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FINAL REPORT

SOCIAL AND ECONOMIC INFLUENCES ON PERIMETER MANAGEMENT AND OPERATION: FINDINGS FROM RESEARCH IN THE MAGGIA VALLEY, NIGER

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EXECUTIVE SUMMARY

Irrigation development is expected to continue to play a significant role in Niger's agricultural development policy. This paper reports the results of socioeconomic research conducted on two dam-fed irrigated perimeters, and examines social and economic influences that may affect operation.

The two perimeters studied are supervised by ONAHA, the parastatal agency charged with developing, managing, and maintaining irrigation infrastructure and with providing training and extension services to farmers. A long-term policy objective is for irrigation perimeters to become self-managed by their management committees, with ONAHA acting as a technical assistance agency.

Review of the agricultural tasks performed during the wet and dry seasons, on and off the perimeters, indicates that added labor is required in irrigated agriculture (both because some tasks take longer under irrigated conditions, and more tasks are performed). Planting and weeding are performed during periods of peak labor demand; farmers may find it difficult to complete tasks on both rainfed and irrigated plots in a timely fashion.

Irrigation schemes in Niger (as in many countries) are managed with the idea that farmers will complete tasks according to a uniform schedule, so that crops may receive maximum benefit from irrigation. An implicit assumption that farmers on a given perimeter are equally able to mobilize resources for agriculture underlies this model. Research findings suggest that not all farmers can mobilize the same levels of resources, because resources are not equally distributed. This variability may account for appparent performance differences and affect perimeter operation.

Social and economic factors affecting perimeter operation were analyzed. These include labor availability; access to cash, land, and other productive resources; and power as it relates to land tenure and property, control over agronomic practices, decision making, and ONAHA's role in perimeter management.

The availability of household labor plays an important role in agricultural production; households with less available labor must limit the area they cultivate, hire labor, or mobilize labor through other means. The majority of households on both perimeters include two to three potentially active working males. Irrigated area and rainfed plots are not evenly distributed among perimeter farmers. The data suggest that the distribution of total area cultivated per household is unequal on each perimeter; therefore, the labor required to cultivate total holdings will vary from household to household. No positive linear

relationship between available male labor and irrigated land area or number of rainfed plots per household was found. Thus, farmers on a given perimeter will have different priorities for allocating labor, based on differential access to land and labor.

Irrigated agriculture is only one element in the household production strategy. During the wet season, more labor is allocated to rainfed plots than to irrigated plots. Labor per unit area allocated to perimeter cultivation appears relatively constant, while that allocated to rainfed agriculture may vary considerably from household to household. Farmers on both perimeters also engage in off-farm activities, many of which generate cash more directly than agriculture.

The availability of cash and its timing also affect a household's production strategy. Most households studied include at least one member engaged in a cash-generating activity outside of agriculture and animal husbandry. Within each perimeter, however, the number of cash-generating members varies widely. Land is another source of cash income. The unequal distribution of irrigated land area and rainfed plots suggests a wide gap in income from land within each perimeter. The emerging picture of two perimeters with both resource-rich and -poor farmers is corroborated by evidence of unequal distribution of livestock and consumer goods. Differential access to cash, labor, land, and other resources may allow some farmers to complete perimeter tasks sooner and better than other farmers. The hypothesis that a more homogenous group of farmers may lead to smoother and more efficient operation is put forth, and various implications are discussed. The issue of heterogeneity versus homogeneity of irrigation units may have important implications for irrigation management and the policy objective of local self-management.

Irrigation development implies changes in property relations and changes in cultivation practices. Laws prohibiting land rental or sale on the perimeters are aimed to prevent land concentration, and less explicitly, towards controlling land use and farm management. However, farmers' rights to make decisions about how their land is cultivated may be compromised by state regulations. Most farmers interviewed wanted to have more choices about cropping patterns and farm practices.

Farmers on both perimeters tend to consider decisions about <u>redevance</u> calculations, irrigation scheduling, timing of planting, and other activities on the perimeters as made by the perimeter director and other ONAHA staff and by the management committee. A description of the pattern of information flow on the perimeters shows that information flows from top to bottom, and only reaches farmers indirectly. This structure is not entirely effective in communicating information to farmers about irrigations. Better communication channels would improve water management and yields and increase farmer participation in

management, thereby helping to meet the policy objective of auto-gestion or self-management.

ONAHA has a somewhat ambiguous role with respect to irrigation management and rule enforcement. Although it is supposed to become a technical assistance agency, ONAHA now manages the perimeters. However, the agency's staff have limited authority to punish farmers who break rules like selling land or failing to pay the redevance. Regional administrative authorities must consent to sanctions; their consent is not always forthcoming.

ONAHA staff try to follow and impose agency guidelines at Moullela and Galmi, while farmers and their families cultivate various, often distant plots, and also make a living from other sources. Because production strategies vary, farmers do not behave uniformly in accordance with agency directives. Day-to-day farming and water management involves the sometimes conflicting agendas of a diverse group of farmers, ONAHA staff, local authorities, and extra-local administrative authorities. Some issues remain a source of debate, while others are resolved, at least temporarily. In Moullela such arrangements have had a longer time to develop. It is not an easy or negotiated give and take, nor is it a bitter constant battle.

The fact that farmers with parcels in a given perimeter do not have uniform access to resources needs to be recognized and taken into account in water management and irrigation system design. Changes that might be instituted include flexible water schedules, wider choice in cropping patterns, changes in the size and perhaps composition of GMPs or their equivalent, and designing control structures and canals that take larger water flows so that selected areas of a perimeter can irrigate fairly quickly even if they are far from the head of the system. The situation of resource-poor farmers might be improved through credit programs. In conclusion, it would be useful to relax assumptions about uniform performance among perimeter farmers.

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I would like to acknowledge the help provided by my research assistants and the many residents in the research area who patiently spent time with us.

PREFACE

This is the final report for sociological research conducted under the USAID Water Management Synthesis-II Project (WMS-II) in Niger. This short term study was designed to complement the agricultural engineering research carried out by Mr. W. Ray Norman for two years, ending in April, 1986.

The general objectives of this study were to provide a socioeconomic profile of the areas served by two irrigated perimeters in the Maggia Valley of Niger, as well as a model of perimeter organization and operation. Terms of reference for the sociological research were drafted by Mr. Ray Norman and Dr. Eric Arnould, consulting anthropologist, in collaboration with the Office National d'Aménagements Hydro-Agricoles (ONAHA) and USAID/Niger. They were later modified in consultation with ONAHA and USAID.

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Chapter One
INTRODUCTION

Irrigated agriculture has played and is expected to continue to play a growing role in meeting Niger's food production requirements. A series of factors including Niger's Sahelian agro-climatic conditions, the sharp decline of its uranium revenues, and the vulnerability of the vast majority of the population to recurrent droughts are behind the government's promotion of irrigated agriculture. In a country where two-thirds to three-quarters of the land area is classified as inutile, or useless desert, rainfed and irrigated agriculture on the remaining band of land to the south is considered a key means for increasing the production of crops for domestic consumption and, to a lesser extent, export.

Nearly 10,000 hectares have been brought under irrigation by the government since independence in 1960.[1] The actual area cultivated during the 1985 rainy season on perimeters managed by the Office National d'Aménagements Hydro-Agricoles (ONAHA, the national irrigation agency) came to 9,115 ha. (USAID, 1986). The irrigated area cultivated during the 1984-85 dry season was 4,197 ha. The rainy season figure represented an increase from the 5,500 irrigated hectares in production in 1983 (USAID, 1984).[2]

Although the importance of irrigation in Niger is indisputable, assessments of and recommendations for irrigation development and perimeter performance are mixed (Horowitz, et al. 1983; USAID, 1984). This is in part due to limitations in the

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[1] The country's total land area is 126,700,000 ha., including land and water (Horowitz, et al. 1983:18).

[2] For additional background consult USAID's (1984) Niger Irrigation Subsector Assessment which contains a general discussion of policy, economic, institutional, engineering, agronomic, marketing, health, and environmental aspects of irrigation in Niger. The Niger Social and Institutional Profile prepared by the Institute for Development Anthropology (Horowitz, et al. 1983) includes chapters on both irrigated and dryland agriculture which provide very thorough and useful information.

quality, amount, and level of aggregation of data available on which to base such assessments and recommendations. In the last few years various studies have attempted to remedy this situation. USAID's WMS-II Project activities in Niger represent part of this effort.

The main objective of this study was to collect and analyze socioeconomic data to complement the hydrological, agronomic, and socioeconomic data collected by Ray Norman in the Maggia Valley of Niger (see Norman, 1986 and 1987, forthcoming dissertation) in order to increase understanding of social and economic factors that affect water management. Previously available socioeconomic data for the Galmi and Moullela perimeters date from pre-project feasibility studies (1981 for Galmi, 1967 and 1969 for Moullela). The data collected by the present study provide a socioeconomic profile of the areas served by the perimeters (i.e., a source of baseline data), and a model of perimeter organization and operation.

The next chapter describes the institutional and organizational framework surrounding irrigation development in Niger. Chapter three provides an introduction to the research area. The fourth chapter consists of a description of the agricultural cycle in the area. Chapters five through seven provide descriptive data and analyses of selected factors affecting perimeter operation. Chapter five deals with labor as a factor affecting perimeter activities. Differential access to cash, land, and other productive resources is discussed in chapter six. Chapter seven examines the relationship between power relations and perimeter management by focusing on property rights and land allocation, crop choice and agronomic practices, decision making and information flows, and ONAHA's role in perimeter management. The last chapter presents concluding comments. A discussion of the methodology employed in data collection is presented in Appendix 1. Finally, Appendix 2 contains frequency distributions of collected quantitative data.

Chapter Two

IRRIGATION IN NIGER: INSTITUTIONAL AND ORGANIZATIONAL CONTEXT

Irrigation development generally takes place through institutions and organizations designed to support it. Examples of such institutions and organizations include laws governing land tenure, marketing cooperatives, and agencies charged with building, operating, and maintaining irrigation infrastructure. This section provides an introduction to the institutional and organizational context of irrigation development in Niger.

LEGAL ASPECTS

According to Nigerien law, all land belongs to the government. Traditionally, village chiefs had authority to allocate and settle disputes involving rainfed agricultural land. While this is still largely the case, in relatively densely populated areas, such as Galmi, the reported purchase and rental of rainfed land indicates the growing presence of a market in land.[3] Land which has been improved by the state through irrigation development belongs to and is controlled by the government; it is illegal to sell or rent perimeter plots. Such plots can, however, be temporarily reallocated or lent to farmers normally outside an irrigation scheme.

AGENCIES INVOLVED IN PERIMETER DEVELOPMENT AND MANAGEMENT

A number of agencies and organizations intervene at different levels to fill various functions related to irrigation development and perimeter operation (see Figure 1). Some of these functions operlap. Perimeters are designed by Genie Rural (Rural Engineering), a division of the Ministry of Agriculture. Genie Rural is also charged with supervising the construction of small irrigation projects, but the execution of large-scale

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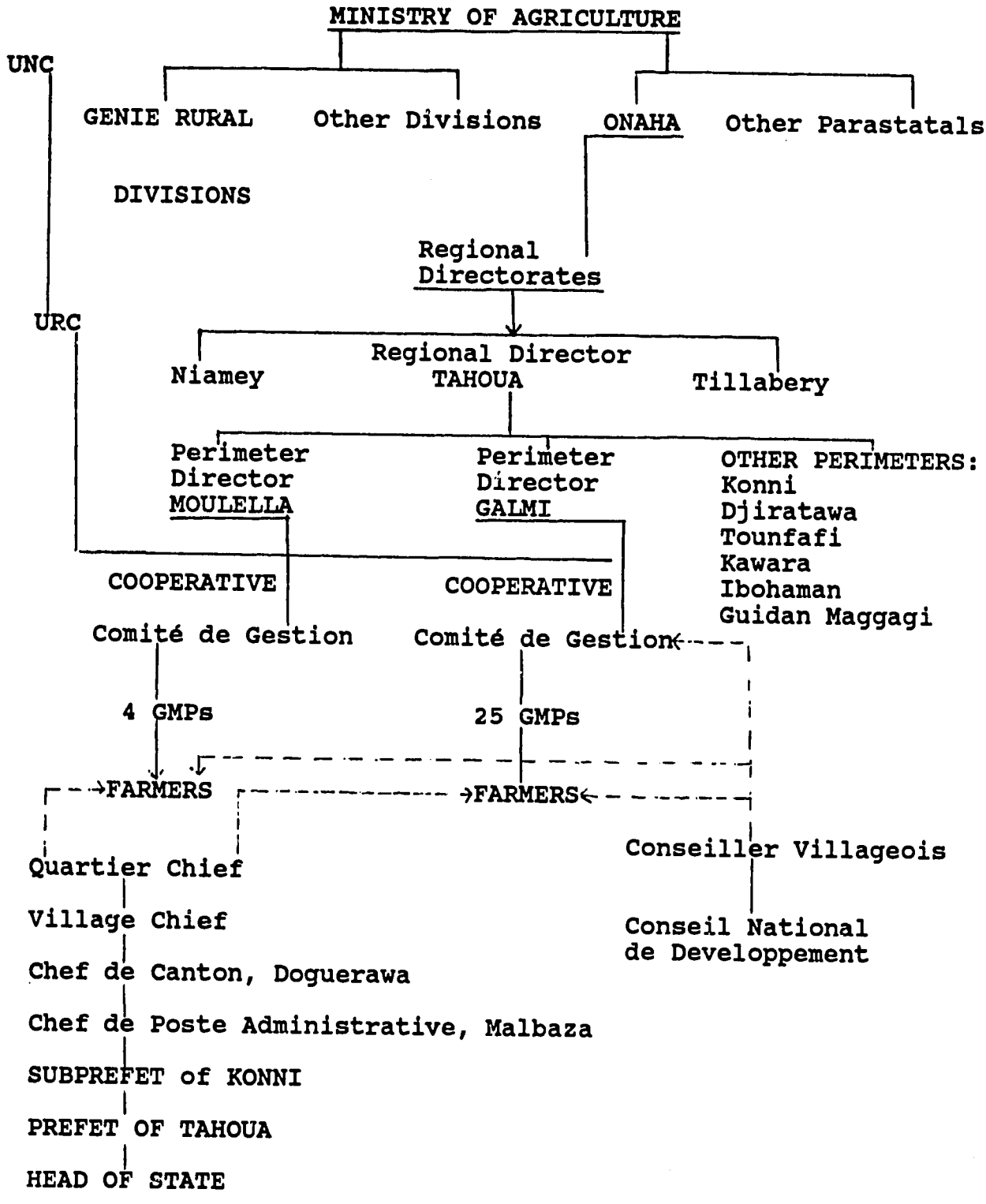
[3] Horowitz, et al. (1983) in a section called "Land Holding Today" suggest that land markets are widespread in areas of higher population density.

FIGURE 1:
ORGANIZATIONS INVOLVED IN IRRIGATION



projects is the joint responsibility of Genie Rural and ONAHA. Because ONAHA has general responsibilities over irrigation development, its activities may overlap with those of Genie Rural. Feasibility studies are often carried out by foreign consulting firms, while perimeter construction is carried out by foreign and local construction firms. Funding for irrigation comes primarily from external donors.

Structure and Function of ONAHA

ONAHA was created in December, 1979, as a parastatal under the Ministry of Rural Development charged with responsibility over irrigation activities. Before this time, irrigation was the responsibility of the Union Nigerienne de Crédit et de Cooperation (UNCC), also under the Ministry of Rural Development. ONAHA's government affiliation was transferred to the Ministry of Agriculture in 1986.

ONAHA is responsible for developing, managing, and maintaining irrigation infrastructure, as well as for providing training and extension services to farmers. In addition to the central office in Niamey, ONAHA has Regional Directorates in Niamey, Tillabery, and Tahoua. Each perimeter is overseen by a perimeter director; perimeter directors are under the authority of their corresponding regional directors. Larger perimeters also include field agents among their associated ONAHA staff.

Auto-gestion, or self-management, is a key element of Niger's irrigation development policy. Government policy is aimed at eventual auto-gestion at the perimeter level, with ONAHA playing the role of a technical assistance agency contracted with for specific tasks by local cooperatives and the comité de gestion (management committee) attached to each perimeter.

Cooperatives

Each perimeter is associated with a local cooperative, or in the case of larger perimeters (such as Konni), with several cooperatives. Village cooperatives are grouped under the National Union of Cooperatives (UNC) at the national level, and

the Regional Union of Cooperatives (UNC) at the regional level (the UNC replaced the UNCC). Cooperatives provide credit, some inputs, marketing, and accounting services to their membership, which includes local farmers practicing rainfed and irrigated agriculture.

The Perimeter Management Committee

Cooperatives associated with irrigated perimeters have a management committee (comité de gestion) which is responsible, in principle at least, for managing the perimeter. Management committee structure is designed to allow for the representation of farmer interests and ONAHA technical assistance or supervision. Each committee includes a president, vice-president, treasurer, and secretary, chosen at farmer meetings. ONAHA staff comprise the rest of the committee.

The committees purchase agricultural inputs from the UNC on credit at the beginning of each season, and repay them at the end of the harvest. Farmers either purchase inputs directly from the cooperative or receive them as part the package of goods and services covered by the redevance, or perimeter user fee. They can also buy inputs in the market.

The redevance is an obligatory fee charged of all perimeter parcel holders. It is calculated each season by ONAHA staff and covers selected inputs, some perimeter maintenance and repairs, and part of ONAHA's operating costs. Specific line items vary from perimeter to perimeter (see Table 2.1). The rate is calculated on a flat per-hectare fee, per farmer, and per season, rather than as a per volume water fee.

Management committees are responsible for collecting the redevance. Part of the money is kept at the perimeter level to be spent on minor repairs and day-to-day expenditures. The rest is deposited in a bank account, from which a portion is taken out and transferred to ONAHA. The portion remaining in the account is to be used under the committee's authority for major irrigation-related expenditures, such as repairs and maintenance.

TABLE 2.1
BREAKDOWN OF REDEVANCE BY LINE ITEM,
PER HECTARE of WET SEASON SORGHUM AND COTTON,
BY PERIMETER, 1985 (CFA)

ITEM	MOULLELA	GALMI
Construction, repairs, heavy works.	15,255	11,000
Agricultural inputs (fertilizer)	12,025	9,000
Vehicle: depreciation	-	2,000
Vehicle: operating costs	-	3,200
Office operation	-	500
Support to ONAHA	3,000	3,000
Cooperative revolving funds	2,000	1,500
Turnout operator's fees	-	300
Total	32,280	30,500

Source: Briend, 1986

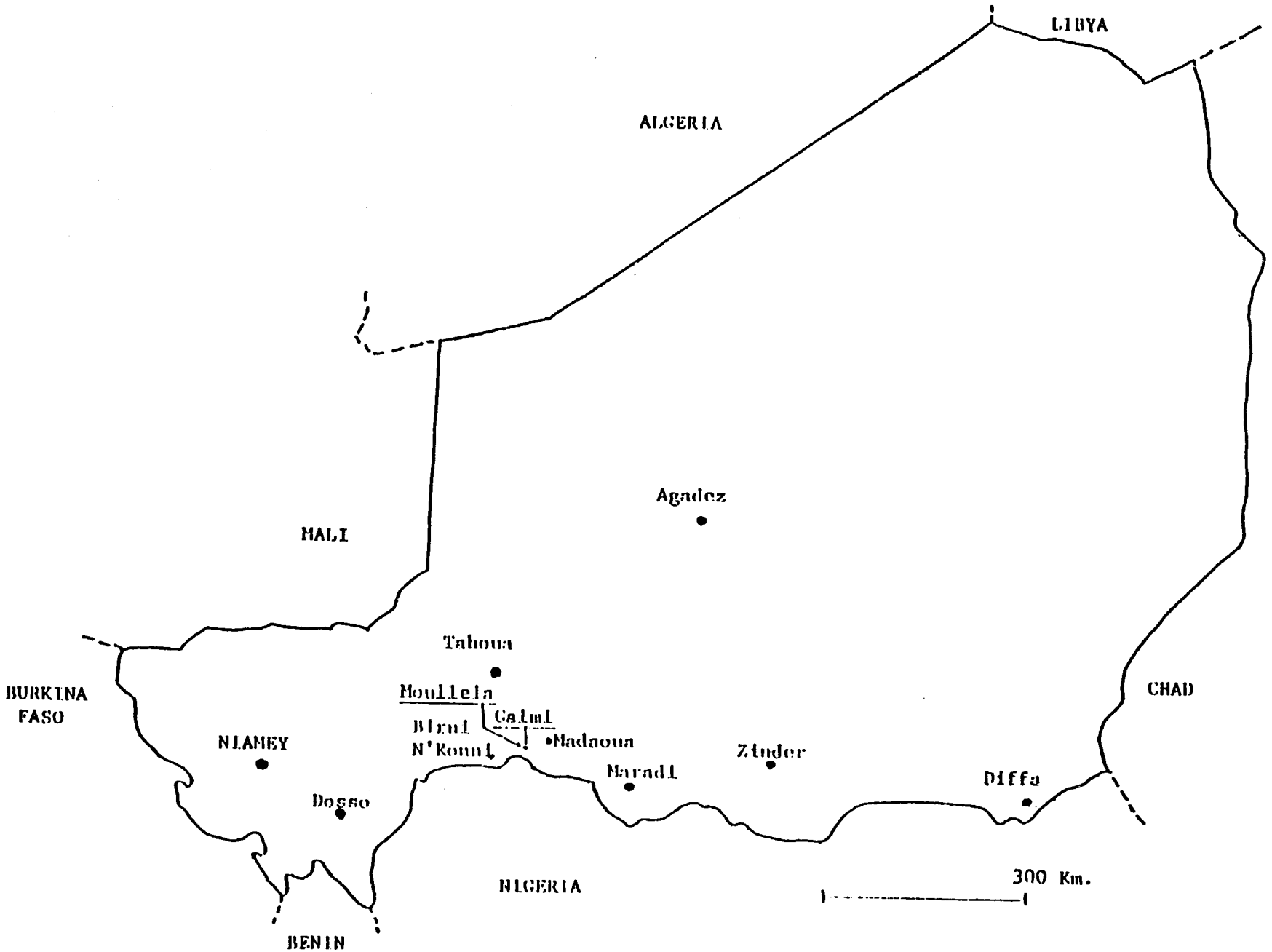
In theory, the management committee and ONAHA staff determine cropping patterns. In practice, cropping patterns are conditioned by a combination of the government's policy of promoting food production and farmers' wishes to grow sorghum, millet, beans, and other crops. In addition to planting a portion of their parcel in food crops, farmers must plant cash crops (i.e., onions, cotton, or wheat) in order to ensure payment of the redevance. Cotton is sold to a French company under terms of an agreement with the government of Niger.

The GMP

Perimeters are divided into organizational units called Groupements Mutualistes de Production (GMP, or Mutual Production Groups). GMPs are composed of farmers whose parcels are located on a single secondary canal; each group has a president, secretary, and treasurer. The GMP president is usually responsible for collecting the redevance from farmers and/or from

his treasurer and turning it over to the management committee.

GMPs are the last link in the long institutional chain that extends from the Ministry of Agriculture at the state level, down through ONAHA to individual farmers (Figure 1). Nigerien farmers' lives are also touched by other local groups and by representatives of national organizations and political authorities. In principle, such institutional chains should provide for a two-way channel of communication between the central government and the population. However, as Ware (USAID, 1984) and Arnould (1986) note, the structure provides for the top-down transmission of state directives rather than mass participation.



MAP 1: NIGER, AND STUDY AREA

Chapter Three

THE RESEARCH AREA: GALMI AND MOULLELA

This section describes the two perimeters where research was conducted and points out their similarities and differences. It also provides background for the social and economic data and issues raised in subsequent sections.[4]

THE SETTING

Galmi perimeter is located just off the paved Route National that runs east-west through the south of Niger connecting Niamey with Zinder. Annual rainfall in the area averages about 400 mm. The perimeter is within one or two kilometers of several villages, varying proportions of whose inhabitants have irrigated parcels. Galmi Birni, Guidan Kare, and Guidan Doutchi, which are right on the paved road, appear to be a single village.[5] Together they represent an important economic center for the area. On market days Galmi is crowded with villagers from throughout the region. At the onion harvests and periodically thereafter, truckers stop to buy sacks of onions which are sold in Togo, Benin, and the Ivory Coast. Locally hired trucks also take part in the onion trade. Onions have been grown in the area for well over fifty years; the violet de Galmi (a local variety) is widely known for its flavor and storage potential.

The largest numbers of irrigated parcel holders on the Galmi perimeter come from these three villages, and from Guidan Miko and Guidan Roro, which are a few kilometers off the highway to the north and northeast. Smaller numbers of parcel holders come

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[4] The selection of Moullela and Galmi perimeters as research sites was conditioned by the terms of reference. The decision was based on the desirability of gathering additional social and economic data on perimeters for which hydrological and engineering data, as well as some socioeconomic data, had been collected by Ray Norman.

[5] These villages will be collectively referred to a "Galmi" in the remainder of the report.

from a few other small villages in the area. A few farmers with parcels in the Galmi perimeter live in Moullela, which is about 6 km. north of Galmi along a dirt road.

The Moullela perimeter is located just north of the village of Moullela. Parcel holders there come primarily from Moullela, although a number of Guidan Miko residents also have parcels on the Moullela perimeter. A small number of farmers have parcels on both perimeters. In contrast to Galmi, the village of Moullela has no market, nor does it have a school. Moullela residents go to Galmi for the market, but not for schooling.

THE PERIMETERS

Table 3.1 presents selected descriptive data for the Moullela and Galmi systems. Moullela has a smaller command area and fewer parcel holders than Galmi. Given the difference in size, it is not surprising that the perimeters have different numbers of ONAHA staff. At Moullela the perimeter director is the only ONAHA agent in residence. At Galmi, however, there are two training and extension agents and an engineering and maintenance agent, in addition to the perimeter director. In addition, a UNC paid accountant/manager works at the cooperative.

Both Moullela and Galmi are gravity flow systems that use water stored in dams for supplemental rainy season and full dry season irrigation. In Moullela, irrigation water reaches individual fields by passing through control structures into field channels. In Galmi, siphons are used to draw water from earthen canals into field channels.

The cropping patterns on the two perimeters are similar at present. During the 1986 rainy season farmers grew cotton on one half of their parcels and millet or sorghum on the other half. The grain to cotton ratio at Moullela depends on a crop rotation pattern that has been in existence for a number of years, but which was modified slightly a few years ago. Now half of each

TABLE 3.1
SELECTED DESCRIPTIVE DATA FOR MOULLELA AND GALMI PERIMETERS

ITEM	Perimeter MOULLELA	GALMI
Date of First Operation	1967	1983 - 1984 (Dry Season)
Hectares Irrigated:		
Wet Season, 1985	62.6	242
Dry Season, 1985-86	11	241
Reservoir Bottom	20	NA
Number of Farmers	124	854
Main Crops:		
Wet Season, 1984	Sorghum, Millet, Cotton, Beans	Sorghum, Millet, Beans
Dry Season, 1985-86	Onions, Corn	Onions, Wheat, Corn
Reservoir Bottom	Onions, Wheat, Corn Sweet Potatoes, Tomatoes, Okra, Squash	NA
Wet Season, 1986	Sorghum, Millet, Cotton	Sorghum, Millet, Cotton
Redevance (CFA/ha.)		
Wet Season, 1985	32,280	30,500
Dry Season, 1985-86	15,170	22,000
Percent Recovery of Redevance (through end of wet season, 1985)	100%	67%

Source: Interviews, and Roger Briend (personal communication).
NA: Not Applicable.

parcel is planted in grains, rather than only a third. Cotton was grown at Galmi for the first time in 1986. Farmers could choose between sorghum and millet for the other half of their parcels. In previous years, the main wet season crops were sorghum and millet. Onions, wheat, and corn are the dry season crops on both perimeters.

Moullela is an older perimeter than Galmi (Table 3.1). Siltation is a problem at Moullela; this is also true of other small dams in the Maggia Valley (Wells, 1985). Although flood recession agriculture is practiced on most of the reservoir bottom, the command area is drastically reduced in the dry season. There is some question as to how many more years dry season cropping will be viable at Moullela (Briend, personal communication). Water availability and siltation do not presently pose a problem at Galmi.[6]

A certain amount of temporary parcel reallocation takes place at Moullela during the dry season to accommodate parcel holders who are willing and able to cultivate within the reduced command area. Some farmers leave their parcels in order to work in Nigeria, but the majority remain. High onion seed prices may prevent some farmers from growing onions. A few non parcel-holding farmers are allowed to plant on the perimeter during the dry season. Arrangements are made either by farmers and approved by the perimeter director, or through the perimeter director and/or the management committee. Non-perimeter parcel holders who farm on the perimeter are charged their proportional (per hectare) share of the redevance.

Parcel changes also take place in Galmi, but in a different manner and for different reasons. Non-perimeter holders are allowed to farm on the perimeter in the dry season for the stated purpose (according to ONAHA staff) of increasing access to irrigated land. High labor requirements for onion cultivation are another reason for reducing plot size. Farmers with more than one parcel have to give up part of their parcels to other farmers. Besides the officially recorded dry-season parcel reassignments, some farmers make private arrangements. In some

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[6] The exception to this generalization about Galmi is that there are times when the tail of the system (GMP 25) does not receive enough water during the dry season. This is due to a secondary canal which should carry 40 lps. according to design, but which for some reason, was installed as a 30 lps. canal.

instances this leads to problems in redevance recovery.

Under officially recorded transactions, each party is responsible for his proportional share of the redevance, although there is some ambiguity over who is supposed to give it to the GMP head. Under private arrangements however, the parcel holder is responsible for the redevance, whether or not he receives it from the other farmer.

The two perimeters have different rates of redevance recovery (Table 3.1). Some Galmi farmers have not paid their redevance since the establishment of the perimeter. At Moullela payment is not considered a problem.

Further differences in farmer behavior on the perimeters were noted at the beginning of the 1986 rainy season. In general, agricultural tasks were completed earlier and more promptly at Moullela. The first rains did reach Moullela before Galmi, which would explain the fact that planting, weeding, and successive tasks would take place later at Galmi. A relative shortage of oxen and plows in Galmi partially explains observed delays in plowing there. Irrigation furrows were reinforced sooner and more adequately at Moullela, and canals were cleaned in anticipation of irrigation. Galmi canals remained full of vegetative growth, and irrigation furrows were only partially reinforced at the beginning of August.

Farmers on both perimeters complain about others irrigating out of turn or excessively, but it was difficult to assess these claims, given the time frame of the field work. Water scarcity is a problem on two of Galmi's GMPs; this was corroborated by numerous individuals, including ONAHA staff, who say that this problem is a design fault rather than a "people problem" (see footnote no.6).

Some Moullela farmers complain about a mass expulsion of farmers that took place in 1974. This sanction was supposed to have been leveled at farmers who did not pay their redevance. A few say that certain individuals did pay, but lost their parcels anyway as a result of actions taken by individuals who

subsequently ended up with land that had been farmed by the excluded farmers. Moullela farmers did not complain about the process of original parcel allocation. Such complaints were heard in the villages served by the Galmi perimeter (see Chapter Seven).[7]

One can attribute some differences between the perimeters to the larger number of irrigators at Galmi, and to the fact that years of experience may have led to local arrangements that allow somewhat smoother operation at Moullela. Clearly both perimeters are operating; however, auto-gestion is not fully realized.[8]

Before examining some of the socioeconomic factors that may affect perimeter management, a brief description of the agricultural cycle on the perimeters is presented in order to provide a context for the subsequent discussion.

[7] Complaints about land allocation on perimeters have been recorded in other areas. See, for example, Republique du Niger (1985:18).

[8] See Laucoin (1971, 1973) for an early discussion of factors constraining auto-gestion.

Chapter Four
THE AGRICULTURAL CYCLE

CROPS

The agricultural cycle includes two cropping seasons. During the rainy season, farmers grow rainfed millet, sorghum, cotton, and beans outside the perimeter. Millet, sorghum, and cotton are grown with supplemental irrigation on the perimeters. Some farmers grow mangos, lemons, and root, fiber, and vegetable plants, in enclosed gardens. To irrigate, they draw water from dug wells with a calabash. Farmers who can afford onion seeds and who can mobilize the necessary labor grow wet season onions outside the perimeters.

During the dry season, farmers grow onions and wheat or corn on the perimeters. Sweet potatoes, okra, squash, and beans are grown on the exposed bottom of the Moullela reservoir. Onions, fruit trees, and some vegetables are grown with calabash irrigation in gardens. A second crop is not possible on rainfed parcels, with the exception of a limited amount of very moist fadama land.[9]

AGRICULTURAL TASKS: SEQUENCE, DURATION, AND PEAK LABOR REQUIREMENTS

This section presents a description of the agricultural calendar with reference to labor requirements. It shows that the period of planting and weeding, from mid-June through August, is a time of concentrated labor requirement. Periods of high labor demand on the perimeter may conflict with other household labor needs.

Farmers with irrigated parcels must coordinate work on their rainfed parcels with perimeter tasks, which follow a schedule fixed by the perimeter directors. Certain tasks which are not necessary on rainfed land, such as plowing and furrowing, must be

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[9] Fadama land refers to moist alluvial soil in valley floors with a high water table.

performed on the perimeter. Tables 4.1 and 4.2 present illustrative interview data on time spent on selected activities.

TABLE 4.1
REPORTED LABOR ALLOCATION BY TASK ON IRRIGATED LAND:
SELECTED CASES FROM GALMI AND MOULLELA
(in Worker Days)

	TYPE OF IRRIGATED PARCEL, CROP(S), AND AREA			
	Wet Season		Dry Season	
Task	Sorghum and Beans, 0.5 ha.	Cotton 0.5 ha.	Wheat 0.125 ha.	Onions 0.125 ha.
Clearing Soil	3	NA	3	3
Plowing	3	NA	NA	NA
Planting	9	4	3	18
First Weeding	9	14	5	18
Second Weeding (or further weeding)	6	19	0	10
Irrigation	1	NA	(8 for both)	
Harvest	20	59	8	18
Tying (Sorghum)	4	0	0	0
TOTAL	55	96	23	71
Working days/ha.	110	192	184	568

NA=Not Available.
Source: Farmer Interviews.

TABLE 4.2
REPORTED LABOR ALLOCATION BY PLOT AND SOIL TYPE
FOR SELECTED TASKS AND CASES FROM GALMI AND MOULLELA
(in Worker Days)

Type and Area of Parcel	Weeding(s)	Harvest	Plot Total	Per Hectare Total
Rainfed Millet, 1.5 ha.	26	16	42	28
Rainfed Millet, 0.5 ha	8	5	13	26
Rainfed Millet on Sandy Soil, 0.5 ha.	8	2	10	20
Rainfed Millet on Fadama Soil, 0.25 ha.	15	3	18	72
Irrigated Millet 0.25 ha.	16	10	26	104

Source: Farmer Interviews.

Labor allocation reported by farmers differs by crop on irrigated parcels (Table 4.1) and, for a given crop, depending on soil type (Table 4.2). It must be stressed that these data come from interviews with selected farmers, and refer to their specific conditions; the information is meant to be illustrative. The irrigation time for sorghum and cotton may be closer to 3 to 4 worker days/ha. (see Norman, 1987). Norman (personal communication) suggests that the total worker days/ha. for sorghum is slightly overestimated, the cotton figure underestimated, while dry-season onions take 350 to 400 worker days/ha. The irrigation time for sorghum and cotton may be closer to 3 to 4 days/ha. per wet season. A narrative overview of the sequence and timing of major tasks will further clarify the significance of labor requirements.

The Rainy Season

Preparation for the rainy season begins in June, when farmers clear rainfed parcels and dry-plant sorghum and millet in anticipation of the first rains. Dry-planting refers to the practice of planting seeds in dry soil just before the beginning of the expected rainy season. If the rains are insufficient or late the seeds may not all germinate; if there is flooding, seeds may rot.[10] Thus, selective re-planting is often necessary. Beans are often planted between the rows of rainfed millet or sorghum. In Moullela, farmers plow rainfed cotton plots. In general, however, rainfed land is not plowed.

According to ONAHA directives, parcels on the perimeters must be cleared and plowed. Farmers who do not own oxen and plows need to pay those who do to get the work done. Due to a shortage of oxen in Galmi, plowing continued into mid July, 1986, in some parts of the perimeter. After plowing, farmers wait for the first rains to plant. Dry-planting on the perimeters is

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[10] Most farmers interviewed at Moullela and Galmi reported treating their millet and sorghum seeds with fungicide to prevent mold.

discouraged by ONAHA agents, who argue that too much seed is lost this way. Many farmers on both perimeters say they would prefer to dry-plant without plowing on the perimeter, to reduce costs and labor requirements.

This is clearly a period of high labor demand, particularly for farmers with both rainfed lands and perimeter parcels, and farmers with larger total holdings, since work must be accomplished everywhere at once. Galmi and Moullela farmers found it difficult to finish their planting both on their outside parcels and on the perimeter, within the time frame recommended by ONAHA personnel. Some farmers reported hiring labor in order to meet the perimeter directors' schedule; these farmers must have had access to cash to pay wages.

Labor requirements remain high through the weeding period, which extends from July to September, depending on the timing of planting and rains. Millet and sorghum are weeded at least twice, both on and off the perimeters. Beans are weeded after the cereal crops. Cotton must be thinned and weeded. Yields are highly responsive to weeding.

The rainy season harvest is also a period of high labor demand, but farmers claimed it was less critical than planting and weeding. The millet and sorghum harvest begins in mid- to late August, continuing through late October. Certain varieties planted on rainfed land are harvested later. Beans are harvested for about a six week period starting in mid-September. Cotton is harvested four to six times between October and mid-December. The different growing periods associated with each crop, together with staggered planting dates and microclimatic differences between parcels may allow the harvest to take place with somewhat less pressure than planting and weeding. Farmers who plant wet season onions, however, face additional labor requirements.

Changes in the cost of hired labor reflect periods of peak labor requirements. Farmers in Galmi reported that laborers were being paid 1,500 CFA per day for weeding during the 1986 wet season. They noted that the price would go down to 1,000 CFA per

day for harvesting and packing. Labor is more expensive in Galmi than in Moulella, where day laborers typically make 500 CFA plus two meals (worth about 150 CFA).[11]

Farmers who can afford to hire labor must balance increased labor costs against anticipated yields. Farmers without the cash to hire labor are largely constrained by household labor availability.[12] Land-short villagers may obtain substantial income during the weeding period by hiring themselves out.[13]

The Dry Season

Soil preparation for the dry season begins as early as October, following the harvest. After clearing and plowing, farmers make beds with raised edges for their onion plants; they then plant wheat or corn and onions. Onions are transplanted from nursery plots begun over a month earlier. Some farmers have their own nurseries; others buy the seedlings. Either way, onions require considerable labor and cash investments. According to one estimate, one hectare of irrigated onions requires 660 person-days of labor (GERSAR, 1981). Galmi farmers usually plant 0.125 ha. (half a parcel) of onions, which would require 82.5 person-days, following the GERSAR estimates.

After transplanting, onions must be weeded. Wheat is also weeded during this period. Harvesting onions includes several

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[11] During the period of research, the exchange rate averaged 360 Francs CFA per $1.00 U.S.

[12] Labor may also be mobilized through gayaa, a traditional form of community labor organization. In addition, close relatives and friends frequently exchange labor. However, it has been suggested (USAID, 1984) that these forms of labor mobilization occur more frequently on rainfed land than on irrigated parcels. Cases of gayaa and labor exchanges were observed on the perimeters during field work. This is an issue that deserves further study in order to determine whether there are systematic differences in labor mobilization patterns between rainfed and irrigated land.

[13] This fact is often ignored by economists and development planners in discussions about the benefits of introducing labor-saving technologies.

operations. The onions are picked, and the leaves are cut, wrapped into bunches, and dried. Most farmers sell their onions immediately after the harvest.

Farmers without pressing cash needs and who have access to storage facilities can store onions and sell them later on at prices of up to ten times the price at harvest. Onions harvested before maturity cannot be stored as long as fully matured ones, which may be stored from five to seven months. Briend (personal communication) notes that many farmers on both perimeters harvest onions before full maturity. This may be due to labor constraints experienced at the wheat and onion harvest. Harvesting before maturity is probably more common among farmers who sell their onions immediately to meet cash needs.

The dry season harvest is generally over by the end of March. During April and early May farmers repair their tools and homes. And of course they continue to perform the various off-farm activities they have engaged in throughout the year. In late May the cycle begins again.

Chapter Five

LABOR AND PERIMETER MANAGEMENT AND OPERATION

Irrigation perimeter management and operation is affected by hydrological, engineering, climatological, agronomic, economic, sociological, and cultural factors. Sociological analysis of irrigation systems implies the examination of economic and social influences on production to describe elements that affect perimeter operation. Three broad elements have been selected for analysis in this report: (1) labor, (2) differential access to cash, land, and other productive resources, and (3) issues of power as related to land tenure and property, control over agronomic practices, decision making and the cooperative and management committee, and ONAHA's role in perimeter management.[14] The first is discussed in this chapter, the second and third in the chapters which follow.

POTENTIAL HOUSEHOLD LABOR

Demographic variables such as total household size and household composition by age and gender determine household labor availability, and therefore have a significant impact on agricultural production of any kind. Labor requirements for irrigated agriculture are higher than for rainfed production because additional tasks are required: plowing, field channel construction, canal cleaning, and irrigating. Also, tasks like weeding require more time under irrigated conditions. Insufficient household labor means limiting the area cultivated, hiring labor, or mobilizing labor through other means.

Agricultural activities on Moullela and Galmi perimeters are performed primarily by men and boys. Children begin working on their elders' fields at the age of seven or eight. Women participate in the cotton harvest, but their contribution to

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[14] Appendix 1 describes the methodology employed in this research.

other agricultural work is indirect and includes preparing and carrying food to men and boys working in the fields. Therefore the number of males of age eight and over can be used as an rough indicator of available household labor for irrigated agriculture.

Data collected on a series of variables related to household size and composition show that the modal household consists of a male head of household, an additional zero to two males eight years or older, one to two women over the age of seven, and two or three children under seven years of age.[15]

Males over the age of eight are defined as potential workers or active males. Table 5.1 shows the distribution of potential working males per household:

TABLE 5.1
DISTRIBUTION OF NUMBER OF POTENTIAL WORKING MALES PER HOUSEHOLD
(Number of Households)

	Number of Males Per Household							
	1	2	3	4	5	6	7	8
Number of Households								
Galmi	6	9	9	6	2	0	2	1
Moullela	1	9	10	5	2	2	-	-
Total	7	18	19	11	4	2	2	1

Source: Survey data.

The majority of households (especially in Moullela) have two or three active males. Assuming a six-day work week, a household with two active males has fifty-six theoretically available worker days per month, and a household with three active males has eighty-four. However, potential labor supply is also

[15] For research purposes, the household was defined as including those individuals with whom the respondent usually lived, ate, or pooled resources. At minimum, Hausa households generally include a male head of household, one or more wives, and unmarried children. In many cases married sons (and their wives and children) remain in the father's compound, and share certain resources in common. Other relatives may also be present. See Horowitz, et al. (1983:27) for further background on definitions of households in Niger.

affected by the (1) timing of tasks, (2) total area of land cultivated, (3) labor actually allocated to agriculture, and (4) the importance of other activities that comprise the household livelihood.

LABOR, LAND DISTRIBUTION, AND THE AREA UNDER CULTIVATION

As noted earlier, planting and weeding are ideally performed on a number of plots at once. Available worker days may be sufficient to work any one household plot, but insufficient to work a number of plots. Accurate measures of total landholdings would be necessary to fully evaluate labor constraints. Gathering such data was beyond the scope of this study. However, data were collected on the area of irrigated land and on the number and type of rainfed plots held by respondents. While in the case of rainfed land the number of plots does not correspond directly to land area, the data give a rough indication of the extent and types of land that draw the farmers' labor. These data can be used in conjunction with data on labor committed for specific tasks to estimate the minimum number of worker-days allocated to cultivate a set of parcels with a given area.

Perimeter Parcels

Table 5.2 shows the distribution of parcels per household for perimeter parcel-holders in Moullela and Galmi.

TABLE 5.2
DISTRIBUTION OF IRRIGATED PARCELS TO WHICH RESPONDENT HAS TITLE
(Number and Percent of Respondents)

Number of Parcels	GALMI (N=31)		MOULLELA (N=29)	
	Number	Percent	Number	Percent
1	29	83%	20	69%
2	2	17%	7	24%
3	-	-	-	-
4	-	-	2	7%
	31	100	29	100

Source: Survey data

Most of the perimeter parcel-holding households sampled have one perimeter parcel. In Galmi, 17 percent of respondents have two irrigated parcels, while in Moullela, the corresponding figure is 24 percent. Two farmers in Moullela reported having four perimeter parcels.[16]

Total irrigated land holding size varies within the perimeters. On the whole, Moullela farmers have larger areas of irrigated land than those on the Galmi perimeter. Furthermore, the distribution of irrigated holding size is wider at Moullela than at Galmi (Table 5.3). For these reasons, the per-household labor requirement for perimeter parcel holders also varies.

TABLE 5.3

DISTRIBUTION OF IRRIGATED LAND AREA, BY PERIMETER
(Number and Percent of Respondents)

Irrigated Area (ha.)	GALMI (N=31)		MOULLELA (N=29)	
	Number	Percent	Number	Percent
0 - 0.25	23	66%	2	7%
0.26 - 0.50	10	28%	11	37%
0.51 - 0.75	2	6%	6	20%
0.76 - 1.24	-	-	3	10%
1.25 - 1.50	-	-	4	14%
1.51 - 1.67	-	-	3	10%
	31	100	29	98

Note: Percentages do not add to 100 due to rounding error.
Source: Survey data.

Differences in irrigated holding size can be partially explained by the different guidelines followed in parcel attribution on the two perimeters. In Galmi between one and three parcels of 0.25 ha. were allocated on the basis of previous landholding and family size (GERSAR, 1981). In Moullela parcels were allocated on the same principle, but with a different formula and no fixed increment of parcel sizes. Furthermore, as

[16] Six of the sampled Moullela farmers with multiple parcels have one on the Galmi perimeter as well.

noted above, Galmi has been operating for a shorter time period. While most farmers in Galmi are the original parcel holders, this is no longer the case in Moullela, where only thirty-one of the original parcel holders remain (see Norman, forthcoming, 1987). According to Norman (personal communication), in approximately 90 percent of the cases of farmers who lost irrigated parcels, the land was reallocated within the same family. Thus, the original attribution procedure provides only a partial explanation for the present uneven distribution of land at Moullela; parcels have also been subdivided among inheriting sons.

The conclusions to be drawn from Table 5.3 with respect to labor requirements are, first, that perimeter parcel holding households are not, by virtue of membership in a perimeter, likely to spend uniform time working on their parcels. Second, Moullela farmers have an average of twice as much irrigated land to cultivate. Third, given land distribution on the Moullela perimeter, calculations of average labor requirements for Moullela farmers as a group will hide wide variation between households.

Reservoir Parcels

In addition to parcels on the perimeter itself, Moullela parcel holders received title to a strip of land on the reservoir bottom, which is cultivated in the dry season as the water recedes. However, 55 percent of the Moullela respondents reported that they did not have parcels on the reservoir bottom (Table 5.4).[17] Moullela farmers who cultivate the reservoir bottom as well as irrigated parcels during the dry season will need more labor in comparison to those who do not farm on the reservoir bottom.

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[17] Norman (personal communication) suggests that some people began farming this land when the perimeter was built, while others did not. Those who began earlier have gradually expanded their holdings over the years. However, the process leading up to the unequal use of the reservoir bottoms is unclear and deserves further study.

TABLE 5.4
DISTRIBUTION OF RECESSION AGRICULTURE PLOTS USED IN THE MOULLELA RESERVOIR (N=29)

Number of Plots	Number of Respondents	Percent
0	16	55%
1	11	38%
2	2	7%

Source: Survey data.

Rainfed Plots

Farmers in the research area classify their rainfed plots according to differences in soil type, altitude, slope, and moisture. For this study rainfed land has been grouped into two broad categories: (1) fadama, low-lying land with moist soils which may flood during the rainy season, and (2) all other rainfed land (which farmers divide into at least four different categories). Data on the distribution of fadama and other rainfed plots are shown in Table 5.5.

TABLE 5.5
PERCENT DISTRIBUTION OF NON-IRRIGATED PLOTS BY TYPE OF LAND AMONG PERIMETER PARCEL HOLDERS
(Number and Percent of Respondents)

	Fadama				Other Rainfed			
Number	GALMI		MOULLELA		GALMI		MOULLELA	
of Plots	No.	%	No.	%	No.	%	No.	%
0	25	71%	15	52%	2	5%	1	3%
1	7	20%	8	28%	13	37%	5	17%
2	2	6%	2	7%	7	20%	7	24%
3	-	-	2	7%	6	17%	4	14%
4	1	3%	1	3%	3	9%	6	21%
5	-	-	-	-	3	9%	3	10%
6	-	-	-	-	1	3%	1	3%
10	-	-	-	-	-	-	1	3%
14	-	-	1	3%	-	-	-	-
25	-	-	-	-	-	-	1	3%
	35	100	29	100	35	100	29	98

Note: Percentages do not add to 100 due to rounding error.
Source: Survey data.

About half of the perimeter parcel-holding farmers in Moullela and 30% in Galmi have at least one fadama plot. The number of plots per household ranges from one to four in both samples. One Moullela farmer reported that he held 14 fadama plots; he is clearly an exception.

In contrast, the vast majority of perimeter-parcel holding farmers have several "other rainfed" plots. Only two respondents from Galmi and one from Moullela reported no "other rainfed" plots (Table 5.5). Eighty percent of Moullela respondents and 58 percent of those in Galmi have two or more rainfed plots. One Moullela farmer reported having twenty-five rainfed plots.

Gardens do not figure prominently as a category of land worked by sampled farmers with perimeter plots. Two Galmi parcel holders and four from Moullela report that they have gardens. The rest of the perimeter holders (94 percent of respondents in Galmi, 86 percent in Moullela) do not. Gardening is more prevalent among non perimeter parcel holders (see Appendix 2, Table VI).[18]

Household Size and Land Area

Cultivated land area may be primarily a function of household size or available labor (see Chayanov, 1966). In order to test whether this was the case among the samples from the two perimeters, the number of active males per household was crosstabulated and correlated against the irrigated area, number of rainfed plots, and number of fadama plots per household.

I found little evidence of a direct positive relationship between available male labor and irrigated area, and number of rainfed or fadama plots. The only positive and significant association (r= 0.44) was between the number of active males and number of rainfed plots per household in Galmi. The correlation

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[18] Further research might investigate whether this is a systematic pattern, and if so, explore the reasons behind this.

coefficient for these two variables for the two perimeters combined was r= 0.18.

These results are difficult to interpret given the lack of data on rainfed area. However, they do show that there is no strong positive linear relationship between available (male) labor and available indicators of land held by farmers on the two perimeters studied. A similar analysis for the Konni I perimeter showed a weak but significant correlation (r=0.30) for these two variables (République du Niger, 1985:18).

Horowitz, et al. (1983:47-51) review a number of studies and conclude that the distribution of landholding on a village level in different regions of Niger is unequal. They note that

> (o)ne of the contributing factors to the differentiation of rural farmers is the uneven access of farming units to land. Although there are few truly landless rural households, many households do not hold enough land to meet either food or cash needs from their farming activities alone (1983:47).

Thus, access to land in the research area--defined in terms of indicators of land holding and land use--also appears to be unequal, and not necessarily related to household size or available labor.

DISCUSSION OF LABOR AVAILABILITY

Labor available for irrigated agriculture and water management is a function of household labor, total irrigated holdings, and total rainfed land. Other factors such as off-farm activities and the capacity to hire labor also affect labor availability for irrigated agriculture. The vast majority of Galmi and Moullela farmers are engaged in a farming system in which irrigated parcels represent only one of various types of plots worked. Half of the Moullela farmers have one fadama plot and a plot in the reservoir, and the majority have at least two other rainfed plots, in addition to their irrigated parcel. In Galmi over a quarter of farmers have one fadama plot and the majority have at least one other rainfed plot.

In order to translate data on number of plots into an estimate of labor allocation for each individual household in the sample, we would need to know the actual area of land for each rainfed plot, as well as mean days of labor invested per unit area. Since these data are not available, we will estimate labor requirements on rainfed plots for the group as a whole by attributing average sizes to different types of plots. Informal interviews indicate that fadama plots vary in size from 0.25 to 0.75 ha., while other rainfed plots range from 0.2 to 3.0 ha. A reasonable estimate for a mid-range fadama plot is therefore about 0.5 ha., and 1.6 ha. for "other rainfed."

Based on these mid-range holding sizes, I have constructed two hypothetical case households for each perimeter (Table 5.6). Case 1 for each perimeter includes a fadama plot, case 2 does not; case 1 for Moullela includes a reservoir bottom plot. Table 5.6 suggests the total land area cultivated for households with mid-range holdings. The actual spread is probably far greater.

TABLE 5.6
ESTIMATED WET SEASON LAND AREA CULTIVATED PER HOUSEHOLD: CASE EXAMPLES

	Average Area of Cultivated Land (ha.)			
	GALMI		MOULLELA	
Type of Plot	Case 1	Case 2	Case 1	Case 2
Perimeter	0.25	0.25	0.50	0.50
Reservoir	-	-	0.08	-
Fadama	0.50	-	0.50	-
Other Rainfed	1.60	1.60	3.20	3.20
	2.35	1.85	4.28	3.70

Note: Case 1 includes fadama land while case 2 does not.
Source: Farmer Interviews.

Data were collected on labor investments on plots of known sizes in the course of the research, from a limited number of farmers (see Tables 4.1 and 4.2). The GERSAR (1981) pre-project study for the Galmi perimeter includes the results of a labor allocation study for a number of crops on rainfed and irrigated land. By incorporating these data into the four cases shown in

Table 5.6, it is possible to calculate the number of working days these households hypothetically invest in agriculture. This is carried out for the wet season crops.

For the purpose of these calculations, I assume that perimeter areas in Table 5.6 are devoted half to cotton and half to millet/sorghum, and that labor is fully and uniformly allocated over a five-month rainy season. The interview data and GERSAR data are similar for irrigated crops, but the GERSAR data show a higher labor allocation on rainfed plots than the data gathered in this study.

The labor allocation values used for the calculations are

1. Irrigated Sorghum and Millet: 100 working-days/ha.
   (Source: Interview Results and GERSAR)

2. Irrigated Cotton: 192 working-days/ha.
   (Source: Interview Results)

3. Rainfed Millet, Fadama soil: 87 working-days/ha.
   (Source: Interview Results)

4. Rainfed Millet, Other soil:
   a) 40 working-days/ha. (Light weeding)
      (Source: Interview Results)
   b) 87 working-days/ha. (Heavy weeding)
      (Source: GERSAR).

Incorporating these results into the data from Table 5.6 gives the results shown in Table 5.7. It must be noted that the total working-days per month are probably underestimated.

The following observations about <u>wet season</u> agriculture can be made based on the results in Table 5.7:

1. The first set of cases (light weeding) is based on interview results and therefore represents actual labor commitments. These figures reflect the <u>availability</u> of labor to the household, not a hypothetical fixed "labor requirement per unit area."

2. The difference between the GERSAR data and interview data on rainfed land indicates that labor input per unit area <u>can be highly variable</u>. We can assume that the GERSAR data represent a case where labor is utilized more intensively, possibly because of greater ability to mobilize labor from within the household,

TABLE 5.7
LABOR INVESTMENTS, WET SEASON AGRICULTURE
(COTTON AND MILLET/SORGHUM):
CASE EXAMPLES
(Number of Working-Days)

Type of Land	GALMI Case 1	GALMI Case 2	MOULLELA Case 1	MOULLELA Case 2
a) Light Weeding				
Perimeter	37	37	73	73
Fadama	44	-	44	-
Rainfed	64	64	144	144
Total	145	101	261	217
Working-days/mo.	29	20	52	43
b) Heavy Weeding				
Perimeter	37	37	73	73
Fadama	44	-	44	-
Rainfed	115	115	230	230
Total	196	152	347	303
Working-days/mo.	39	30	69	61

Sources: Table 5.6 and labor allocation values presented above.

or to draw on cash resources to hire labor. The discrepancy might also be explained by different soil and water conditions. However, the overall conclusion, that there is great potential variation in labor input per unit area depending on labor availability and cash costs, still seems valid.

3. Total labor allocation to perimeter plots is relatively constant in the two sources of data (GERSAR and interviews), while the actual (based on interviews) labor commitment to rainfed land is much lower that that given by GERSAR. While this may simply be a function of the higher labor intensity required on the perimeter for a given crop, it also suggests that, in the research area, labor may be preferentially committed to the perimeter plots. That is, labor allocated to the perimeter is relatively constant, but labor allocated to rainfed land may fall with declining labor availability.

These preliminary results indicating preferential labor allocation to perimeter plots may reflect (1) the greater reliability of perimeter agriculture in relation to rainfed agriculture (at least during drier years), or (2) the closely supervised nature of perimeter agriculture, or (3) the need for cash from cotton and onions, or (4) the relatively higher labor intensity of certain perimeter crops such as cotton and onions (although cotton is also grown on rainfed plots and onions are grown in gardens, or (5) all of the above. In order to provide irrigation planners with adequate baseline information, further research should address the question of how households respond to different levels of labor availability, especially with respect to allocation choices between rainfed and perimeter agriculture. The relationship between whether a given year is "good" or "bad" with respect to rainfall, and labor allocation between perimeter and rainfed land should also be investigated. It is possible that on "good" years, farmers try to spend relatively less time on the perimeter since their marginal product on rainfed land would be higher than on a "bad" year, when it might be more economical to concentrate on getting a good harvest from the perimeter.

4. With respect to the actual working days, the case of light weeding (I), the data in Table 5.7 show that monthly labor investment ranges from 20 and 29 days per month in Galmi, to 43 and 52 days per month in Moullela. (Note again that these ranges reflect actual labor committed.) We can conclude that one adult male could cultivate the set of Galmi parcels, but that two adults, or one adult and two children, would be required for the set of Moullela parcels.

In the set of cases of heavy weeding (II), monthly labor requirements (now potential rather than actual) would range from 30 to 39 working days in Galmi; this could be accomplished by an adult and a child, or two adults for the second case). In Moullela the labor requirements would be 61 and 69 working-days,

which would require, for example, two adults and a child, or one adult and three to four children.

These represent typical or average cases for Galmi and Moullela. As the data on land distribution show (Table 5.6), the actual range is greater than given by these cases; many households farm larger areas of land. The problem of matching total available labor in a given area to unequally distributed land leads to the utilization of institutions of labor exchange (hiring labor, kinship networks, etc.); this may represent a bottleneck that can constrain marginal labor productivity in any smallholder agricultural system.

5. The proportion of agricultural working-days allocated to the perimeter in the wet season are given in Table 5.8.

TABLE 5.8
PROPORTION OF TOTAL AGRICULTURAL LABOR
ALLOCATED TO THE PERIMETER, WET SEASON

	GALMI		MOULLELA	
	Case 1	Case 2	Case 1	Case 2
I. (Actual)	26%	37%	28%	34%
II. (Potential)	19%	24%	21%	24%

Source: Table 5.7.

The majority of working time is allocated not to the perimeter, but to rainfed land. This implies that during the wet season, perimeter agriculture is not the primary component of the household production strategy, at least in terms of labor committed. These results refer to the wet season, and therefore do not necessarily imply that income from or total household labor allocated to the perimeter is correspondingly small. Some farmers are able to make a relatively large income from cash crop agriculture on the perimeter, particularly during the dry season (see Chapter Six).

ACTUAL LABOR ALLOCATED TO AGRICULTURE, BY GENDER

Table 5.9 summarizes the aggregate survey data on potential labor available versus actual labor allocated to agriculture by gender, for each perimeter.

TABLE 5.9
POTENTIAL AND ACTUAL LABOR ALLOCATION
FOR MALES AND FEMALES EIGHT YEARS OF AGE AND OVER
(Number and Percent of Males and Females)

	MOULLELA (29 Households)	GALMI (56 Households)
MALES		
Potentially Available Males	85	107
Males Actually in Agriculture (at least part-time)	79	82
Percent of Total Males not in Agriculture	7%	23%
FEMALES		
Potential Available Females	66	140
Females Actually in Agriculture (not necessarily full-time)	37	91
Percent of Total Females not in Agriculture	44%	85%

Source: Survey Data.

Male Labor

Data on actual labor allocated to agriculture shows that the theoretically available labor of males over the age of eight is not allocated entirely to agriculture. Off-farm activities compete with agriculture for household labor.

A much greater proportion of available male labor is allocated to non-agricultural activities in Galmi than Moullela. In Moullela, 7 percent of active males are engaged full-time in non-agricultural activities, whereas in Galmi the corresponding figure is 23 percent. This difference is probably explained by the greater availability of alternative sources of income

generating activities in Galmi. The remainder (93 percent of active males in Moullela, 77 percent in Galmi) are engaged in agriculture on either a part-time or full-time basis. These figures include children whose labor contribution is not equivalent to that of an adult. Nevertheless, all of these males are counted as full-time male adult workers for the purpose of this study. This overestimates available male labor.

Female Labor

The data in Table 5.9 show that the proportion of females over seven years of age working in agriculture is significantly different for the two perimeters. Seventy percent of households in the Moullela perimeter subsample had one or two women performing some agricultural work (primarily in the cotton harvest). That is, 50 percent of the women over age seven in the Moullela subsample were involved in some kind of agricultural work. In contrast, only a little over one-quarter of Galmi perimeter households had one or more women engaged in some agricultural activity. Of the total number of females over age seven in this subsample, only 15 percent performed at least some agricultural tasks.

The higher proportion of women involved in agriculture among parcel-holding households in Moullela--as opposed to those from Galmi--may be due to the longer history of cotton cultivation in Moullela. There may also be a relationship between women's higher participation in agriculture and the apparent higher proportion of (male) labor migration in Moullela. Another reason behind this difference may have to do with wider opportunities for women to generate income through non-agricultural activities, in Galmi. Processing and/or selling food would be an example of such activities.

LABOR MIGRATION

Labor migration affects agricultural production by changing the extent and seasonality of available household labor and by

providing additional cash income. Migrants are often considered to represent labor that might otherwise be allocated to agriculture. However, insofar as labor migration is a kind of rite of passage that young men in rural areas practice to accumulate cash, it does not necessarily follow that this labor would just as easily be allocated to agriculture.

Data on the number of people usually considered to be part of the household, but who were currently absent and employed or seeking employment, show that migration is more prevalent in Moullela than Galmi (Table 5.10). This is corroborated by data

TABLE 5.10
NUMBER OF MIGRANTS PER HOUSEHOLD
(Parcel-holding Subsample)

	Number of Migrants per Household				
	0	1	2	3	Overall
Number of Households					
Galmi	19	6	7	3	35
Moullela	10	14	2	3	29
Percent of Households					
Galmi	54%	17%	20%	9%	100%
Moullela	35%	48%	7%	10%	100%
Total	29	20	9	6	

Source: Survey Data.

from the subsample of non-perimeter parcel holders: over 90 percent of the non-perimeter holding subsample in Galmi had no migrants, whereas in Moullela, 43 percent did not (see Table I, Appendix 2). The greater proportion of migrants in Moullela, for parcel holders and non-parcel holders alike, might be explained by the few options for cash generation there.

FARM VERSUS OFF-FARM ACTIVITIES

The survey results show that respondents with perimeter parcels engage in a variety of non-agricultural activities. Variables representing the respondents' primary and secondary activities were constructed based on answers to questions about

time spent on different activities (Table 5.11). (Note that the activities of the male head of household are listed, not the activities of other household members.) These data illustrate differences in the importance of agriculture as a primary activity in Moullela and Galmi.

TABLE 5.11
PRIMARY AND SECONDARY
ECONOMIC ACTIVITIES OF PERIMETER PARCEL-HOLDING RESPONDENTS
(Number and Percent of Respondents)

	Primary				Secondary			
	GALMI		MOULLELA		GALMI		MOULLELA	
	no.	%	no.	%	no.	%	no.	%
Agriculture	26	74	25	86	2	6	1	3
Agriculture and Livestock	1	3	2	7	10	29	16	55
Local Non-Ag. Wage Labor	3	9	-	-	4	11	-	-
Migrant Wage Labor	-	-	-	-	3	9	2	7
Agricultural Wage Labor	-	-	-	-	2	6	3	10
Commerce and Trade	3	9	1	3	4	11	2	7
Petty Commerce	1	3	-	-	2	6	1	3
Mechanic	-	-	1	3	-	-	1	3
Blacksmith	1	3	-	-	1	3	-	-
Butcher	-	-	-	-	2	6	-	-
Trucker	-	-	-	-	1	3	-	-
Baker	-	-	-	-	-	-	1	3
No Secondary Occupation					4	11	2	7
	35	101	29	99	35	101	29	98

Note: Percentages do not add up to 100 due to rounding error.
Source: Survey data

We can conclude from the data in Table 5.11 that agriculture is the dominant primary activity for farmers on both perimeters, but it is relatively more important at Moullela. Other primary activities include commerce/trade and mechanical repairs at Moullela; and commerce/trade, petty commerce,[19] non-agricultural wage labor, and blacksmithing, at Galmi. Second, most farmers on both perimeters are engaged in a range of secondary activities, many of which are not agricultural. A higher proportion of respondents at Galmi are engaged in secondary activities that do not include agriculture or livestock than at Moullela.

CONCLUSIONS AND QUESTIONS FOR FURTHER RESEARCH

In summary, labor requirements per unit of land for irrigated agriculture are higher than for rainfed production. Insufficient household labor means limiting the area cultivated, hiring labor, or mobilizing labor through other means. The majority of households on both perimeters include two to three potentially active working males, which translates into fifty-six to eighty-four working days per month. This labor is allocated primarily but not entirely to agricultural activities.

Labor allocated to agriculture is only partly a function of the total area cultivated. The relationship between available male labor and irrigated land area or number of rainfed plots per household was found to be negative or weak for the two perimeters.

Land is not evenly distributed among sampled farmers; this is true particularly of irrigated land in Moullela, but also holds for the distribution of the number of rainfed plots. With respect to irrigated land, there are also differences between the two perimeters; on average, farmers in Moullela cultivate twice as much irrigated land as in Galmi (but the number of available males per household is roughly similar the perimeters).

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[19] Petty commerce refers to selling anything from cigarettes and chewing gum to batteries, mosquito coils, and cans of tomato paste, from a small roadside table.

Furthermore, reservoir bottom land (available only in Moullela) is only used by about one-half the sampled farmers.

This suggests that the distribution of total area cultivated per household (rainfed and irrigated) on each perimeter is unequal. Unequal land distribution implies that the labor necessary to cultivate a set of plots will vary from household to household. That is, households do not face uniform labor demands. The relevance of this issue to water management is that farmers on a perimeter will have different priorities for allocating labor, based on differential access to land and labor. Coordinating their activities may be problematic.

Calculations based on reported labor allocation to various types of plots and estimates of total land area suggest that during the rainy season, a greater proportion of labor is allocated to rainfed plots than to irrigated plots. That is, working irrigated plots is only one part of the overall household livelihood strategy, and is balanced against utilization of other land resources. The data suggest that the labor per unit area allocated to perimeter cultivation is relatively constant, while labor per unit area allocated to rainfed agriculture may vary considerably from household to household.

A higher proportion of male labor is allocated to non-agricultural activities among Galmi parcel holders than among those from Moullela. This may be due in part to the greater opportunities for non-agricultural labor in Galmi, which is situated on the main road, and perhaps also by the smaller average land area held by Galmi households. A higher proportion of females in parcel-holding Moullela households participate in agriculture than in Galmi. This is primarily a function of the longer history of cotton cultivation in Moullela.

Labor migration is more prevalent among Moullela perimeter holders than those from Galmi. This is probably due to the

relative lack of non-agricultural work for young males in Moullela.[20]

Agriculture is the dominant primary activity among respondents from both perimeters, but especially in Moullela. Farmers on both perimeters, however, do engage in a range of additional activities. Secondary activities for Galmi parcel holders include a greater proportion of cash-generating occupations outside of agriculture and animal husbandry than for Moullela parcel holders.

[20] The lower rates of labor migration in Galmi may be related to the proximity of the Nigerian border. Men from Galmi can make shorter, more frequent trips, which are not defined as exode (labor migration), but which would preclude other (agricultural) activities and would represent a source of cash income.

Chapter Six

INCOME, LAND, OTHER PRODUCTIVE RESOURCES, AND MATERIAL INDICATORS OF POTENTIAL RESOURCE MOBILIZATION

Farmers' incomes (cash or in-kind), land, and other productive resources such as animals, tools, and equipment, influence agricultural production in general, and irrigated agriculture in particular. Different levels of income and other resources may translate into differences in investment in fertilizer, costly seeds such as onions, or labor, and consequently into differences in total production.

Most irrigation schemes in Niger are managed with the idea that farmers will complete tasks according to a uniform schedule. In this way an entire crop will receive maximum benefit from any given irrigation by virtue of being at the same stage of growth and water requirement. Underlying this model of perimeter operation is the implicit assumption that all farmers on a given perimeter are equally able to mobilize resources for agriculture.

For example, the expectation that all farmers on a perimeter will weed by a certain date assumes they can either use their own and family labor, or hire the necessary labor, all within a limited time period. Even if we assume an adequate overall labor supply, it is not evident that individual farmers can uniformly mobilize labor--whether hired or not.

Not all farmers can mobilize the same levels of resources, whatever the resource. This <u>variability</u> alone may account for apparent performance differences and be a crucial influence on perimeter operation. It is therefore important to examine the distribution of resources among farmers associated with a given perimeter. Unequal distribution of resources indicates a gap between resource-rich and -poor farmers. The wider the gap the more difficult it may be to coordinate activities among a group of farmers. Variables indicating differences in potential resource mobilization are discussed in this chapter.

CASH

The availability of cash and its timing determine farmers' ability (1) to hire labor during periods of peak labor demand, (2) to purchase adequate inputs when needed and pay the redevance, (3) to invest in animals, equipment, and other productive resources, (4) to store a portion of the crop (e.g. onions) for later sale at a higher price or for consumption, rather than selling immediately to pay outstanding debts or bills, and (5) to purchase consumption and other goods. Payments received in-kind may be sold for cash or retained for consumption or future sale.

Farmers generally obtain cash not only from agriculture, but by engaging in non-agricultural work. They may also receive cash from other household members who earn cash. Data on total cash income were not collected, but information on participation in cash-generating activities can serve to indicate variability in access to cash--and by logical extension, differential resource mobilization potential. Cash available from agricultural production is discussed separately.

Cash-Generating Activities

As noted in Chapter Five, Moullela and Galmi farmers are engaged in a variety of activities, many of which generate cash faster and with greater regularity and reliability than agriculture. Table 6.1 shows that, although most farmers on both perimeters allocate their time to more than one productive activity, a higher proportion of respondents from Galmi have primary as well as secondary activities which generate cash directly.[21] While these data refer only to the respondent, the data in Table 6.2 present information on all household members engaged either full- or part-time in a cash-generating activity.

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[21] Livestock may also be considered a cash-generating activity. Animals such as sheep and goats are controlled primarily by women.

TABLE 6.1
RESPONDENT'S PRIMARY AND SECONDARY ACTIVITY,
BY PERIMETER
(Percent of Respondents)

	Primary		Secondary	
	GALMI	MOULLELA	GALMI	MOULLELA
Agriculture and Livestock (irrig. & rainfed)	77%	93%	35%	58%
Other: Cash-Generating	24%	6%	55%	33%
No Secondary Livelihood	-	-	11%	7%
	101%	99%	101%	98%

Note: Percentages do not add up to 100 due to rounding error.
Source: Table 5.11

TABLE 6.2
NUMBER OF HOUSEHOLD MEMBERS ENGAGED IN
CASH-GENERATING ACTIVITIES
(Number and Percent of Respondents)

Number of Household Members	Galmi		Moullela	
	Number	Percent	Number	Percent
0	5	14	5	17
1	6	17	8	28
2	11	31	6	21
3	4	12	5	17
4	6	17	4	14
5	2	6	1	3
7	1	3	-	-
	35	100	29	100

Source: Survey Data.

Table 6.2 shows that most farm households sampled from both perimeters include at least one member who is engaged in a cash-generating activity outside of agriculture and animal husbandry. Moullela respondents tend to have fewer cash-generating members per household. For each perimeter, the range for the number of

household members earning cash is wide. The presence of one as opposed to six or seven cash-generating household members suggests significant variability in access to cash among households in each perimeter.

Variability in the number of out-migrants per household ranges from one to three persons for farmers sampled from both perimeters (Table 5.10). This suggests another source of variability in access to cash among perimeter households.

INCOME FROM LAND

The amount of land cultivated by household members helps determine total agricultural production, which is a type of income. As noted, production may be used for consumption or it may be sold. Rainfed land may also be sold or rented to generate income.[22] Perimeter plots cannot be legally rented or sold, but farmers may lend all or a part of their plot during the dry season in exchange for redevance payment--which might be considered a form of rent.

Cotton, onions, wheat, and corn are the major cash crops grown in the study area. Farmers on the Galmi and Moullela perimeters grow some rainfed cotton, but cash crop production takes place primarily on the perimeters. Millet and sorghum are used primarily for consumption. The irrigated area worked by a farmer and his household is an indicator of the volume and value of cash crop production, and therefore, of income from cash crops.[23]

Data on land distribution (Tables 5.2 through 5.5), show considerable variation in the distribution of irrigated land on both perimeters. This suggests a wide gap in income from

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[22] Land may also be lent in exchange for part of the production, future reciprocal loans, or gifts.

[23] This assumes that differences in soil types, etc., are held constant.

irrigated agriculture between farmers with the smallest parcels and those with the largest.

Data on irrigated and rainfed agricultural production for nine cases from Moullela are shown in Table 6.3.

TABLE 6.3
SELECTED DATA ON AGRICULTURAL VALUE OF PRODUCTION,
FOR NINE MOULLELA FARMERS
1985-1986 AGRICULTURAL YEAR (CFA)

		NET VALUE OF PRODUCTION (Cash Crops)				
Farmer	House-hold Size	Perimeter Total (A)	A/C Percent	Rainfed Total (B)	B/C Percent	Overall Total (A+B=C)
1	11	52,850	62.4%	31,900	37.6%	84,750
2	6	71,380	72.5%	27,100	27.5%	98,480
3	3	82,815	66.6%	41,450	33.3%	124,265
4	8	59,890	44.8%	73,850	55.2%	133,740
5	8	124,285	84.1%	23,550	15.9%	147,835
6	10	92,550	49.2%	95,600	50.8%	188,150
7	7	113,225	51.1%	108,500	48.9%	221,725
8	7	389,085	78.7%	105,000	21.1%	494,085
9	14	436,150	70.55	182,750	29.5%	618,900

Net Value of Production was calculated by subtracting reported cash costs of production from total value of production for rainfed and perimeter production.
Total Value of Production figures were in turn calculated by multiplying reported quantity of production by price at harvest for each crop, and adding the values for each farmer, for rainfed and perimeter production.
Source: Farmer Interviews.

A gap of 383,300 CFA (US $1,095) between the lowest and highest net value of all perimeter production, and a gap of 534,150 CFA ($1,526) between the lowest and highest net value of total agricultural production (on and off the perimeter) indicates considerable variability in the income available from agriculture both on and off the perimeters for Moullela farmers.

Two general patterns are discernible from the data in Table 6.3. First, in general, as the net value of total agricultural

production increases, the net value of total perimeter production rises as well. Second, a greater proportion of the net value of production tends to be derived from the perimeter than from rainfed production (there are two exceptions). However, it must be emphasized that these data encompass an entire agricultural year, and that the dry season production on the perimeter accounts for a significant part of the difference in the net value of production between rainfed and perimeter land.

OTHER PRODUCTIVE RESOURCES

Draft animals and beasts of burden are also productive resources. Possessing a pair of oxen or a donkey eliminates the need to rent the former for plowing or the latter for transport. Other productive resources include tools (hoes, shovels, etc.) and equipment (plows, etc.). Bicycles can also be considered a productive resource in that they shorten the time it takes to go to a distant field. Data on the distribution of draft and transportation animals are shown in Table 6.4.

The table shows that a much higher proportion of farmers own oxen in Moullela than in Galmi. However, oxen ownership must be used with caution as an indicator of a productive resource for two reasons. First, the situation in both perimeters has been changing. Fifty-one farmers on the Galmi perimeter and twelvefrom Moullela (or six and ten percent of the total number of farmers on each perimeter, respectively) were in different stages of receiving pairs of oxen through a credit project financed by the European Development Fund (FED). After the distribution process is completed, the proportion of farmers owning oxen on each perimeter will increase. However, it appears that the relative difference between the perimeters will remain largely unchanged. Furthermore, while the distribution of the ownership of oxen within a perimeter will be somewhat less unequal, differences will remain.

TABLE 6.4
DRAFT AND TRANSPORTATION ANIMALS:
PERIMETER PARCEL HOLDERS
(Number and Percent of Respondents)

	Galmi		Moullela	
	Number	Percent	Number	Percent
Number of Oxen				
0	31	89	12	42
1	0	0	1	3
2	4	11	15	52
4	0	0	1	3
Number of Donkeys				
0	26	74	24	24
1	5	14	4	14
2	4	12	1	3
Number of Horses				
0	34	97	27	93
1	1	3	2	7
Number of Camels				
0	35	100	28	97
2	0	0	1	3

Source: Survey Data.

Second, at present, oxen distribution at Galmi is a function of the fact that farmers have sold a large number of oxen which had been purchased through the Caisse National de Crédit Agricole (National Agricultural Credit Bank), in many cases before repaying the loans. Informants said farmers used the money to buy younger draft animals (which would not have been coded as oxen in this study), to invest in other livestock, or to buy food during the drought.

Table 6.4 shows that the majority of farmers on both perimeters do not own horses or camels. Ownership of donkeys is slightly more common. A greater proportion of farmers at Galmi have donkeys than at Moullela. This is probably explained by the opportunities to make money transporting water in large metal drums from the well located at ONAHA headquarters to the main part of town--a distance of three kilometers.

Table 6.5 shows the distribution of bicycles among parcel-holders in the survey sample. Nearly a third of the Moullela respondents have one bicycle; in Galmi, only 11 percent do. None of the farmers in the sample reported owning more than one bicycle.

TABLE 6.5
BICYCLE OWNERSHIP: PERIMETER PARCEL HOLDERS
(Number and Percent of Respondents)

	Galmi		Moullela	
	Number	Percent	Number	Percent
Number of Bicycles				
0	31	89	20	69
1	4	11	9	31

Source: Survey Data.

The range of the distribution of oxen, donkeys, horses, camels, and bicycles is not very wide, but this does not signify equal distribution of these resources. The mere presence or absence of any one of these is significant, since they represent large initial expenditures. Recurrent maintenance costs are also associated with the animals. In conclusion, the data indicate considerable differences in potential resource mobilization among parcel holders <u>within</u> each perimeter. Certain differences, such as the proportion of oxen ownership, appear to be significant <u>between</u> the two perimeters.

MATERIAL INDICATORS OF WEALTH AND POTENTIAL RESOURCE MOBILIZATION

The material goods owned by a respondent and his household can serve as indicators of wealth and income, and of potential resource mobilization. Some of these goods can be considered indirect productive resources, such as livestock, while others, such as radios or metal beds, are consumer goods and not productive resources. Frequency distributions of these items can be used to identify groups of farmers with different levels of

resources, and with assumed corresponding differences in the resources they might invest in agricultural production.

Data were collected on the number of various material goods possessed by respondents. Certain items have been selected for discussion; their distributions are presented in Table 6.6 and Table 6.7.

These tables show that sheep and goats are unevenly distributed among parcel holding households on both perimeters. Sheep and goats also represent important economic investments. Females provide milk for consumption and sale; males are also slaughtered for major religious feasts. The distribution range is somewhat wider for Moullela respondents for both types of ruminants. The distribution of tables, radios, metal beds, and vehicles is also uneven for the two perimeters. Similarly, the range between the lowest and highest count of any given item is wider at Moullela than Galmi, with the exception of vehicles, which were not found among Moullela respondents.

TABLE 6.6
DISTRIBUTION OF SHEEP AND GOATS: PERIMETER PARCEL HOLDERS
(Number and Percent of Respondents)

	Galmi		Moullela	
	Number	Percent	Number	Percent
Number of Sheep				
0	21	60	7	24
1 - 2	7	20	7	24
3 - 4	5	14	7	24
5 - 6	1	3	3	10
9 - 12	1	3	3	10
21 - 22	0	0	2	7
Number of Goats				
0	13	37	6	21
1 - 2	5	14	6	21
3 - 4	8	23	3	10
5 - 6	4	11	5	17
7 - 9	4	11	0	0
10 - 14	0	0	6	20
20+	1	3	3	10

Source: Survey Data.

TABLE 6.7
DISTRIBUTION OF CONSUMER GOODS
(Number and Percent of Respondents)

	Galmi		Moullela	
	Number	Percent	Number	Percent
Number of Radios				
0	26	74	19	66
1	9	26	10	34
Number of Metal Beds				
0	11	31	10	35
1	15	43	6	21
2	5	14	6	21
3	2	6	3	10
4	2	6	3	10
6	0	0	1	3
Number of Vehicles				
0	34	97	0	0
3	1	3	0	0
Number of Tables				
0	28	80	24	72
1	6	17	4	14
2	1	3	2	7
3+	0	0	2	14

Source: Survey Data.

While it cannot be automatically assumed that all farmers spend the same proportion of income on material goods, their distributions can be taken as indicators of differential levels of potential resource mobilization. In other words, a farmer who owns a radio, several tables, and six metal beds probably has more resources to invest in agriculture than one who does not have a radio or a table, and has one metal bed. This does not necessarily mean that he will invest in agriculture in proportion to his wealth.

CONCLUSIONS

This chapter opened with the proposition that variability in the level of resources which can be mobilized and invested in agriculture may be an important influence on perimeter operation. This variability was documented by examining the distribution of numbers of cash-generating members per respondent's household, non-agricultural primary and secondary activities, irrigated land area, value of agricultural production, various productive resources, and finally, selected material goods.

Based on the unequal distribution of these variables among parcel holders on each perimeter, we can conclude that both Galmi and Moullela have "richer" and "poorer" farmers--cultivators who may not all be able to mobilize the same set of resources for production.

Establishing this fact, however, does not explain the extent to which irrigation development has produced or perpetuated these inequalities, nor does it explain what the precise impact of these differences is on perimeter management. With respect to the first problem, it is possible that at Moullela, the longer period of perimeter operation has allowed some farmers (probably those with higher initial levels of labor, cash, and land), to accumulate more resources than others, and to take better advantage of the benefits of perimeter production. In Galmi, however, the uneven (but not as wide) distribution of resources does not reflect accumulation allowed by the perimeter because the perimeter is recent. The distribution may reflect original differences in cash, labor, and land. It may also reflect ongoing resource accumulation based on activities other than irrigated agriculture.

The ways in which patterns of differential access to resources can affect perimeter operation deserve further research. Tentative information about this, based on informal interviews, suggests the following. Differential access to cash, labor, total land area, and other resources allows some farmers to complete perimeter tasks sooner and better than others, and perhaps to benefit more from irrigation. GMPs with

larger proportions of farmers who can do this may more effectively coordinate the timing of their activities. We can hypothesize that the more homogeneous a group of farmers is with respect to resource distribution (whether at the GMP or perimeter level), the easier it will be to coordinate their agricultural activities.

The issue of differentiation versus homogeneity of irrigation units may have important implications for _auto-gestion_. Is self-management more likely to succeed where groups of irrigators have more or less equal access to cash and labor, and the corresponding differences in status which accompany such variation? Implications of this issue are discussed in Chapter Eight.

Chapter Seven

POWER AND PERIMETER MANAGEMENT

The previous two chapters discussed ways in which the availability of labor, land, and cash may affect activities on the irrigated perimeters under study. But quantifiable resources such as these are not the only influences on perimeter operation and management. This chapter presents discussions of selected qualitative influences that affect perimeter management and operation. These influences have to do with power relationships of different kinds. The first two sections center around the government's power to establish property rights and control over perimeter land. The issue is explored through discussions of potential implications of farmers' attitudes about property for perimeter management, and of the role of village chiefs in land allocation. The next three sections focus on power relations between farmers and ONAHA staff. This issue is approached in discussions of control over agronomic practices, decision making and information flows, and ONAHA's role in perimeter management.

In addition to affecting present perimeter activities, these are issues which, along with the resource-based factors presented earlier, relate to the problem of auto-gestion or self-management--at present an important ONAHA policy objective. Assuming that self-management is based on some degree of farmer participation in management decisions, or at least widespread farmer approval of those actually making decisions, then a perimeter where farmers are fairly involved in, or pleased with the way activities are managed may have a better chance of attaining self-management. This chapter aims to draw out contradictions between the goal of self-management on one hand, and present power relations between farmers and local and national authorities and policy on the other.

LAND TENURE AND PROPERTY RIGHTS

Irrigation development implies a heavy financial investment in infrastructure and a modification of the land surface which is to be put under irrigation. It may also imply changes in existing patterns of land tenure and distribution, and in definitions of property. Both the manner in which these modifications are made in the course of building perimeters, and the arrangements set in place to maintain these modifications will affect perimeter management and operation.[24] There may be contradictions between the government mandate for auto-gestion and some of the institutional changes and arrangements made in the course of irrigation development.

The legal code in Niger (and many other countries) gives property rights to irrigation infrastructure over to the government in the case of government and/or externally financed irrigation development. In Niger, rights to and control over irrigated land also rest with the state. Thus the state can establish rules concerning property rights to irrigated land. These rules presently include the prohibition of land rental and sale on the perimeters. Such rules are geared towards preserving initial perimeter land allocation and preventing land concentration, and, less explicitly, towards controlling land use and farm management.

There is, however, a certain dissonance between state control of the land and a farmer's sense of property. A farmer who has a parcel in an area targeted for irrigation development will lose control over that parcel and in its stead receive a (usually smaller) perimeter plot. But in addition to a change in the area he can cultivate, the farmer experiences a change in the property rights he can excercise over his land (see Laucoin, 1971:54-55).

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[24] See Coward (1985) for a discussion of property as a critical factor in water management, and El-Kholy (1985) for a discussion on the same topic, based on an Egyptian case.

It may be argued that in the historical absence of private property in this region, any analysis of land tenure and property is of minor importance. But property cannot be equated with private property alone. While land may not have been held as private property (transferable, part of a land market, etc.,) it is clear from interviews that farmers in Galmi and Moullela conceived of the parcels over which they had use rights before the perimeters were built as their own land--just as they now consider that they own their rainfed land (Laucoin, 1971:54-55).

This conception changed dramatically with the creation of the perimeter. When asked who the irrigated plots belong to, most farmers on both perimeters answered "the government." Only a minority answered that they belonged to whomever they were allocated (see Table VI, Appendix 2). Some farmers who gave the first answer explained that the parcel was on loan to them by the government. Clearly, farmers' sense of property has undergone a transformation.

A relationship between stable land tenure and/or property rights in irrigation systems and productive investments and participation in system management and maintenance has been suggested. This may be attributed to the relationship betweeen property rights (or stable tenure) and higher degrees of control over agricultural practices and decisionmaking. The implications for self-management are clear. Farmers' rights to make decisions about how their land is cultivated and used are compromised by state regulations. Farmers' property rights are limited, and we can expect that their interest in self-management may be correspondingly limited.[25]

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[25] This is not to say that perimeter operation will necessarily be compromised, but that self-management may be. The more congruent government policy and control over irrigated land is with farmers' practices and resource constraints, the less this will pose a problem for perimeter operation and management. But farmers' differential access to resources must be kept in mind when evaluating policy effectiveness.

LAND ALLOCATION AND THE ROLE OF VILLAGE CHIEFS

In principle, land on both perimeters was allocated to all farmers who had parcels on the area affected by perimeter development, including the present command area, the reservoir, drainage ditches, etc. In order to accommodate all the farmers with rights to parcels, formulas based on family size and area previously held were used to allocate parcels. Therefore, most farmers received smaller areas than they originally held. Several complaints about this process emerged in the course of informal interviews with farmers in the Galmi area.

Old property markers were destroyed by bulldozers before surveys were carried out to determine the pre-existing pattern of land distribution. This led to difficulties in determining exactly who had how much land before hand. Some farmers report that this allowed some individuals to claim they had land in the affected area, and thereby gain access to perimeter plots, when in fact they did not have such rights. There are also farmers who claim to have had land on the affected area but who did not receive parcels. It is clear that parcels were allocated on the basis of land tenure surveys conducted AFTER bulldozers had cleared the command area, destroying previous plot boundaries. It is impossible and perhaps pointless to do anything about this now, however, in the future, land attribution surveys should be conducted BEFORE the bulldozing begins.

A few informants noted that village chiefs were not consulted during that period. This means that a potentially useful source of information on land holding patterns was bypassed. Planners of future parcel attribution procedures might consider utilizing village chiefs and elders as a source of information, particularly with respect to land holding data.

The relationship between perimeter-related organizations and village chiefs as a local institution deserves further analysis. Village chiefs from Moullela and the villages served by the Galmi perimeter are active in perimeter organizations, but to varying degrees. Some hold office in the management committees (Moullela

and Guidan Roro); others hold office on GMP committees. Others, however, either do not hold offices in these organizations or do not have perimeter parcels.

Opinions among farmers and chiefs vary with regard to the relationship they consider to be appropriate between chiefs and perimeter activities. Some people think village chiefs should play an active role in land and water disputes, a role chiefs do play for rainfed land disputes and some chiefs play in reference to the perimeter. Others do not consider this a pressing issue.

When more than one village is represented in a cooperative and management committee, people from some villages may not feel adequately represented. In Guidan Miko, one of the villages served by the Galmi perimeter, farmers suggested that village-level representation in perimeter organizations should be stronger.

CROP CHOICE AND AGRONOMIC PRACTICES

Irrigation development implies changes in cultivation practices as well as property relations. Some farmers may need to learn new techniques (e.g. how to irrigate); in other instances they may have to learn to perform a task in a different manner. Furthermore, choices about cropping patterns are often constrained.

Farmers at Moullela and Galmi, while generally positive about the benefits of reduced crop failure risk obtained through the perimeters, listed several complaints related to agronomic aspects of perimeter management. Most farmers interviewed wanted to have more choice with respect to cropping patterns--both in terms of deciding what portion of their parcel to devote to crops planted, and in terms of planting additional crops.

For example, in Galmi, the prescribed cropping mix for the 1986 wet season was half cotton, and half millet or sorghum. Nevertheless, at least a dozen farmers planted their plots entirely with millet. These farmers were due to receive written warnings from the management committee and the perimeter

director. (Three warnings are grounds for removal from the perimeter.) In another example of farmers' interest in increasing cropping choices, several farmers interviewed said they would like to enlarge the area planted in beans. Farmers also cited okra, gourds, additional sorghum and millet varieties, peanuts, and rama,[26] as crops they would like to plant on the perimeter.

Reports that ONAHA staff have uprooted "illegal" crops is evidence of conflict over crop choices. Eight out of 15 farmers interviewed from Moullela (53 percent) said they had had crops uprooted at some point in the perimeter's seventeen-year history. The corresponding figure for Galmi since 1982 was 19 percent (out of 32 farmers). Norman (personal communication) suggests that ONAHA staff uproot crops planted in earth canals or drainage ditches.

Dry-planting is an agronomic practice over whose benefits farmers and agronomists appear to disagree. Dry-planting can save labor if the rains arrive at the right time. Many farmers say they would dry-plant on the perimeters if it were allowed; some do anyway.

ONAHA staff attach priority to finishing tasks on the perimeter. Farmers on both perimeters reported that they began planting and weeding on rainfed plots before doing so on their perimeter parcels. In other words, farmers begin by dry-planting off the perimeter, and then, depending on the timing of the rains, juggle their work between the perimeter and rainfed plots as best they can. This reflects the fact that the timing of planting on rainfed plots is more critical. Farmers on both perimeters were aware of the importance attached by ONAHA staff to the timely completion of perimeter tasks, although they did not always understand the reasons for this, and did not necessarily comply.

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[26] Rama is the Hausa term. The plant can be used to make rope, and the leaves may be eaten.

DECISION MAKING AND THE FLOW OF INFORMATION: ONAHA, THE COOPERATIVE, AND THE MANAGEMENT COMMITTEE

Farmers on both perimeters tend to view decisions about redevance calculations, irrigation scheduling, timing of planting, and other activities on the perimeters as made by the perimeter director and other ONAHA staff and by the management committee. However, there are some differences between the two perimeters. A greater proportion of sampled farmers from Moullela see their perimeter director as making most decisions. The comité de gestion is seen as making most decisions by a greater proportion of sampled farmers from Galmi than from Moullela (see Table VII, Appendix 2). These differences may be due to what seems to be a very close working relationship between the Galmi perimeter director and the comité de gestion. It is possible that more Galmi farmers identify the committee and the director as forming a single decision making unit.

The following pattern of information flow regarding decisions about what to do and when on the perimeters is reported by ONAHA staff. After making a decision, the director (or the director and his staff, at Galmi) informs the management committee and/or GMP heads, depending on the type of decision. In the case of decisions that need to be communicated to farmers, such as when the next irrigation will take place, the director tells the GMP heads to pass the information on to farmers, and informs the management committee members about the decision. If the decision requires further decisions or ratification by the management committee, a meeting is held between the committee and ONAHA staff. GMP heads either communicate information directly to the group of farmers for which they are responsible, or tell a member of their GMP committee to pass on the information. In Moullela the director said he told GMP and management committee members about his decisions.

Thus, information flow is top-down and only reaches farmers indirectly. The information flow structure is not entirely effective with respect to communicating information about

irrigations. Eighty-four percent of farmers sampled on each perimeter said they often did not hear about irrigations in a timely way. This suggests that farmers or family members may not always be present during irrigation, with consequent negative implications for both crop stress and water efficiency. For example, if farmers are not present during irrigation, they cannot build or remove temporary field channel openings within their plots which means that crops may receive too much or too little water, and water may be wasted. Effective communication channels must be developed in order to improve water management and yields, and to increase farmers participation in management, particularly if auto-gestion continues to be a policy objective.

ONAHA'S ROLE IN PERIMETER MANAGEMENT

A current government policy objective is the eventual transformation of ONAHA into a technical assistance agency, with perimeters managed by their management committees. In the interim, however, ONANA is charged with supervising perimeter activities. In practice, ONAHA staff are responsible for scheduling and delivering water and supervising the maintenance and repair of the facilities. They are also responsible for ensuring that farmers plant specific portions of their parcels with particular crops, finish tasks according to schedule, follow agricultural practices as prescribed, and do not break rules against the sale or rental of perimeter land. In short, in addition to their role in water delivery and system operation and maintenance, ONAHA staff are put in a policing role.

However, ONAHA's authority to employ available sanctions is limited. Major sanctions, including removing farmers from a perimeter, must be approved by political authorities. While ONAHA staff can give written warnings, they cannot remove a farmer after issuing three warnings without the consent of the political authorities (e.g. chef de canton and sous-prefet). This consent is not always forthcoming.

The fact that ONAHA must follow political directives puts ONAHA staff in an ambiguous position.[27] In Galmi, farmers who have never paid their redevance remain in the perimeter because "it is too early, farmers have to be given a chance, and besides the authorities have not given their approval."[28] The point is not that farmers should or should not be removed, but rather, that ONAHA's ambiguous role with respect to making policy and enforcing existing rules should be defined more clearly.

A MODEL OF PERIMETER MANAGEMENT

Based on the discussion in the preceding sections, a model of perimeter operation emerges for both Moullela and Galmi in which ONAHA staff try to follow and impose their agency's guidelines for agronomic practices, crop rotations, committee organization, and irrigation management. At the same time, farmers and their families are busy trying to cultivate their various and sometimes distant plots, while they also make a living from other sources. Because there is no such thing as an average farmer (Horowitz, et al. 1983:23), it is difficult for all farmers to perform uniformly in accordance with agency directives. This may have adverse effects on goals of economic and technical efficiency.

The day-to-day practice of farming and managing water involves some struggle on all sides: a diverse group of farmers, ONAHA staff, local authorities, and extra-local political authorities. Certain issues remain a source of debate, while arrangements may be reached over others, at least for a while. In Moullela such arrangements have had a longer time to develop. It is not an easy or negotiated give and take, nor is it a bitter constant battle.

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[27] An agronomist familiar with the region cites higher political authorities with interfering with ONAHA's management role.

[28] Interview with ONAHA employee.

Chapter Eight

CONCLUSIONS AND RECOMMENDATIONS

Research findings suggest that farmers on the Moullela and Galmi perimeters differ in their potential ability to mobilize resources for agriculture, whether irrigated or rainfed. The explanation for this lies in their variable access to resources such as labor, land, cash and other income, and livestock. Farmers with certain sets of resources will be in a better position to take advantage of irrigation and to complete tasks on the perimeter within ONAHA's guidelines. It is worth reflecting on the implications of this variability for perimeter management.

If the hypothesis proposed in chapter six is correct, that, all else being equal, a more homogeneous group of farmers leads to smoother and more efficient operation, then it follows that policies that discourage differentiation among farmers and promote more even distribution of resources will enhance perimeter management. More equal access to resources among farmers on a perimeter can be achieved in a number of ways.

The first is through selection: the exclusion of outliers (the very rich or poor) from the perimeter. Selection may occur either at initial project stages, by selecting farmers with a minimum level of resources, or during the course of perimeter operation, when resource-poor farmers who are unable to keep up redevance payments or other perimeter obligations lose their land. This process has occurred to some extent at Moullela. When a relatively resource-rich "farmer" such as a town merchant gains control of irrigated land, the selection process increases heterogeneity rather than promoting more equal resource distribution among farmers, so that the operation of the perimeter may be negatively affected. A number of Galmi area farmers say that this took place on the Galmi perimeter.

A second method for achieving a degree of homogeneity on the perimeter is to institute controls which prevent or slow the widening of the gap between rich and poor farmers. Government

policies banning the sale or rental of perimeter lands are intended to prevent concentration. This clearly has some impact in slowing down differentiation in access to irrigated land. However, the policy does not address the problems of differentiation in access to other resources, especially labor and cash. Banning land sales does not necessarily affect the forces which lead farmers to sell land, so that they may find other means to achieve the same end, and the control of large areas of land by a few individuals may become covert. Control over the sale of irrigated land does not affect distribution of or differentiation in access to rainfed land, which this study has shown to be a major part of the household agricultural system. Moreover, it does not affect the differential ability of farmers to mobilize resources for cash crop production--an important source of income and therefore of differentiation on the perimeter.

Another method for maintaining or promoting homogeneity would be through ongoing redistribution or subsidization of key resouces for resource-poor farmers. One alternative would be to make low-cost credit available to poorer farmers.[29] Money can in turn allow farmers to hire labor or draft animals at key times in the agricultural cycle. A second alternative is the provision of employment opportunities during slack periods in the agricultural cycle, so that farmers can obtain money which can be invested in agriculture.

It would be useful to know how households cultivating unequal areas of land, and operating under differing labor and capital constraints, mobilize and allocate labor for various kinds of agricultural activities. A typology of farmers with shared cash, labor, and land constraint levels could be used to

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[29] Poorer farmers can also gain access to scarce cash through moneylenders or their equivalent. Information on moneylending was not obtained in this research. This form of gaining access to money is almost always very expensive for the borrower, and is more likely to promote differentiation than to ameliorate it.

analyze the ways in which farmers in different strata accumulate (or fail to accumulate) resources. Such research could also determine how different constraints on the availability of labor, cash, and land affect agricultural production and levels of well-being.

The issue of finding a compromise between overall management goals which involve uniformity of operations as a means of achieving technical and economic efficiency and maximizing individual choice is central to perimeter management. The former promotes the smooth running of a perimeter; the latter allows farmers to best utilize their particular mix of resources. The question is, how can an irrigation system be effectively managed to increase production while minimizing the top-down control that this technology so often entails.

This question suggests a need for continuing research efforts. It would be useful to test several models of irrigation scheduling, cropping patterns, and organizational arrangements. These models should be designed to increase the choice of crops available to farmers. One approach would be to reserve a portion of a perimeter or of GMP for garden crops which could be planted following the harvest of early millet varieties. The effect of intercropping on yields and on labor allocation to different tasks (especially weeding) should be tested to see whether and under what conditions intercropping would save enough labor to make this practice worthwhile, even if yields decline somewhat.

Changing the size and composition of irrigation units is another possible strategy for applied research. For example, the viability of GMPs composed of smaller groups of farmers with more uniform access to productive resources could be examined. Reducing GMP size may require design changes such as shortening secondary and/or tertiary canals. Another design change would be to modify canals and control structures in order to increase water capacity so that GMPs at the end of a system could irrigate more quickly. This would enhance scheduling flexibility by permitting selected areas to irrigate separately.

The role and performance of local institutions (e.g., village chiefs,) should also be examined. Stronger village-level representation is an issue that deserves further discussion, especially with respect to larger perimeters, where numerous villages have to coordinate their decisions and activities.

A related issue is that of ONAHA's role in perimeter management and the agency's relationship with the management committee. If self-management continues to be an objective, it will be important to clarify the relationship between farmers, the management committee, ONAHA staff, and local and extra-local political authorities, in order to reduce ambiguity over decisionmaking and enforcement powers.

In conclusion, the fact that farmers with parcels on a given perimeter do not have uniform access to resources needs to be recognized and taken into account in water management and irrigation system design. Because of this variability, it would be useful to relax assumptions about uniform performance among perimeter farmers. An alternative to reducing variability among farmers through compensatory programs (e.g. credit) would be to manage perimeters in a way that assumes variability rather than uniformity. This would imply, at a minimum, more flexible scheduling, selective irrigation, wider choices in cropping patterns and cultivation practices, and changes in the size and perhaps composition of GMPs or their equivalent.

APPENDIX 1

RESEARCH METHODOLOGY

METHODOLOGY

The data on which this report is based were collected over a thirteen week period, ending August 10, 1986. Part of this period was devoted to coding and data analysis.

The methodology adopted for this research included the following data collection strategies: proxy participant observation, open-ended individual and group interviews, and formal surveys. Three field assistants worked in different quartiers of Galmi, two in Moullela, and one in Guidan Miko, a village located between Galmi and Moullela. Assistants lived temporarily in the villages in order to gather qualitative data by means of participant-observation. Each assistant kept a journal covering topics such as cooperative meetings, perimeter activities, informal interviews on perimeter management, etc.

Open-ended group and individual interviews, conducted in French or through an interpreter, provided a second source of data. These interviews were conducted with ONAHA personnel, individuals occupying positions of responsibility at the cooperative, perimeter, and village levels, and with perimeter parcel holders.

Four survey instruments were developed and administered to varying samples in the course of the research.[30] The first questionnaire (schedules 1 through 5) was designed to collect quantitative data on household composition and labor availability; migration; access to land; land use; possession of household items, tools, farming equipment, and animals; and participation in rainfed agriculture and non-agricultural activities.

A second questionnaire (schedule 6) was used to gather information from people occupying positions of responsibility in

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[30] Copies of the questionnaires are available from the Cornell Irrigation Studies Group, Cornell University, Ithaca, New York, 14853.

local cooperatives, village institutions, and GMPs. This instrument includes questions on the number of positions held by the respondent, his duties, means of attaining posts, and perceived advantages and disadvantages associated with the jobs. It was administered to a non-random sample of 39 respondents selected by the field assistants and therefore is not treated in the discussion on sampling presented below.

The third set of questions was based on three questionnaires drafted by Eric Arnould in January, 1986. The questions cover land tenure, perimeter management, and cooperative organization. This instrument was administered to the same sample drawn for the first questionnaire, but a subsample was selected for analysis due to time limitations. (Table A-3, below, shows the sample sizes associated with the different instruments.)

A fourth and final set of questions was designed to gather more detailed information about yields, production costs, land use, crop choices, changes in women's access to land, and selected agronomic practices. Due to the length of the questionnaire and to pressing time limitations, this instrument was only administered to a subsample of irrigators.

SAMPLING

The questionnaires were administered to different subsamples of an initial sample; however, due to time constraints, their results were only partially coded and analyzed. The first questionnaire was administered to an initial stratified random sample consisting of a stratum of irrigators from the Galmi and Moullela perimeters, and a stratum of non-irrigators from the villages associated with the perimeters. The sample was also stratified on the basis of village residence in order to ensure an adequate representation of the villages associated with the two perimeters.

The sample of irrigated parcel holders was randomly drawn from a sampling frame consisting of a list of parcel holders available for each perimeter. The sample of individuals without

an irrigated perimeter parcel was randomly drawn from lists constructed at the village level by asking village chiefs and other key informants for the names of people without any perimeter parcels.[31] For each village, the list of non-irrigators was made very long (relative to the actual sample size to be drawn) in an attempt to reduce the bias intruduced by the sampling technique. The sampling frame was obtained in this manner due to difficulties in obtaining disaggregated census data.

Sample sizes were determined on the basis of projected data collection capacity and an effort to include approximately 20 percent of the irrigators at Moullela and 10 percent at Galmi, and a roughly corresponding number of non-irrigators. Sampling was not based on calculations of the probability of representativeness of key variables for the population for two reasons. A probabilistic sample would have required accurate census data and reasonable estimates of the variance of the phenomena under study for the population. Difficulties were encountered in locating recent dissagregated census data for all of the villages, and estimates of variance for the variables studied were not available.

Table A-1 displays the sample sizes as percent of the number of irrigators associated with each perimeter, and as percent of the population of adult males in villages served by the perimeters. The latter is based on aggregated census data for 1983 for those villages for which data were available.

[31] Village chiefs are responsible for collecting taxes, and therefore have a reasonably accurate idea of who lives in the village and what they do for a living.

TABLE A-1

SAMPLE SIZES AS PERCENT OF IRRIGATORS
AND PERCENT OF ADULT MALES RESIDING IN THE AREA

PERIMETER	TOTAL NUMBER of IRRIGATORS	SAMPLE of IRRIGATORS as % of TOTAL IRRIGATORS	TOTAL SAMPLE as % of MALE POP.
MOULLELA	124	23	25-35
GALMI	854	8	10

Note: The higher figure for total sample as percent of male population for Moullela is based on the male population of Moullela alone. The lower range was calculated by adding a quarter of the male population of Guidan Miko to that of Moullela. This was done to preserve the proportionality of village membership.

The breakdown of the original sample by village and by irrigator/non-irrigator category is presented in Table A-2. As noted, not all of the data gathered from the first questionnaire were analyzed, nor were subsequent questionnares administered and analyzed on the basis of the original sample. The scope of work was reduced in an attempt to collect AND analyze data within the project time frame.

TABLE A-2

ORIGINAL SAMPLE BY PERIMETER AND VILLAGE

		PERIMETER MEMBERSHIP		
PERIMETER	VILLAGE	IN	OUT	TOTAL
MOULLELA	Moullela	24	23	47
	Guidan Miko	4	0	4
	Guidan Sofo	1	0	0
	SUB TOTAL	29	23	52
GALMI	Moullela	2	0	2
	Guidan Miko, Tounga and Taganaoua	11	13	24
	Galmi Birni	21	15	36
	Guidan Doutchi	15	12	27
	Guidan Kare	8	9	17
	Guidan Roro and Zongo Annissar	14	13	27
	SUB TOTAL	69	62	131
OVERALL TOTAL		98	85	183

Table A-3 presents the sample sizes for data collected and analyzed with questionnaires 1, 3, and 4. (As mentioned earlier, the second questionnaire was administered to a separate judgment sample and therefore is not included in this table.)

TABLE A-3

SAMPLE SIZES FOR DATA COLLECTED AND ANALYZED,
FOR QUESTIONNAIRES 1, 3, AND 4,
BY PERIMETER, AND PERIMETER PARCEL HOLDING STATUS.
(Number of Cases)

QUESTIONNAIRE	No. 1		No. 3		No. 4	
PERIMETER AND STATUS	Collected	Analyzed	Coll.	Analyzed	Coll.	Analyzed
MOULLELA						
on perimeter	29	29	29	19	19	15
off perim.	23	23	23	0	0	0
GALMI						
on perimeter	69	35	35	32	32	32
off perim.	62	33	33	0	0	0
SUBTOTAL						
on perimeters	52	64	64	51	51	47
off perim.s	131	56	56	0	0	0
TOTAL	183	120	120	51	51	47

The criterion used to reduce the sample size at each iteration was to maintain the proportion of respondents earning their livelihoods primarily through farming, through commerce, or a mixture of both, fairly close to the proportions found in response to the first questionnaire. Responses to questions associated with this criterion were examined for the entire sample before reducing the sample for the first round of analysis. Non-perimeter parcel holders were left out of the analysis of the third questionnaire and out of the data collection for the fourth questionnaire because of time

constraints and because as a group they were felt to be less central to issues of land tenure, cooperative organization, and perimeter management. The full data set is available and can be analyzed in the future.

Appendix 2

DATA COLLECTED

Notes to Tables in Appendix 2:

IN = Farmers with perimeter parcels

OUT = Farmers without perimeter parcels

HH = Household

R = Respondent

TABLE I-1

FREQUENCY DISTRIBUTIONS FOR DEMOGRAPHIC VARIABLES

VARIABLES AND CATEGORIES	MOULLELA						GALMI						OVERALL TOTAL	
	IN		OUT		TOTAL		IN		OUT		TOTAL			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Number of wives														
0							1	2.9	2	6.1	3	4.4	3	2.5
1	22	75.9	19	82.6	4'	78.8	23	65.7	19	57.6	42	61.8	83	69.2
2	6	20.7	3	13.0	9	17.3	8	22.9	10	30.3	18	26.5	27	22.5
3	1	3.4	1	4.3	2	3.8	3	8.6	1	3.0	4	5.9	6	5.0
4							0	0	1	3.0	1	1.5	1	0.8
Adult women														
0							0	0	1	3.0	1	1.5	1	0.8
1	10	34.5	11	47.8	21	40.4	8	22.9	8	24.2	16	23.5	37	30.8
2	7	24.1	8	34.8	15	28.8	12	34.3	8	24.2	20	29.4	35	29.2
3	7	24.1	1	4.3	8	15.4	6	17.1	8	24.2	14	20.6	22	18.3
4	4	13.8	–	–	4	7.7	6	17.1	3	9.1	9	13.2	13	10.8
5	1	3.4	1	4.3	2	3.8	1	2.9	3	9.1	4	5.9	6	5.0
6	–	–	1	4.3	1	1.9	2	5.7	2	6.1	4	5.9	5	4.2
7	–	–	1	4.3	1	1.9	–	–	–	–	–	–	1	0.8
R's children														
0	2	6.9	3	13	5	9.6	3	8.6	2	6.1	5	7.4	10	8.3
1-2	7	24.1	5	21.7	12	23.1	5	17.2	7	21.3	13	19.1	25	20.9
3-4	10	34.5	9	39.1	19	36.5	10	28.6	11	33.3	21	30.9	40	33.3
5-7	8	27.5	4	17.3	12	23.1	11	31.4	6	18.2	17	25.0	29	24.1
8 +	4	14.4	7	21.2	12	17.7	9	7.4	2	6.9	2	8.6	4	7.6

TABLE I-2

FREQUENCY DISTRIBUTIONS FOR DEMOGRAPHIC VARIABLES

VARIABLES AND CATEGORIES	MOULLELA						GALMI						OVERALL TOTAL	
	IN		OUT		TOTAL		IN		OUT		TOTAL			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total HH size														
2	1	3.4	2	8.7	3	5.8	2	5.7	0	0	2	2.9	5	4.2
3-4	5	17.2	4	17.3	9	17.3	3	8.6	4	12.1	7	10.3	16	13.3
5-6	5	17.2	9	39.1	14	26.9	7	20.0	10	30.3	17	25.0	31	25.9
7-9	10	34.5	6	26.0	16	30.8	13	37.2	9	27.3	22	32.4	38	31.7
10-13	6	20.5	-	-	6	11.5	6	17.2	7	21.3	13	19.1	19	15.8
14 +	2	6.9	2	8.6	4	7.6	4	11.5	3	9.0	7	10.4	11	9.1
Active males														
1	1	3.4	9	39.1	10	19.2	6	17.1	4	12.1	10	14.7	20	16.7
2	9	31.0	9	39.1	18	34.6	9	25.7	13	39.4	22	32.4	40	33.3
3	10	34.5	2	8.7	12	23.1	9	25.7	11	33.3	20	29.4	32	26.7
4	5	17.2	1	4.3	6	11.5	6	17.1	2	6.1	8	11.8	14	11.7
5	2	6.9	-	-	2	3.8	2	5.7	3	9.1	5	7.4	7	5.8
6	2	6.9	2	8.7	4	7.7	0	0	0	0	0	0	4	3.3
7							2	5.7	0	0	2	2.9	2	1.7
8							1	2.9	0	0	1	1.5	1	0.8
Children < 7														
0	9	31.0	5	21.7	14	26.9	7	20.0	6	18.2	13	19.1	27	22.5
1	5	17.2	3	13.0	8	15.4	3	8.6	5	15.2	8	11.8	16	13.3
2	1	3.4	7	30.4	8	15.4	10	28.6	7	21.2	17	25.0	25	20.8
3	5	17.2	5	21.7	10	19.2	5	14.3	5	15.2	10	14.7	20	16.7
4	5	17.2	2	8.7	7	13.5	4	11.4	4	12.1	8	11.8	15	12.5
5	2	6.9	-	-	2	3.8	1	2.9	3	9.1	4	5.9	6	5.0
6	2	6.9	1	4.3	3	5.8	3	8.6	1	3.0	4	5.9	7	5.8
7							1	2.9	1	3.0	2	2.9	2	1.7
8							0	0	1	3.0	1	1.5	1	0.8
38							1	2.9	0	0	1	1.5	1	0.8

TABLE I-3
FREQUENCY DISTRIBUTIONS FOR DEMOGRAPHIC VARIABLES

VARIABLES AND CATEGORIES	MOULLELA						GALMI						OVERALL TOTAL	
	IN		OUT		TOTAL		IN		OUT		TOTAL			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Type H.H.														
1. Coup. no child	1	3.4	3	13.0	4	7.7	2	5.7	2	6.1	4	5.9	8	6.7
2. Nuc. w/child	17	58.6	16	69.6	33	63.4	18	51.4	19	57.6	37	54.4	70	58.3
3. Sibs. + child	3	10.3	2	8.7	5	9.6	1	2.9	2	6.1	3	4.4	8	6.7
4. 3 generations	8	27.6	2	8.7	10	19.2	14	40.0	10	30.3	24	35.3	34	28.3
Males in ag.														
0							4	11.4	0	0	4	5.9	4	3.3
1	5	17.2	12	52.2	17	32.7	7	20.0	15	15.2	12	17.6	29	24.2
2	7	24.1	4	17.4	11	21.2	11	31.4	12	36.4	23	33.8	34	28.3
3	8	27.6	5	21.7	13	25.0	6	17.1	10	30.3	16	23.5	29	24.2
4	8	27.6	1	4.3	9	17.3	3	8.6	4	12.1	7	10.3	16	13.3
5	1	3.4	0	0	1	1.9	2	5.7	2	6.1	4	5.9	5	4.2
6	0	0	1	4.3	1	1.9	1	2.9	0	0	1	1.5	2	1.7
7							1	2.9	0	0	1	1.5	1	0.8
HH Women in ag.														
0	7	24.1	10	43.5	17	32.7	26	74.3	28	84.8	54	79.4	71	59.2
1	10	34.5	11	47.8	21	40.4	6	17.1	2	6.1	8	11.8	29	24.2
2	10	34.5	2	8.7	12	23.1	1	2.9	3	9.1	4	5.9	16	13.3
3	1	3.4	0	0	1	1.9	2	5.7	0	0	2	2.9	3	2.5
4	1	3.4	0	0	1	1.9	0	0	0	0	0	0	1	0.8

TABLE I-4

FREQUENCY DISTRIBUTIONS FOR DEMOGRAPHIC VARIABLES

VARIABLES AND CATEGORIES	MOULLELA						GALMI						OVERALL TOTAL	
	IN		OUT		TOTAL		IN		OUT		TOTAL			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
HH members with non-ag. income														
0	5	17.2	4	17.4	9	17.3	5	14.3	1	3.0	6	8.8	15	12.5
1	8	27.6	6	26.1	14	26.9	6	17.1	9	27.3	15	22.1	29	24.2
2	6	20.7	6	26.1	12	23.1	11	31.4	13	39.4	24	35.3	36	30.0
3	5	17.2	3	13.0	8	15.4	4	11.4	7	21.2	11	16.2	19	15.8
4	4	13.8	3	13.0	7	13.5	6	17.1	2	6.1	8	11.8	15	12.5
5	1	3.4	1	4.3	2	3.8	2	5.7	1	3.0	3	4.4	5	4.2
7							1	2.9	0	0	1	1.5	1	0.8
Women foodsellers														
0	19	65.5	21	91.3	40	76.9	28	80.0	27	81.8	55	80.9	95	79.2
1	9	31.0	1	4.3	10	19.2	4	11.4	5	15.2	9	13.2	19	15.8
2	1	3.4	1	4.3	2	3.8	1	2.9	0	0	1	1.5	3	2.5
3							2	5.7	1	3.0	3	4.4	3	2.5

TABLE II-1

FREQUENCY DISTRIBUTIONS FOR LIVESTOCK VARIABLES

VARIABLES AND CATEGORIES	MOULLELA						GALMI						OVERALL TOTAL	
	IN		OUT		TOTAL		IN		OUT		TOTAL			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Oxen														
0	12	41.4	19	82.6	31	59.6	31	88.6	31	93.9	62	91.2	93	77.5
1	1	3.4	1	4.3	2	3.8	0	0	1	3.0	1	1.5	3	2.5
2	15	51.7	3	13.0	18	34.6	4	11.4	1	3.0	5	7.4	23	19.2
4	1	3.4	0	0	1	1.9	0	0	0	0	0	0	1	0.8
Cattle (not oxen)														
0	16	55.2	18	78.3	34	65.4	24	68.6	26	78.8	50	73.5	84	70.0
1-2	6	20.6	0	0	6	11.5	10	28.6	5	15.2	15	22.1	22	17.5
3-4	2	6.9	4	17.3	6	11.5	1	2.9	0	0	1	1.5	7	5.8
5-10	3	10.2	1	4.3	4	7.6	0	0	1	3.0	1	1.5	5	4.0
20							0	0	1	3.0	1	1.5	1	0.8
21	1	3.4	0	0	1	1.9	0	0	0	0	0	0	1	0.8
41	1	3.4	0	0	1	1.9	0	0	0	0	0	0	1	1.8
Sheep														
0	7	24.1	11	47.8	18	34.6	21	60.0	21	63.6	42	61.8	60	50.0
1-2	7	24.1	7	30.4	14	27.0	7	20.0	7	21.2	14	20.6	28	23.4
3-4	7	24.1	2	8.7	9	17.3	5	14.3	1	3.0	6	8.8	15	12.5
5-6	3	10.3	3	13.0	6	11.5	1	2.9	1	3.0	2	2.9	8	6.7
9/10-12	3	10.3	0	0	3	5.7	1	2.9	1	3.0	2	3.0	4	3.1
21-22	2	6.8	0	0	2	3.8	0	0	0	0	0	0	2	1.6
26	-		-				0	0	1	3.0	1	1.5	1	0.8
31	-		-				0	0	1	3.0	1	1.5	1	0.8

TABLE II-2

FREQUENCY DISTRIBUTIONS FOR LIVESTOCK VARIABLES

VARIABLES AND CATEGORIES	MOULLELA						GALMI						OVERALL TOTAL	
	IN		OUT		TOTAL		IN		OUT		TOTAL			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Goats														
0	6	20.7	11	47.8	17	32.7	13	37.1	13	39.4	26	38.2	43	35.8
1-2	6	20.6	3	13.0	9	17.3	5	14.3	5	15.2	10	14.7	19	15.8
3-4	3	10.3	6	26.1	9	17.3	8	22.8	6	18.2	14	20.6	23	19.2
5-6	5	17.2	2	8.7	7	13.4	4	11.4	4	12.2	8	11.7	15	12.5
7-9	–		–		–		4	11.5	2	6.1	6	8.8	6	5.0
10-14	6	20.6	1	4.3	7	13.4	0	0	0	0	0	0	7	5.9
15-17	–		–		–		0	0	2	6.0	2	3.0	2	1.6
20-21	2	6.8	0	0	2	3.8	1	2.9	0	0	1	1.5	3	2.5
34	1	3.4	0	0	1	1.9	0	0	0	0	0	0	1	0.8
39	–		–		–		0	0	1	3.0	1	1.5	1	0.8
Horses														
0	27	93.1	22	95.7	49	94.2	34	97.1	33	100	67	98.5	116	96.7
1	2	6.9	1	4.3	3	5.8	1	2.9	–	–	1	1.5	4	3.3
Donkeys														
0	24	82.8	19	82.6	43	82.7	26	74.3	25	75.8	51	75.0	94	78.3
1	4	13.8	4	17.4	8	15.4	5	14.3	5	15.2	10	14.7	18	15.0
2	1	3.4	0	0	1	1.9	4	11.4	1	3.0	5	7.4	6	5.0
4	–		–		–		0	0	1	3.0	1	1.5	1	0.8
7	–		–		–		0	0	1	3.0	1	1.5	1	0.8
Camels														
0	28	96.6	23	100	51	98.1	35	100	33	100	68	100	119	99.2
2	1	3.4	0	0	1	1.9	–	–	–	–	–	–	1	0.8

TABLE III-1

FREQUENCY DISTRIBUTIONS FOR VARIABLES OF MATERIAL GOODS

VARIABLES AND CATEGORIES	MOULLELA						GALMI						OVERALL TOTAL	
	IN		OUT		TOTAL		IN		OUT		TOTAL			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Chairs														
0	13	44.8	16	69.6	29	55.8	11	31.4	13	39.4	24	35.3	53	44.2
1	8	27.6	5	21.7	1	13	16	45.7	10	30.3	26	38.2	39	32.5
2	4	13.8	1	4.3	5	9.6	1	2.9	5	15.2	6	8.8	11	9.2
3	1	3.4	0	0	1	1.9	1	2.9	3	9.1	4	5.9	5	4.2
4	2	6.9	1	4.3	3	5.8	3	8.6	2	6.1	5	7.4	8	6.7
5 +	1	3.4	0	0	1	1.9	3	8.6	0	0	3	4.4	4	3.3
Tables														
0	24	72.4	18	78.3	39	75.0	28	80.0	19	57.6	47	69.1	86	71.7
1	4	13.8	5	21.7	9	17.3	6	17.1	10	30.3	16	23.5	25	20.8
2	2	6.9	0	0	2	3.8	1	2.9	2	6.1	3	4.4	5	4.2
3	1	3.4	0	0	1	1.9	0	0	1	3.0	1	1.5	2	1.7
4	1	3.4	0	0	1	1.9	0	0	1	3.0	1	1.5	2	1.7
Radio														
0	19	65.5	18	78.3	37	71.2	26	74.3	24	72.7	50	73.5	87	72.5
1	10	34.5	5	21.7	15	28.8	9	25.7	8	24.2	17	25.0	32	26.7
2	–	–	–	–	–	–	0	0	1	3.0	1	1.5	1	0.8
TV														
0	29	100	–	–	52	100	32	91.4	32	97.0	64	94.1	116	96.7
1	–	–	–	–	–	–	3	8.6	1	3.0	4	5.9	4	3.3

TABLE III-2

FREQUENCY DISTRIBUTIONS FOR VARIABLES OF MATERIAL GOODS

VARIABLES AND CATEGORIES	MOULLELA						GALMI						OVERALL TOTAL	
	IN		OUT		TOTAL		IN		OUT		TOTAL			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Bicycles														
0	20	69.0	21	91.3	41	78.8	31	88.6	26	78.8	57	83.8	98	81.7
1	9	31.0	2	8.7	11	21.2	4	11.4	7	21.2	11	16.2	22	18.3
Refrigerator														
0	29	100			52	100	34	97.1	32	97.0	66	97.1	118	98.3
1	-	-			-	-	1	2.9	1	3.0	2	2.9	2	1.7
Metal beds														
0	10	34.5	12	52.2	22	42.3	25	36.8	11	31.4	14	42.4	47	39.2
1	6	20.7	9	39.1	15	28.8	23	33.8	15	42.9	8	24.2	38	31.7
2	6	20.7	2	8.7	8	15.4	12	17.6	5	14.3	7	21.2	20	16.7
3	3	10.3	0	0	3	5.8	3	4.4	2	5.7	1	3.0	6	5.0
4	3	10.3	0	0	3	5.8	3	4.4	2	5.7	1	3.0	6	5.0
5							1	1.5	0	0	1	3.0	1	0.8
6 +	1	3.4	0	0	1	1.9	1	1.5	0	0	1	3.0	2	1.6
Oil lamps														
0	1	3.4	0	0	1	1.9	1	1.5	1	2.9	0	0	2	1.7
1	10	34.5	11	47.8	21	40.4	19	27.9	9	25.7	10	30.3	40	33.3
2	6	20.7	11	47.8	17	32.7	23	33.8	13	37.1	10	30.3	40	33.3
3	5	17.2	0	0	5	9.6	17	25.0	9	25.7	8	24.2	22	18.3
4	4	13.8	1	4.3	5	9.6	6	8.8	3	8.6	3	9.1	11	9.2
5	1	3.4	0	0	1	1.9	1	1.5	0	0	1	3.0	2	1.7
6	1	3.4	0	0	1	1.9	0	0	0	0	0	0	1	0.8
7	1	3.4	0	0	1	1.9	1	1.5	0	0	1	3.0	2	1.7

TABLE III-3

FREQUENCY DISTRIBUTIONS FOR VARIABLES OF MATERIAL GOODS

VARIABLES AND CATEGORIES	MOULLELA						GALMI						OVERALL TOTAL	
	IN		OUT		TOTAL		IN		OUT		TOTAL			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Vehicle														
0	29	100	23	100	52	100	67	98.5	34	97.1	33	100	119	99.2
3	-	-	-	-	-	-	1	1.5	1	2.9	-	-	1	0.8
Metal bucket														
0							2	2.9	1	2.9	1	3.0	2	1.7
1	2	6.9	1	4.3	3	5.8	14	20.6	6	17.1	8	24.2	17	14.2
2	8	27.6	11	47.8	19	36.5	25	36.8	15	42.9	10	30.3	44	36.7
3	9	31.0	8	34.8	17	32.7	13	19.1	8	22.9	5	15.2	30	25.0
4	2	6.9	1	4.3	3	5.8	9	13.2	5	14.3	4	12.1	12	10.0
5	3	10.3	1	4.3	4	7.7	2	2.9	0	0	2	6.1	6	5.0
6	2	6.9	0	0	2	3.8	1	1.5	0	0	1	3.0	3	2.5
7	1	3.4	1	4.3	2	3.8	1	1.5	0	0	1	3.0	3	2.5
8	2	6.9	0	0	2	3.8	0	0	0	0	0	0	2	1.7
9	-	-	-	-	-	-	1	1.5	0	0	1	3.0	1	0.8

TABLE IV-1

FREQUENCY DISTRIBUTIONS FOR LAND AREA AND TENURE

VARIABLES AND CATEGORIES	MOULLELA						GALMI						OVERALL TOTAL	
	IN		OUT		TOTAL		IN		OUT		TOTAL			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Irrig. plots owned														
0	0	0	23	100	23	44.2	–	–	33	100	33	48.5	56	46.7
1	20	69.0	–	–	20	38.5	29	82.9	–	–	29	42.6	49	40.8
2	7	24.1	–	–	7	13.5	6	17.1	–	–	6	8.8	13	10.8
4	2	6.9	–	–	2	3.8	0	0	–	–	0	0	2	1.7
Area of perim. plots														
0-.25	2	6.8	23	100	25	48.0	23	65.7	6	18.2	29	42.7	32	26.6
.26-.50	11	36.5	0	0	11	21.0	10	28.6	0	0	10	14.8	21	17.4
.51-.75	6	20.4	0	0	11	21.0	2	5.8	0	0	2	3.0	8	6.6
.76-1.24	3	10.2	0	0	3	5.7	0	0	0	0	0	0	3	2.4
1.25-1.5	4	13.1	0	0	4	7.6	0	0	0	0	0	0	4	3.3
1.51-1.67	3	10.2	0	0	3	5.7	0	0	0	0	0	0	3	2.4
98 NA	0	0	0	0	0	0	–	–	27	81.8	27	39.7	49	40.8
Parcels in reservoir														
0	16	55.2	20	87.0	36	69.2	35	100	32	97.0	67	98.5	103	85.8
1	11	37.9	3	13.0	14	26.9	–	–	1	3.0	1	1.5	15	12.5
2	2	6.9	0	0	2	3.8	–	–	0	0	–	–	2	1.7

TABLE IV-2

FREQUENCY DISTRIBUTIONS FOR LAND AREA AND TENURE

VARIABLES AND CATEGORIES	MOULLELA						GALMI						OVERALL TOTAL	
	IN		OUT		TOTAL		IN		OUT		TOTAL			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Rainfed plots														
0	1	3.4	1	4.3	2	3.8	2	5.7	2	6.1	4	5.9	6	5.0
1	5	17.2	2	8.7	7	13.5	13	37.1	8	24.2	21	30.9	28	23.3
2	7	24.1	8	34.8	15	28.8	7	20.0	8	24.2	15	22.1	30	25.0
3	4	13.8	6	26.1	10	19.2	6	17.1	8	24.2	14	20.6	24	20.0
4	6	20.7	1	4.3	7	13.5	3	8.6	4	12.1	7	10.3	14	11.7
5	3	10.3	4	17.4	7	13.5	3	8.6	0	0	3	4.4	10	8.3
6	1	3.4	1	4.3	2	3.8	1	2.9	1	3.0	2	2.9	4	3.3
7							0	0	1	3.0	1	1.5	1	0.8
8							0	0	1	3.0	1	1.5	1	0.8
10	1	3.4	0	0	1	1.9	0	0	0	0	0	0	1	0.8
25	1	3.4	0	0	1	1.9	0	0	0	0	0	0	1	0.8
Fadama														
0	15	51.7	9	39.1	24	46.2	25	71.4	19	57.6	44	64.7	68	56.7
1	8	27.6	9	39.1	17	32.7	7	20.0	5	15.2	12	17.6	29	24.2
2	2	6.9	4	17.4	6	11.5	2	5.7	4	12.1	6	8.8	12	10.0
3	2	6.9	0	0	2	3.8	0	0	2	6.1	2	2.9	4	3.3
4							1	2.9	1	3.0	2	2.9	2	1.7
5	1	3.4	1	4.3	2	3.8	0	0	0	0	0	0	2	1.7
6							0	0	1	3.0	1	1.5	1	0.8
7							0	0	1	3.0	1	1.5	1	0.8
14	1	3.4	0	0	1	1.9								
Gardens														
0	25	86.2	22	95.7	47	90.4	33	94.3	21	66.7	55	80.9	102	85.0
1	3	10.3	0	0	3	5.8	2	5.7	11	33.3	13	19.1	16	13.3
2	0	0	1	4.3	1	1.9	0	0	0	0	0	0	1	0.8
4	1	3.4	0	0	1	1.9	0	0	0	0	0	0	1	0.8

TABLE IV-3

FREQUENCY DISTRIBUTIONS FOR LAND AREA AND TENURE

VARIABLES AND CATEGORIES	MOULLELA						GALMI						OVERALL TOTAL	
	IN		OUT		TOTAL		IN		OUT		TOTAL			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Tenure														
0							–	–	1	3.0	1	1.5	1	0.8
All Inherited	9	31.0	4	17.4	13	25.0	22	62.9	9	27.3	31	45.6	44	36.7
Inh.-Loans-Gifts	4	13.8	9	39.1	13	25.0	4	11.4	11	33.3	15	22.1	28	23.3
Inh. & Rented	4	13.8	6	26.1	10	19.2	6	17.1	8	24.2	14	20.6	24	20.0
All Rented	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inh.-Bought	3	10.3	0	0	3	5.8	3	8.6	3	9.1	6	8.8	9	7.5
Inh.-Rent-Bought	9	31.0	4	17.4	13	25.0	0	0	1	3.0	1	1.5	14	11.7
Rented Plots														
0	16	55.2	12	52.2	28	53.8	30	85.7	25	75.8	55	80.9	83	69.2
1	9	31.0	8	34.8	17	32.7	2	5.7	3	9.1	5	7.4	22	18.3
2	2	6.9	1	4.3	3	5.8	1	2.9	3	9.1	4	5.9	7	5.8
3	0	0	1	4.3	1	1.9	2	5.7	1	3.0	3	4.4	4	3.3
4	0	0	1	4.3	1	1.9	0	0	1	3.0	1	1.5	2	1.7
6	1	3.4	0	0	1	1.9	0	0	1	3.0	1	1.5	1	0.8
25	1	3.4	0	0	1	1.9	0	0	0	0	0	0	1	0.8
Perim. Plots Worked, not Owned														
0	25	86.2	20	87.0	45	86.5	34	97.1	26	78.8	60	88.2	105	87.5
1	3	10.3	2	8.7	5	9.6	1	2.9	6	18.2	7	10.3	12	10.0
2	1	3.4	1	4.3	2	3.8	0	0	1	3.0	1	1.5	3	2.5
Original Per. Plot Owner?														
0 = never had one							0	0	33	100	33	48.5	49	40.8
1 = yes	21	72.4	NA	NA	21	73.3	34	97.1	0	0	34	50.0	55	45.8
2 = no	8	27.6	NA	NA	8	26.7	1	2.9	0	0	1	1.5	9	1.5
3 = excluded							0	0	0	0	0	0	7	5.8

Table V

RESPONDENT'S REPORTED METHOD
OF ACQUIRING IRRIGATED PARCEL(S) BY PERIMETER
(Perimeter subsamples only)

(Number of respondents by number of parcels)

Method of acquisition	Number of parcels	GALMI (N=32)		MOLLELA (N=19)		Total (N=52)	
		Number	% of N	Number	% of N	Number	% of N
Inherited through the father	0	4	13	2	11	6	12
	1	27	85	13	68	40	78
	2	1	3	4	21	5	10
Inherited through the mother	0	32	100	19	100	51	100
Borrowed by respondent	0	30	94	19	100	49	96
	1	2	6	-	-	2	4
Given to respondent	0	31	97	18	95	49	96
	1	1	31	1	53	2	49
Purchased by respondent	0	30	94	19	100	49	96
	1	2	63	-	-	2	4
Rented by respondent	0	32	100	19	100	51	100
Acquired after another farmer's exclusion	0	32	100	14	74	46	90
	1	-	-	5	26	5	10

Note: Percentages may not round up to 100 due to rounding.

Source: Survey data.

TABLE VI-1

OCCURENCE OF DISPUTES

(Has respondent ever had a land or water dispute?)

	Galmi (N = 32)		Moullela (N = 19)		Both (N = 51)	
	Number	%	Number	%	Number	%
Yes	8	25	10	53	18	35
No	24	75	9	47	33	65

Source: Survey data

TABLE VI-2

TYPE OF PARCEL INVOLVED IN DISPUTE

	Galmi (N = 8)		Moullella (N = 10)		Both (N = 18)	
	Number	%	Number	%	Number	%
Perimeter	1	12	9	90	10	56
Rainfed	7	88	1	10	8	44

Source: Survey data

TABLE VI-3

TYPE OF CONFLICT

	Galmi (N = 8)		Moullela (N = 10)		Both (N = 18)	
	Number	%	Number	%	Number	%
Irrigation out of turn	1	12	4	40	5	28
Boundary dispute	7	88	6	60	13	72

Source: Survey data

TABLE VI-4

CONFLICT RESOLUTION LEVEL
FOR ALL CONFLICTS

	GALMI (N = 8)		MULLELLA (N= 10)		BOTH (N = 18)	
	Number	%	Number	%	Number	%
With the Farmers Involved	3	38	5	50	8	44
Farmers and GMP Head	0	0	1	10	1	6
With Local Authorities (Village Chief, Conseiller Villageois)	2	25	1	10	3	17
With Perimeter Director	0	0	3	30	3	17
Higher Political Authorities	1	12	0	0	1	6
Not Resolved	2	25	0	0	2	11

Source: Survey Data NOTE: Percentages may not add to 100 due to rounding error.

TABLE VII -1

PERIMETER MANAGEMENT AND ORGANIZATION
(PARCEL HOLDERS)

VARIABLES AND CATEGORIES	GALMI (N=32)		MOULLELA (N=19)		BOTH (N=51)	
	#	%	#	%	#	%
Who do perim. plots belong to?						
NA	5	15.6	3	15.8	8	15.7
1 - Govnt.	22	69.3	14	73.7	36	70.6
2 - Farmers farming	5	15.6	2	10.5	7	13.7
3 - ONAHA	0	0	0	0	0	0
4 - Other	0	0	0	0	0	0
Total	32	100	19	100	51	100
Who advises the Comité de Gestion?						
NA	2	6.3	1	5.3	3	5.9
1 - Perim. director	14	43.8	14	73.7	28	54.9
2 - Farmers	0	0	0	0	0	0
3 - Local authorities	5	15.6	0	0	5	9.8
4 - Higher local auth.	0	0	0	0	0	0
5 - Agents & director	7	21.9	1	5.3	8	15.7
6 - ONAHA Tahoua	2	6.3	3	15.8	5	9.8
9 - Don'nt know	2	6.3	0	0	2	3.9
Total	32	100	19	100	51	100
Who calcul. redev.?						
NA	1	3.1	0	0	1	2.0
1 - Perim. director	5	15.6	11	57.9	16	31.4
2 - Agents & director	3	9.4	1	5.3	4	7.8
3 - C.G.	10	31.3	1	5.3	11	21.6
4 - Dir, Com., Agents	7	21.9	1	5.3	8	15.7
5 - GMP heads & dir.	0	0	0	0	0	0
6 - GMP heads	0	0	0	0	0	0
7 - Farmers	0	0	0	0	0	0
8 - Tahoua office	2	6.3	4	21.1	6	11.8
9 - Don't know	4	12.5	1	5.3	5	9.8
Total	32	100	19	100	51	100

TABLE VII -2

PERIMETER MANAGEMENT AND ORGANIZATION
(PARCEL HOLDERS)

VARIABLES AND CATEGORIES	GALMI (N=32)		MOULLELA (N=19)		BOTH (N=51)	
	#	%	#	%	#	%
Who decides when to plant?						
NA	1	3.1	0	0	1	2.0
1	2	6.3	17	89.5	19	37.3
2	2	6.3	1	5.3	3	5.9
3	16	50.0	0	0	16	31.4
4	7	21.9	1	5.3	8	15.7
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	2	6.3	0	0	2	3.9
9	2	6.3	0	0	2	3.9
Total	32	100	19	100	51	100
Who decides when to irrigate?						
NA	1	3.1	0	0	1	2.0
1	8	25.0	17	89.5	25	49.0
2	2	6.3	0	0	2	3.9
3	14	43.8	2	10.5	16	31.4
4	6	18.9	0	0	6	11.8
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	1	3.1	0	0	1	2.0
Total	32	100	19	100	51	100

TABLE VII -3

PERIMETER MANAGEMENT AND ORGANIZATION
(PARCEL HOLDERS)

VARIABLES AND CATEGORIES	GALMI (N=32)		MOULLELA (N=19)		BOTH (N=51)	
	#	%	#	%	#	%
Who decides who gets ox?						
NA	1	3.1	0	0	1	2.0
1	0	0	2	10.5	2	3.9
2	0	0	0	0	0	0
3	22	69.3	12	63.2	34	66.7
4	1	3.1	1	5.3	2	3.9
5	0	0	0	0	0	0
6	0	0	2	10.5	2	3.9
7	0	0	2	10.5	2	3.9
8	0	0	0	0	0	0
9	8	25.0	0	0	8	15.7
Total	32	100	19	100	51	100
Does R attend comité/ coop meetings?						
NA--no perim. parcels	2	6.3	0	0	2	3.9
1 - yes	13	40.6	18	94.7	31	60.8
2 - no	14	43.8	1	5.3	15	29.4
3 - sometimes	3	9.4	0	0	3	5.9
Total	32	100	19	100	51	100
Relation to GMP head						
NA	1	3.1	3	15.8	4	7.8
1 = same family	15	46.9	10	52.6	25	49.0
2 = same quartier	11	34.4	2	10.5	13	25.5
3 = not related	5	15.6	4	21.1	9	17.6
Total	32	100	19	100	51	100

TABLE VII - 4

PERIMETER MANAGEMENT AND ORGANIZATION
(PARCEL HOLDERS)

VARIABLES AND CATEGORIES	GALMI (N=32)		MOULLELA (N=19)		BOTH (N=51)	
	#	%	#	%	#	%
Has R received warning from GMP head						
NA	1	3.1	3	15.8	4	7.8
1 = yes	2	6.3	3	15.8	5	9.8
2 = no	29	90.6	13	68.4	42	82.4
Total	32	100	19	100	51	100
Who tells to clean the canals?						
NA	3	9.4	0	0	3	5.9
1 - Perim. director	2	6.3	7	36.8	9	17.6
2 - GMP head	23	71.9	9	47.4	32	62.7
3 - Other farmers	1	3.1	0	0	1	2.0
4 - No one, just does	2	6.3	0	0	2	3.9
5 - Other	1	3.1	3	15.8	4	7.8
Total	32	100	19	100	51	100
How does R pay redevance?						
NA	1	3.1	1	5.3	2	3.9
1 - Cash crop sales	13	40.6	18	94.7	31	60.8
2 - Cash & food crops	6	18.9	0	0	6	11.8
3 - Commerce & crops	2	6.3	0	0	2	3.9
4 - Commerce rev.	3	9.4	0	0	3	5.9
5 - Migration income	2	6.3	0	0	2	3.9
6 - Animal sales	1	3.1	0	0	1	2.0
7 - Salary	2	6.3	0	0	2	3.9
8 - Skill-inc, crops	1	3.1	0	0	1	2.0
9 - From relative	1	3.1	0	0	1	2.0
Total	32	100	19	100	51	100

TABLE VII - 5

PERIMETER MANAGEMENT AND ORGANIZATION
(PARCEL HOLDERS)

VARIABLES AND CATEGORIES	GALMI (N=32)		MOULLELA (N=19)		BOTH (N=51)	
	#	%	#	%	#	%
What day does R irrig.?						
NA	2	6.3	2	10.5	4	7.8
1	14	43.8	2	10.5	16	31.4
2	11	34.4	6	32.6	17	33.3
3	2	6.3	4	21.6	6	11.8
4	1	3.1	3	15.8	4	7.8
6	0	0	0	0	0	0
7 +	0	0	0	0	0	0
8 OK, others do it	1	3.1	0	0	1	2.0
9 doesn't know	0	0	0	0	0	0
Total	100	19	100	51	100	
Who notifies R of irrig.?						
NA	2	6.3	2	10.5	4	7.8
1 - perim. director	2	6.3	6	32.6	8	15.7
2 - GMP head, Coop.pres.	21	65.6	7	36.8	28	54.9
3 - other farmers	2	6.3	0	0	2	15.7
4 - no one/knows sched.	4	12.5	4	21.1	8	15.7
5 - tam-tam	1	3.1	0	0	1	2.0
Total	32	100	19	100.0	51	100.
Does R hear about irr. in time ?						
NA	2.	6.3	2	10.5	4	7.8
1 = yes	3	9.4	1	5.3	4	7.8
2 = no	27	84.4	16	84.2	43	84.3
Total.	32	100	19	100	51	100
Lack of water?						
NA	2	6	2	10.5	4	7.8
1 - not enough	4	12	3	15.8	7	13.7
2 - enough	20	63	11	57.9	31	60.8
3 - sometimes insuff.	5	16	3	15.8	8	15.7
8 - OK, other irrig.	1	3	0	0	1	2.0
9 - doesn't know	0	0	0	0	0	0
Total	32	100	19	100	51	100

BIBLIOGRAPHY

Arnould, Eric
1986 "Maggia Valley Systems, Report of the Consulting Anthropologist." WMS-II Project. Cornell University and USAID/ Niger.

Briend, Roger
1986 "Rapport Annuel; Campagne Hivernal 1985, Campagne Saison Sèche 1985/86." Niger: ONAHA.

Chayanov, A.V.
1966 Theory of Peasant Economy, ed. D. Thorner, B. Kerblay, and R. Smith. Homewood, Illinois: Richard D. Irwin, Inc.

Coward, E. Walter
1985 "Property in Action: The Property Factor in Irrigation Development." Khon Kaen University, Thailand: Paper presented at Conference at Khon Kaen University.

El-Kholy, Heba Aziz
1985 Property Relations and Irrigation Organizations: A Case Study of Water Lifting Devices in an Egyptian Village in the Delta. M.S. thesis, Ithaca, New York: Cornell University.

GERSAR
1981 Aménagement Hydroagricole de la Plaine de Galmi: Projet, Etudes Preliminaires. Niger: ONAHA.

Horowitz, M.
1983 "Niger: A Social and Institutional Profile." New York: Institute for Development Anthropology.

Laucoin, Guy
1971 "Vers l'autogestion des aménagements au Niger." Developpement et Civilisations, no. 44:54-62.

1973 "La gestion des aménagements hydro-agricoles au Niger." Developpement et Civilisations, no. 51:21-31.

Norman, W. Ray
1986 "Gestion de l'eau dans l'aménagement hydro-agricole de Moullela: Une presentation des données de la campagne de 1985." Paper prepared for the Office National d'Aménagements Hydro-Agricoles, République du Niger. Special Study, USAID/WMS-II Project.

1987 "Developed and Traditional Small-Scale Irrigation in Niger, West Africa." Ph.D dissertation, draft. Ithaca, New York: Cornell University.

République du Niger
1985 "Evaluation du temps de travail des paysans sur quelques aménagements hydro-agricoles du Niger." Niger: Ministere du Plan.

SOGETHA
1968 Etude Agro-Economique des Petits Périmètres en Exploitation dans la Vallée de la Maggia, Mission 1967. Grenoble, France: SOGETHA.

1970 Etude Agro-Economique des Petits Périmètres en Exploitation dans la Vallée de la Maggia, Mission 1969--Rapport Final. Grenoble, France: SOGETHA.

United States Agency for International Development
1984 "Niger Irrigation Subsector Assessment," Volumes One and Two. Niger: USAID.

1986 "Applied Irrigation Research and Coordination (AIRC)." Project Identification Paper, USAID/Niger.

Wells, John Craig
1985 "Sedimentation of Small Irrigation Reservoirs in the Ader Doutchi Maggia." WMS-II Project Trip Report. Ithaca, New York: Cornell University.