costs of fuel, seed, etc. continue to be incurred by farmers.

Once the sole supplier of credit to farmers, SAED today is disengaging itself from this role. It is the CNCAS (Caisse Nationale de Crédit Agricole du Sénégal) which is expected to take over. The 1987 contrat plan between SAED and CNCAS envisions a three-year transition period during which SAED will withdraw from supplying credit for inputs and land preparation.

The danger is, however, that the CNCAS will not be fully prepared to take charge, and that it will be much more cautious in lending to farmer groups with high risk levels, thereby potentially creating a situation similar to that of 1985 when tomato yields plummeted from more than 20 tons per hectare to 5 tons per hectare following SAED's withdrawal as supplier of credit for pesticides.

An alternative source of funds for the purchase of necessary inputs and equipment is the abundant remittances sent to Bakel by migrant workers in Dakar and France. It is easy, however, to overlook the hierarchy of investment priorities among the Soninké. Until now, the bulk of earnings sent back has been spent on food purchases, the construction of cement homes, the establishment of French and Arabic schools, investment in real estate in Dakar and other urban centers, and construction of rural health clinics and post offices.

Perhaps more important still is the claim on large portions of such earnings that lineage elders maintain. The control elders have over younger brothers and sons is perpetuated through a system of debt and high bride prices. One of the greatest monetary investments a young man will make in his life is in marriage; this is true also for women. A mother will expend very much to put together her daughter's dowry.

In other words, it is important not to assume that any shortages in credit will be compensated by increased investments of remittance earnings in irrigation farming.

C. Returns to Labor in Irrigated Farming

At the beginning of this report it was stated that in the Bakel region labor is the scarce factor of production, given continued large-scale outmigration of Soninké men from the region and the overlapping of key agricultural activities for various crops. Economic theory suggests that farmers employ opportunity cost concepts when trying to arrive at the optimal allocation of their scarce factors of production among various activities. Economists have applied this notion to farm households which employ family members in the production process, theorizing that such household economic units base their short-run resource allocation decisions, all else being equal, on the average returns to the scarce factor of production.

One of the few economic analyses to date of the Bakel perimeters was undertaken by Steven Franzel in the late 1970s. His study showed that notwithstanding the relatively high costs of inputs for irrigation (for the purchase of seed, fertilizer, pumping services, tools, and payment of dues to farmer groups), and the relatively low prices fixed by the government for rice (the main cash crop), irrigation is still profitable from the perspective of the individual farm unit (Franzel 1981, p. 18) This conclusion, it should be noted, is based on calculations of returns per hectare. It is questionable whether this is the correct ratio given that labor is the scarce resource.

Irrigation is more labor-intensive than dryland farming and requires more purchased inputs; output for a given area of land, though, tends to be higher when there is irrigation. Whether that holds true for output per man-day is not clear. Field research in the Department of Bakel has thus far been unable to discover whether rainfed or irrigated production yields higher returns per unit of labor. However, a study undertaken by the University of Michigan of farming experiences in the Gambia River Basin collected data on output per man-day on irrigated and rainfed fields. Because the data collected came, in part, from a Soninké village, the findings and conclusions drawn by this study may give some insight into the situation in Bakel.

The village of Alunhari is a Soninké village situated at the far eastern end of the Gambia River Basin. It is similar to the Soninké villages in the department of Bakel in that not all households undertake rainy season irrigation, the rate of labor migration is fairly high, and household members engage primarily in agricultural work, domestic work, and travel. It may also be similar in another very important respect. One can find a privileged group of farmers in Alunhari, termed 'master farmers' by the Gambia River Basin report. These master farmers and their family members enjoy ready access to improved technology (e.g. fertilizer, tractor plowing, etc) via non-government channels. And, they are in a position to control the operation and management of water distribution (University of Michigan 1985, pp. 209, 263).

Apparently, within Alunhari those households involved in rainy-season irrigation all maintain some kind of relationship to a 'master farmer.' Other households which undertake irrigation activities do so only during the dry season. Table 5, below, presents the comparative returns to production in Alunhari. Average area irrigated by households involved in rainy season irrigation was 0.38 hectares; for households that irrigated only in the dry season the average area was 0.27 hectares. This difference in size of parcels reflects both the larger size of households of rainy-season irrigators and their tendency to reduce or even eliminate farming of at least one of the more labor-intensive rainfed crops.

It is clear that returns per man-day, or gross margins on a per man-day basis, are highest for irrigated rice. What the table does not reveal is that those households that took part in rainy season irrigated rice production all benefitted from ties to 'master farmers'. This implies that critical inputs were made available on time, delivery of water to the parcels was efficient and reliable, and households had access to mechanical plowing services. Moreover, such households were generally larger than others not engaged in rainy season irrigation. These

TABLE 5
ALUNHARI: COMPARATIVE RETURNS TO PRODUCTION

	HHolds without Irrigation Group B			HHolds with Irrigation Group A		
1. Rainy Season Crop Association	Costs per ha	Returns per ha	Returns per MD	Costs per ha	Returns per ha	Returns per MD
L. Millet & Assoc.	170.44	90.00	0.77	117.76	183.00	3.51
Sorghum & Assoc.	160.29	193.00	3.53			
G'nut & Cereals	164.82	574.00	2.36	174.34	608.00	4.12
G'nut & Cowpea/Sqsh				197.12	220.00	1.50
G'nut & Cowpea	189.10	304.05	1.36			
G'nut & Squash	212.31	181.00	0.98			
Maize & Assoc.	245.52	-154.00	-1.07[a]	83.15	-14.00	-0.14[a]
Groundnuts	159.66	759.70	4.16			
Irrigated Rice				433.22	1861.78	10.70
2. Dry Season	Costs per ha	Returns per ha	Returns per MD	Costs per ha	Returns per ha	Returns per MD
Irrigated Rice	354.60	1945.40	6.95	421.61	1873.40	7.49

SOURCE: IVS data and tables.

NOTE: a) Negative returns to maize are explained by high costs of D246/ha and very low production.

(Reprinted from University of Michigan 1985.)

households, then, were in a position to benefit from conditions conducive to achieving high returns. As a result, many devoted less time, or none altogether, to at least one of the more labor-intensive rainfed crops (University of Michigan 1985, p. 261).

The majority of households not irrigating during the rainy season, however, were not associated with a master farmer and thus could not benefit from the resources available to the latter. In the words of the report,

> *The majority of Gambian farmers neither have nor can benefit from the resources available to master farmers. Unwilling to incur debts for inputs and services which may be provided late or inadequately, farm households with fewer land and labor resources opt for the more familiar although lower yielding traditional rainfed crops. (University of Michigan 1985, p. 263)*

The experience from Alunhari suggests that returns per man-day are greatest for irrigated rice and that farmers, when they can expect to benefit from these high returns, will shift their scarce labor to production of irrigated rice. But it also suggests that achieving such returns is contingent on certain conditions being met, conditions which, it has been shown above, are often absent for farmers irrigating the Bakel small perimeters.

D. Land Tenure Considerations in Labor Allocation Decisions

Land tenure may also figure in the farmers' decisions about labor allocation. The Gambia River Basin study alludes to this when it states that often the reason farmers shift their labor from irrigated parcels to rainfed fields at certain critical periods of the growing season is because in doing so they annually reclaim their usufruct rights over the land they previously inherited or cleared (University of Michigan 1985, p. 259).

Among the Soninké in the department of Bakel one finds a comparable situation. According to a villager from Tuabou, one of the reasons for cultivating rainfed land is to maintain usufruct rights to the land. In the past, if a cultivator did not farm his land, but rather let it be farmed by someone else who in turn offered him payment, he could retrieve the land if the need arose. Today, however, with the implementation of the National Land Law, which stipulates that farmers maintain their usufruct rights to land only as long as they continue to farm the land actively, a farmer fears that if he does not farm his land every year, he risks losing it to another cultivator who may come to farm it and who may eventually make an official request to the Rural Council for that land.

A similar sort of reasoning applies to irrigated land. A villager from Tuabou was asked why, if Tuabou's perimeter is so unsuccessful, 63 villagers continue to irrigate. He answered that there is still hope among some that the perimeter will become viable at some point. By continuing to cultivate their parcel now they assure themselves access to the perimeter later when irrigation may be a more profitable alternative. He also suggested that some members are just waiting for the others to leave in order to acquire larger parcels. Finally, he noted that all 63 who still irrigate have benefitted by acquiring not only a parcel on the current perimeter, but also a field where the preliminary perimeter was established in the middle 1970's.

E. Perimeter Organization and Its Effect on Farmers' Labor Allocation Decisions

Good perimeter organization is especially important for ensuring success of irrigated production. A producer group leader must have the organizational and management skills to ensure the proper establishment and enforcement of working rules related to the maintenance of the perimeter, the fair distribution of water, the coordination of the principal farming activities (planting, transplanting, hoeing, crop protection, and harvesting), and the collection of dues from each participant. The quality of leadership of a producer group affects the morale and motivation of its members and therefore the degree of effort and attention accorded to irrigation farming.

It should be noted that good leadership does not imply an authoritarian approach. Producer groups whose autocratic leaders do not allow members to participate in decision making often encounter problems. What does seem to be important, however, are the penalties incurred when rules are broken. According to a USAID agricultural engineer, penalties should be fairly stiff. For example, in the Delta, anyone who does not

repay debts or who shirks maintenance work for the upkeep of the perimeter is expelled. As a result, only the most dedicated farmers remain on the perimeter, and these farmers benefit from larger parcel sizes as the land of those expelled is redistributed. These larger parcel sizes, in turn, make it more worthwhile for farmers to devote increased attention to their irrigated parcels.

Interviews with the presidents and the members of perimeters in three Soninké villages served to reinforce the idea that the role of the producer group leader is extremely important. One of the three perimeters has had very little success, the other two have both been quite successful. The success of the latter two has been partly the result of good management techniques which include:

1) Requiring that members pay for their share of fuel at the start of the growing season. Experience has shown that if dues are collected after the harvest, there will always be some members who will claim they cannot pay. Then efforts must be made to ascertain whether they cannot pay because of perimeter malfunctioning during the growing season, or some other related mishap, or whether they do not want to pay.

2) Requiring that all members pay for fuel, regardless of whether or not they actually irrigate their parcels. A problem encountered by one of the producer groups mentioned above, is that some members prefer to farm their parcels without irrigating. What happens is that the group cannot raise enough money to pay for the fuel necessary to irrigate the remaining plots. On this particular perimeter, SAED's policy of confiscating parcels from those who do not irrigate has not been enforced.

3) Appointing both men and women supervisors to head work groups. This has proven beneficial for those groups whose members include both men and women irrigators. Experience has shown that women prefer to be supervised by other women.

4) Assisting members whose parcels are poorly watered due to faulty canal work or perimeter layout. In doing so, all members of the perimeter are in a position to repay dues and this works to the advantage of the entire producer group.

5) Maintaining a collective field, the proceeds from which are used to cover expenses. One producer group has been very successful in this respect. Bananas and sorghum are both grown on its collective field and then sold to cover the entire cost of fuel as well as of pump amortization. Thus there are no individual dues to be paid and no problems in collecting them.

III. SUMMARY OF GENERAL DISCUSSION

In discussing the factors which influence farmers' decision on the allocation of labor between dryland and irrigated production, various explanations have been noted.

First, constraints imposed by the absence of suitable market outlets for both staple and vegetable crops and by the small size of irrigated parcels have severely inhibited the possibility of surplus production. As such, farmers cannot expect to bring their crop to market and prefer to meet subsistence needs, as much as possible, from the less costly and risky rainfed cultivation.

Second, the risky nature of irrigation in Bakel, due to such factors as faulty perimeter construction, the unreliability of input delivery, poor management of irrigation activities, and the current unstable situation with respect to credit availability, has induced farmers to divert their labor to dryland parcels when they expect rain.

Third, farmers do apply opportunity cost principles in the allocation of their scarce factors of production. Thus, when they expect to benefit from high returns from irrigation, they will shift labor from rainfed to irrigated farming. But these high returns are contingent on certain conditions being met, such as the availability of labor-saving technology, reliable input supplies, and efficient management of perimeter activities.

Fourth, farmers may wish to continue farming rainfed and irrrigated parcels simultaneously in order to maintain usufruct rights to different land areas.

Fifth, the better the leadership quality of a producer group, the greater the likelihood of success in irrigation, and therefore the greater the motivation and the degree of effort and attention accorded by producer group members to irrigation farming.

IV. CASE STUDIES

Here we present excerpts from several interviews which have influenced the conclusions of this report. The most interesting observation to be made about these various case studies is the great diversity of experiences they reveal. It is important to understand that organization of labor allocation within families varies greatly depending on such factors as family size, other economic and non-economic activities of members, ability to hire outside labor, the type of crops grown, planting techniques adopted, and whether irrigated fields are family fields or individual fields.

Because the narratives were transcribed word-for-word, they contain some extraneous material. Entries within brackets are the author's explanations. Also, respondents' names have been changed to protect the anonymity of the interviewees. Following each narrative, some comments are made.

A. Fousei Traoré

Fousei Traoré is a kome (slave caste) who lives in Mouderi. He belongs to two perimeters in Mouderi, the first of which is very successful, the second of which has just been constructed. He is the kagumme of a ka in which there are only two men, himself and his brother Moussa, the remaining members being women and children.

1) Narrative

This is the first year I will actually be irrigating. I am a sailor, but will soon be retiring. In July I am leaving to go to sea and will come back permanently in December. Moussa, my younger brother, will begin to irrigate for me.

We have two parcels, one in Mouderi II, and one in Mouderi VI. In Mouderi II, the parcel is a te xoore, and is approximately 0.5 ha. In Mouderi VI I have taken a parcel as my saluma, and also a parcel for the women to farm. The women's parcel is divided up such that each women has a section to herself. Some of the women in the ka are also in Mouderi I.

*Moussa has been farming the parcel in Mouderi II for me for the last three years, but the parcel is under my name. Harvests have been o.k.; in the first year Moussa harvested 11 sacks [*100kg.*] of rice and 3 sacks of sorghum; in the second year he harvested 12 sacks of rice and 3 1/2 sacks of sorghum, and in the third year together we harvested 23 sacks of rice and 4 sacks of sorghum. The dramatic increase in the third year is due to the help which I was able to give: an extra pair of hands almost doubled the harvest.*

*Currently, we farm only on the perimeters and on kollanga land [*an inland basin which receives both flood waters and rain*]. Before joining the perimeter we farmed on rainfed land and on the kollanga. Mouderi II is now located where we practiced rainfed cultivation before.*

We do encounter labor shortages. At times there is a conflict between work on kollanga land and work on the perimeter. I work with the daba as do Moussa and the women and children. The women help with sowing, leveling of the parcel, weeding, and harvesting. We do not hire salaried labor because it is simply too difficult. The perimeter yields more than the kollanga. Before, when it rained a lot, the kollanga was well flooded for an appropriate amount of time and the harvests were plentiful. Now the kollanga is flooded for only a short period and harvests are not so good.

*When it rained, we were able to harvest more from our rainfed fields than we are now able to harvest from the perimeter [*the rainfed field was larger than the parcel*]. Now, with the perimeter, we have quite a few problems largely having to do with the high costs of irrigation. Yet, I have never regretted joining the producer group because it no longer rains enough.*

2) Observations

Several interesting things come out of this narrative. First, the predominant crop grown on the parcel on Mouderi II is not sorghum, but rice. Rice is both a cash crop and a subsistence crop. Perhaps because Mouderi II is a relatively successful perimeter, Fousei chooses to farm the more labor-intensive and costly, but also the potentially more lucrative, rice crop.

Second, though Fousei's family continues to farm on non-irrigated land, once his family began to farm on the perimeter, they shifted their labor away from rainfed cultivation altogether, and continued farming only their kollanga land. Again, this may be due to the relative success they have had on the perimeter.

And third, Fousei claims that most of the problems associated with irrigation have to do with its high cost. Mouderi II happens to be one of the perimeters that does not have a collective field. As such, the costs per participant on the perimeter cannot be lessened from collective field proceeds.

B. Diadié Diallo

Diadié Diallo is a moodi (clerical caste) who lives in Mouderi and belongs only to Mouderi II.

1) Narrative

This is my fourth year in the perimeter. I grow rice and millet on my parcel which is a te xoore. In the beginning, I was not sure how to farm my irrigated land and so farmed only a section of it. That which I harvested, I put in my granary. This year, however, I will try to cultivate the entire parcel. I will keep for myself the amount necessary to feed my family for the year, and the rest I will sell. Some members who have farmed their entire parcel have harvested as many as 40 sacks.

In the first year I harvested five sacks of rice and two of millet. In the second year, there was no harvest because of the crickets. In the third year, I had eight sacks of rice and one of millet.

My ka is rather large, so we divide up into two groups. One group, consisting of one of the men of the ka, his two wives, and his talibes (disciples associated with a Muslim religious leader), leave Mouderi during the rainy season to farm some rainfed land near Bondji. They go there because there are hills nearby and when it rains over the hills, the water flows down onto the plain; the ground there remains moist for up to three weeks. The other groups, consisting of myself, my wife, and my brother remain and farm in Mouderi.

I am the only one who actually works on the perimeter. I used to work with a younger ka member, but he left for Dakar. My brother stays in Mouderi, but does not farm on the perimeter. He cultivates a fenced-in field right next to the compound.

I am able to manage the work on the perimeter alone because of a work method that is quite efficient. First, I use a product which kills weeds; this saves me the task of weeding. And second, I stagger the sowing. I sow one section directly; for the other section I have prepared a nursery early on and transplant the rice when the rainy season begins. Sometimes, though rarely, my wife will help me with the transplanting and with the weeding if it needs to be done.

The major problems I have encountered have been with rats and crickets. I use a certain product to control the rats, but this product is difficult to get. Usually the president of Mouderi II sells it, or it can be gotten from SAED.

2) Observations

This narrative, when contrasted to the first, is a good example of the immense diversity which can be found in the organization of labor allocation within kas. Also important is the complete harvest failure in the second year of the perimeter because of an infestation of crickets. This risk factor may help to explain why, notwithstanding the potential gains to be had from farming on the perimeter, the rest of the family farms elsewhere, either out near Bondji, or on a field next to the compound.

Two other points stand out. The younger member of the ka, with whom Diadié used to farm on the perimeter, left to find work in Dakar. Perhaps young men still perceive work opportunities in urban areas and abroad to be more lucrative than agricultural pursuits at home. And, Diadié's main concern with farming on the perimeter is the difficulty he has in acquiring the correct product to control rats and crickets.

C. Samba Fofana

Samba Fofana is a xoore (noble caste) from Tuabou who has been farming on the perimeter since its creation in the middle 1970's. To date, Tuabou's perimeter is probably one of the least successful of the region.

1) Narrative

I have been irrigating since Diabé [Diabé Sow, the president of the Federation] *first brought word to the villages. In the very beginning, only Tuabou and Bakel irrigated. And Tuabou's producer group at first consisted of only fifteen members.*

When I first began irrigating, I was told by the Préfet, and some Europeans, not to become discouraged. They told me that later on, with the building of the Diama and Manantali dams, there would be plenty of water and that I would be able to farm well. They also urged us not to accept credit from the government. In any case, I have stuck with the perimeter in expectation of the operation of the dams.

Early on, we used to farm elsewhere near an inland water basin. When we left the first perimeter to establish the second perimeter nearer to

the river, everyone kept their parcel on the original perimeter. Now, everyone has one parcel near the river, but each parcel is divided in two. One part, nearer the river, is irrigated, the other is rainfed.

I also have two rainfed te xoore. One is located between Manuel and Tuabou, the other is near the inland water basin. From these I get approximately twenty sacks of maize and sorghum each year.

It takes me two days to plant the two parcels from the old and new perimeters. My sons help me out, but the women of the ka do not. My irrigated parcel is a te xoore, but since it is not too big, approximately 0.55 hectares, it is almost more like a saluma for me. So because I have help from my sons and my fields are not too large, I do not encounter any real labor-short periods.

On my parcel, on the irrigated section, during the rainy season, I grow maize. During the dry season I grow onions, cabbage, tomatoes, and eggplant. On average, during the rainy season, I harvest about five sacks of maize. This rainy season, however, the perimeter was not irrigated, yet I still harvested four sacks of maize. Ever since I joined the perimeter, I have gained something from it. I get five sacks of maize from farming the land which used to be my parcel in the first perimeter. And I get an additional five sacks of maize from the current perimeter. Still, if I had to say which I prefer most, my rainfed fields or my irrigated parcel, I would have to say my rainfed fields. I harvest almost double the amount from my rainfed fields and there I don't have to pay the 10,000 FCFA fee which I pay to farm my irrigated parcel.

2) Observations

This narrative reveals the strategy of some farmers to continue farming particular tracts of land in order to maintain their access to it should cultivation become more profitable. In the case of Samba Fofana the decision to allocate labor to the perimeter, notwithstanding his preference for his rainfed fields, is part of a strategy to maintain farming rights to land which, with the operation of the dams, may turn out to be quite productive after all. Indeed, he is even willing to pay 10,000 FCFA each year in producer group fees, even though farming the parcel without irrigating it yields almost the same amount of produce.

V. CONCLUSIONS

This paper has identified some of the major constraints (poor market outlets, small parcel sizes, riskiness, unreliable credit and input supplies, absence of labor-saving equipment, land tenure considerations, poor producer group organization) to successful irrigated farming. It has been argued that these constraints have created a situation in which most farmers of the region produce largely "to eat and not to sell", and in which some farmers continue to devote themselves primarily to rainfed farming activities.

The picture painted here has not been very bright. The author would like, however, to conclude on a different note. Despite the problems associated with irrigation in the Bakel region, the number of farmers

irrigating is not diminishing -- it is growing. In 1984/85 the total number of producer group members in the region totalled 3,864; by 1986/87 the number had increased to 5,423 (SAED statistics). Clearly, farmers still maintain hope in the viability of irrigation farming.

What are needed are for measures to be taken on the part of all concerned (the government of Senegal, SAED, and farmers) to reduce the risk inherent on today's perimeters and to ensure the profitability of irrigation farming.

Appendix I: Examples of Field Research Questions

Questions relating to risk:

* What are the problems you have encountered on your dryland fields?
* What are the problems you have encountered on your irrigated parcel?
* According to you, what are the solutions to these problems?
* With regard to the farming of your dryland fields, in which year did you have the most success? Can you describe that year?
* With regard to the farming of your irrigated parcel, in which year did you have the most success? Can you describe that year?
* Why would you say there are some farmers who do not irrigate?

Questions relating to marketing:

* Have you sold any part of your harvest in past years?
* Which crops have you brought to market?
* What are the principal crops you grow for subsistence?
* What are the principal crops you grow for sale?
* Where did you sell your crops last year?
* Did you have any problems regarding the sale of your crop?

Questions relating to decision-making:

* How many irrigated parcels do the members of your ka farm?
* To whom does each parcel belong?
* In what years did you begin to farm each parcel?
* Why did you not all start irrigating the same year?
* Which member of the ka made the decision to begin irrigating?
* Which member of the ka decides who is going to work on the irrigated parcel and when?
* Which member of the ka determines what is going to be cultivated on the irrigated parcel?

Questions relating to labor allocation:

* Do you ever find yourself without enough agricultural labor? If so, for which tasks?
* Aside from salaried workers, are there any other villagers who assist you in your fields?
* How many salaried workers did you hire last year? And the year before?
* Who works on the perimeter? Do they work there all of the time, some of the time?
* Can you tell me something of the amount of work required on the perimeter?
* Can you describe to me the work required on the perimeter?
* Which tasks require most labor? Do you have enough labor for those tasks? Who participates?

REFERENCES

Bloch, Peter, "An Egalitarian Development Project in a Stratified Society: Who Ends Up with the Land?" Bakel Discussion Paper no. 6, April 1988.

Diemer, Geert and Ellen van der Laan, L'irrigation au Sahel: La Crise des Périmètres Irrigués et la Voie Haalpulaar. Paris: Karthala, 1987.

Franzel, Steven, "An Interim Evaluation of Two Agricultural Production Projects in Senegal: The Economics of Rainfed and Irrigated Agriculture", published under terms of the Agency for International Development and Michigan State University contract AID/afr-C-1260, 1981.

Le, Khoi Nguyen, "A Proposed Credit System for Bakel Irrigated Perimeters", Unpublished Paper, Document 0250Y (undated)

Le, Khoi Nguyen, "Comments on IDA Paper: 'Les Activités Agricoles dans la Basse et Moyenne Vallée du Sénégal; Problèmes et Propositions de Solution'", memorandum, IWME, June 6, 1988.

Le, Khoi Nguyen, "Comments on SAED's Draft of the Third 'Lettre de Mission', memorandum, IWM/WM, May 20, 1987a.

Le, Khoi Nguyen, "Comments on SAED 'TROISIEME LETTRE DE MISSION'", memorandum, IWME, November 6, 1987b.

Pollet, Eric and Grace Winter, La Société Soninké, Brussels: Institut de Sociologie de l'Université Libre de Bruxelles, 1971.

SAED Delegation de Bakel, "Rapport Trimestriel; Octobre-Novembre -Decembre 1986", Bakel, January 1987a.

SAED Delegation de Bakel, "Rapport Trimestriel; Juillet-Août -Septembre 1987", Bakel, October 1987b.

Sella, Monica, "Irrigation and Dynamics of Access to Land Among the Soninké: Field Research Impressions from Tuabou and Moudery." Bakel Discussion Paper no. 8, November 1988.

Seymour, Matt, Laura McPherson, and David Harmon, "Development Management in Africa: The Case of the Bakel Small Irrigated Perimeters Project in Senegal". AID Evaluation Special Study No. 34, December 1985.

University of Michigan, Rural Development in the Gambia River Basin, Gambia River Basin Studies, Prepared for U.S. Agency for International Development (USAID) and Gambia River Basin Development Organization (OMVG), September, 1985.

Weigel, J.Y., Migration et Production Domestique des Soninké du Senegal. Paris: ORSTOM, June 1982.