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Traditional Farmer-Managed Irrigation System in Central Nigeria

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Abstract

This paper examines the characteristics of a traditional farmer-managed irrigation system in Nigeria, through the presentation of a detailed case study. It documents the development of a traditional irrigation system in the inland valley of the Bida region in central Nigeria and the features of its operation and management. The physical structure and the composition of system users were surveyed in detail. In addition, the characteristics of community management of several irrigation systems in the region were investigated. Farmers were able to mobilize necessary local resources for irrigation development and maintenance although they did this without any external support. The irrigation management institution in the area was highly linked to the local land tenure system. The involvement of landlords in the irrigation community greatly affected the performance of irrigation management. There was no clear definition of water rights. In times of water shortage, water was rotated and shared but water scrambling had become a severe problem in recent years with the higher demand for off-season crops. Irrigation communities were organized informally without tiers of nested organizations. Unfairness in water distribution and contribution to system maintenance existed between top-enders and tail-enders of irrigation canals. Nevertheless, the multi-layered and fragmented land ownership of the region made coordination among different irrigation communities difficult and the unfairness problem could not be solved without institutional changes.

Discipline: Irrigation, drainage and reclamation / Agricultural economics
Additional key words: community-managed irrigation, farmer organization, off-season crop production, rice production, water management

Introduction

After the failure of many large-scale irrigation schemes, many aid donors and development agencies have become increasingly involved in informal small-scale irrigation in sub-Saharan Africa[1,2]. With the attempt to achieve agriculture intensification and modernization, the Nigerian government had put a substantial investment of more than US$ 200 million into irrigation development between 1976 and 1990[9]. Nevertheless, some of these large-scale irrigation schemes have totally collapsed mainly due to lack of proper maintenance while others are functioning far below full capacity. On the contrary, traditional small-scale irrigation systems are long established and are of growing economic significance*. According to FAO and World Bank estimates, the area of informal irrigation developed spontaneously by farmers increased from 120,000 ha to 800,000 ha during 1958-78 in Nigeria[6,13]. Most traditional and indigenous irrigation systems in West Africa are characteristically single-source, single-user systems, therefore the aid donors in Nigeria are also focusing on well-boring and provision of subsidized petrol pumps[10]. However, increasing water scarcity and unchecked population growth will increasingly necessitate the use of shared water sources for irrigated production. Market development has also been stimulating the spontaneous development of such single-source, multiple-user irrigated production systems[11]. Enhancing the management of such systems will effectively improve agricultural productivity for system users. This study examines characteristics of a farmer-managed irrigation system in the inland valley of the Bida region in central

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Nigeria. It documents the development of a traditional system and the features of its operation and management.

Site description and methodology

The research was conducted in the southern part of Bida (8˚99' N, 5˚99' E), a town in Niger State in central Nigeria. The vegetation of the area belongs to the Guinea savanna zone. The yearly precipitation is about 1,100 mm and the mean annual temperatures are in the range of 23-34ºC. The region is characterized by a 6-7 month wet season during which rain-fed agriculture is practiced, and a 5-6 month dry season in which farmers may cultivate small, irrigated plots. The farmer-managed irrigation system selected for surveying was located in the upstream basin of River Emikpata (Fig. 1), which runs dry in most parts during late January to April. The site is an intensively used, productive system of irrigated farms which has developed autonomously under local initiative with no external assistance. Initial reconnaissance visits were carried out during August to September 2004. The basic organizational structure and management of several traditional irrigation systems in

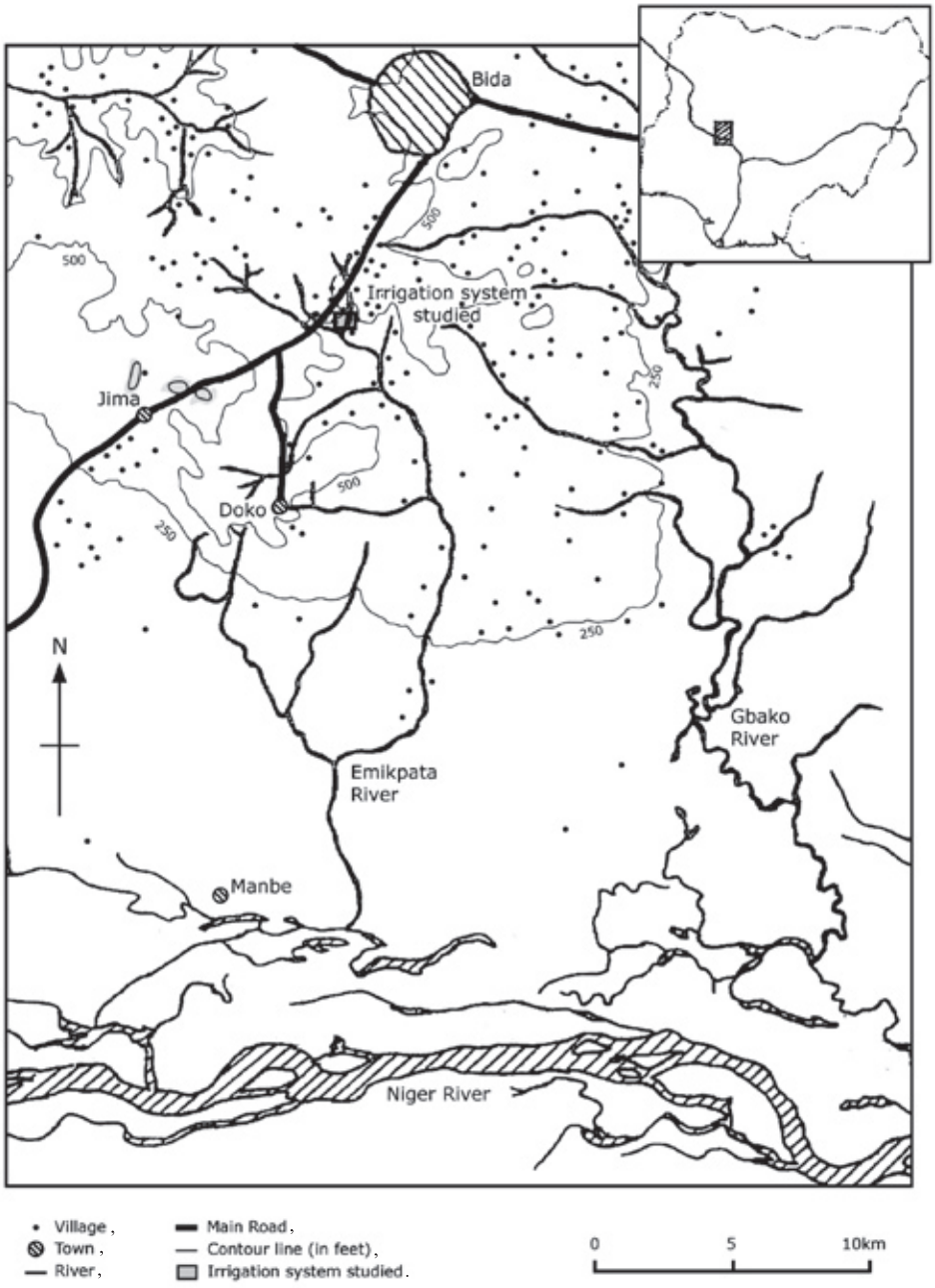

Fig. 1. Bida and location of the research site

the region were initially assessed by informal interviews with farmers and village heads. A farmer survey form was developed which addressed a broad range of issues related to community organization, land tenure, channel development and maintenance, water allocation, and farm production and marketing. Forty farmers were interviewed with the survey form during January to February 2005. The irrigation channels and the irrigated farm plots of the selected site were physically surveyed and measured in detail by a simple total station and measuring tape. Based on the survey map, the surface areas of farm plots in the research site were determined by a digital area-line meter (PLANIX EX of Tayama Technics Inc.). The subsequent exchange rate was around one US dollar to 132 Nigerian Naira during 2004 to 2005 based on the data obtained from the Central Bank of Nigeria.

Findings and discussion

1. Inland valley farming system of Nupe farmers

Irrigation systems in the inland valleys of Bida are used for rice cultivation and some off-season crop production. Interviewed farmers sold 57% of the rice they harvested. They farmed 2.11 rice plots and generated an amount of rice worth N 32,330 (~US$ 245) on average. Off-season crop production is more elastic to changes in market prices and farmers always alter the type and quantity of crops they plant during the dry season. Most of the harvested off-season crops are for sale, especially okra, red pepper and cassava which very often are almost all sold to merchants. Informants cultivated 2.08 irrigated plots and generated N 83,577 (~US$ 633) on average from the sale of off-season crops.

Table 1. Rice production of interviewed Nupe farmers

	No. of Entries	Average	Minimum	Maximum	Standard Deviation
No. of rice plot farmed	27	2.11	1	4	0.89
Rice selling price per a sack of 75 kg (in Naira)	22	N 2,539	N 1,800	N 3,800	N 593
Gross production of rice* (in Naira)	27	N 32,330	N 5,000	N 87,500	N 21,176
Percentage of harvested rice sold	26	57%	0%	100%	31%

Source: Farmer survey.
*: Includes the amounts for household-consumption and for sale.

Table 2. Off-season crop production figures of interviewed Nupe farmers

	No. of Entries	Average	Minimum	Maximum	Standard Deviation	% of total gross income
No. of plots farmed	24	2.08	1	5	0.88	
Gross income from off-season crops (in Naira)	24	N 83,577	N 1,600	N 234,600	N 68,653	
Income from each type of crop (in Naira):						
Okra	13	N 29,546	N 5,000	N 161,000	N 41,431	19%
Sweet Pepper	21	N 52,763	N 4,800	N 225,000	N 54,168	55%
Sweet Potato	10	N 5,400	N 1,500	N 18,000	N 4,927	3%
Cassava	23	N 7,316	N 800	N 64,000	N 13,063	8%
Garden Egg	6	N 32,200	N 800	N 160,000	N 63,001	10%
Cowpea	5	N 3,470	N 250	N 10,500	N 4,111	1%
Spinach	2	N 1,200	N 1,000	N 1,400	N 283	0%
Sorrel	2	N 6,750	N 1,500	N 12,000	N 7,425	1%
Sugar Cane	1	N 5,000	N 5,000	N 5,000	-	0%
Tomato	1	N 60,000	N 60,000	N 60,000	-	3%

Source: Farmer survey.

2. Traditional irrigation system management

(1) Physical structure and development

Small-scale irrigation systems account for 94% of the total irrigated area in Nigeria[8] and surface (gravity) irrigation methods are the most predominant[12]. In central Nigeria, small weirs and channels are widely constructed to divert natural drainage water around inland valley swamps. Figure 2 shows the layout of the irrigation system surveyed. Plots cultivated by farmers of different villages are assorted in different patterns. The system is a typical traditional irrigation system commonly seen in the Bida area. Simple semi-permeable diversion modules were built using brushwood and earth to divert water from River Emikpata and River Emma into the two canals. Sixty-one irrigated plots with a total area of 181,376 m^2 were surveyed. Within such a small area, there were at least 49 farmers coming from 14 villages cultivating their irrigated plots. The average plot size was just 2,973 m^2 (Table 3). Canal 1 and canal 2 have been dug by farmers for over 80 years and 60 years respectively. The dimensions of the two canals are about 0.5 m in depth and 0.5 m in width at the ground surface. Informants indicated that about 28 years ago farmers began to join in a collective effort to weed and to maintain the system. The initiation of this community effort was probably related to a drought that occurred in the early to mid 1980s when farmers realized individual effort was not enough to secure water. The expanding demand for off-season crops since the last decade is leading to higher competition for water. Some farmers even revealed that they sometimes needed to sleep in their fields at night to secure water, which would have never happened in the past when off-season crop cultivation was less common.

(2) General management features

The fundamental tasks for irrigation system management are the organization of water allocation, physical maintenance activities and conflict management[4,7]. Some general features of how farmers organize these tasks for irrigation management in the region are discerned†.

First of all, there is a high degree of embeddedness of irrigation system roles in other powerful roles in the local society. Traditionally each village has a farmer's leader, *Etsunu*, who facilitates farming activities and coordinates community work of villagers, including management of

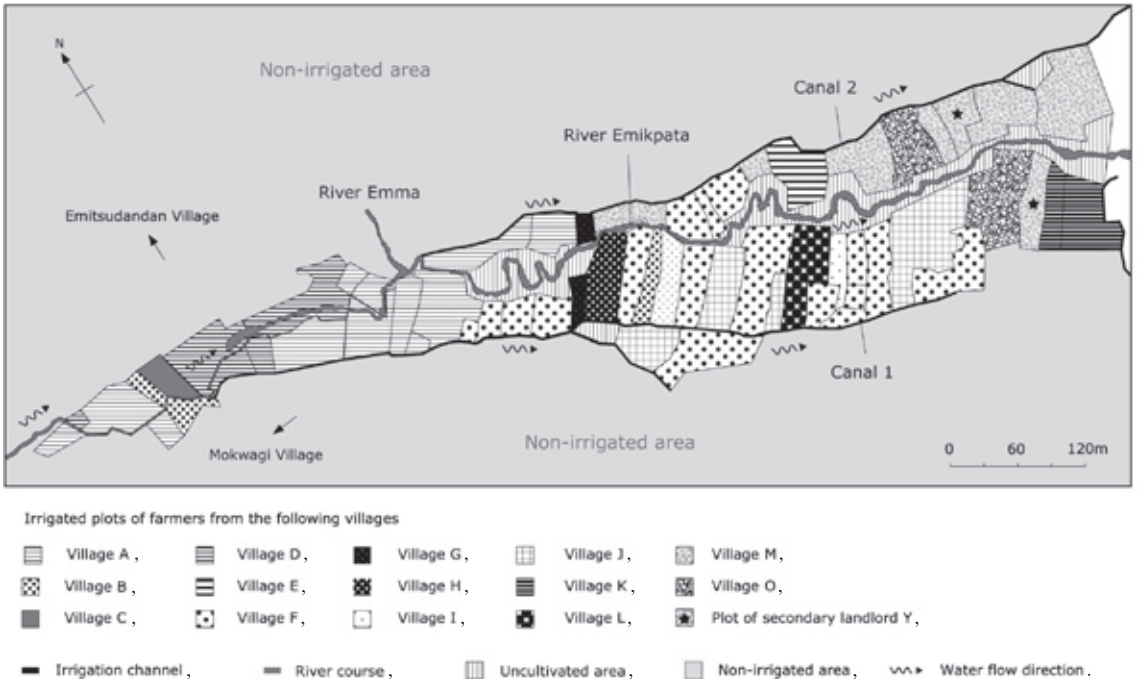

Fig. 2. Layout of the farmer-managed irrigation system surveyed

Table 3. Area of plots surveyed

No. of Entries	Average	Minimum	Maximum	Standard Deviation
61	2,973 m^2	377 m^2	9,652 m^2	1,989 m^2

Source: Survey conducted by author.

agricultural water. However, his influence on irrigation management is minor because a canal is usually utilized by farmers of various villages whom he is not entitled to monitor. The legitimate leaders of irrigation communities are usually the secondary landlords. Land is held in trust by the *Bida Emir* in the region. Under the *Emir* there are primary landlords which were created by the feudal system of the old Nupe kingdom. Secondary landlords are the "land managers" at community level. They have always been charged with the responsibility of settling minor land tenure disputes within the communities. Therefore, it is perhaps natural that they would come to play the important roles in the management of irrigation systems as they developed into important economic entities. The construction and extension of any irrigation canal should be approved beforehand by the secondary landlords. In times of water shortage, secondary landlords normally play an important role in facilitating water rotation among system users. They are the only persons at the community level who have the right to evict farmers from their plots when they seriously misbehave. Figures 3 and 4 indicate the landownership of the system surveyed.

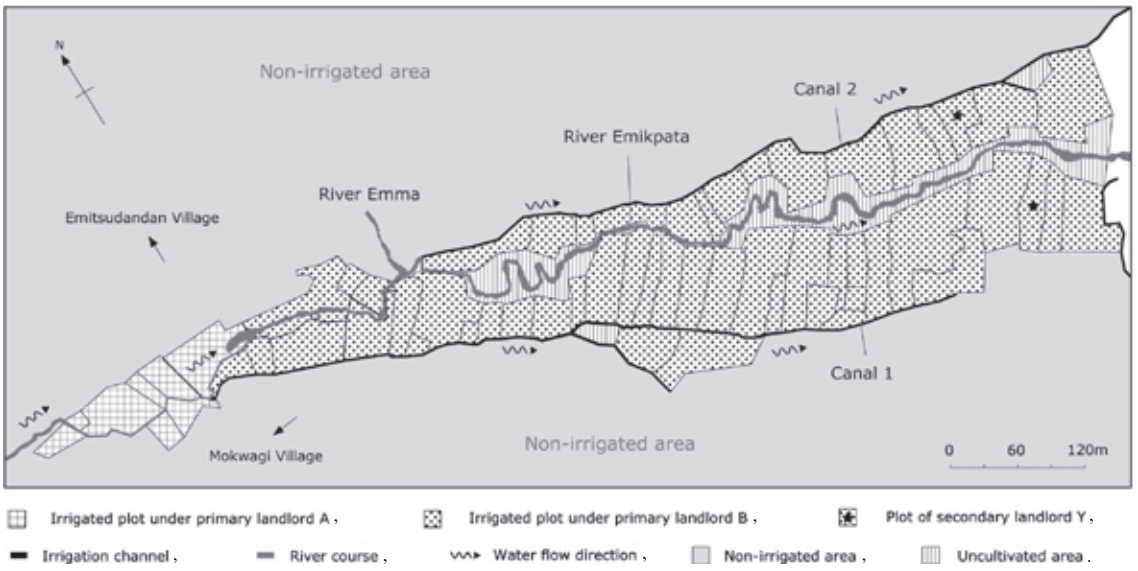

Fig. 3. Primary landownership of the system surveyed

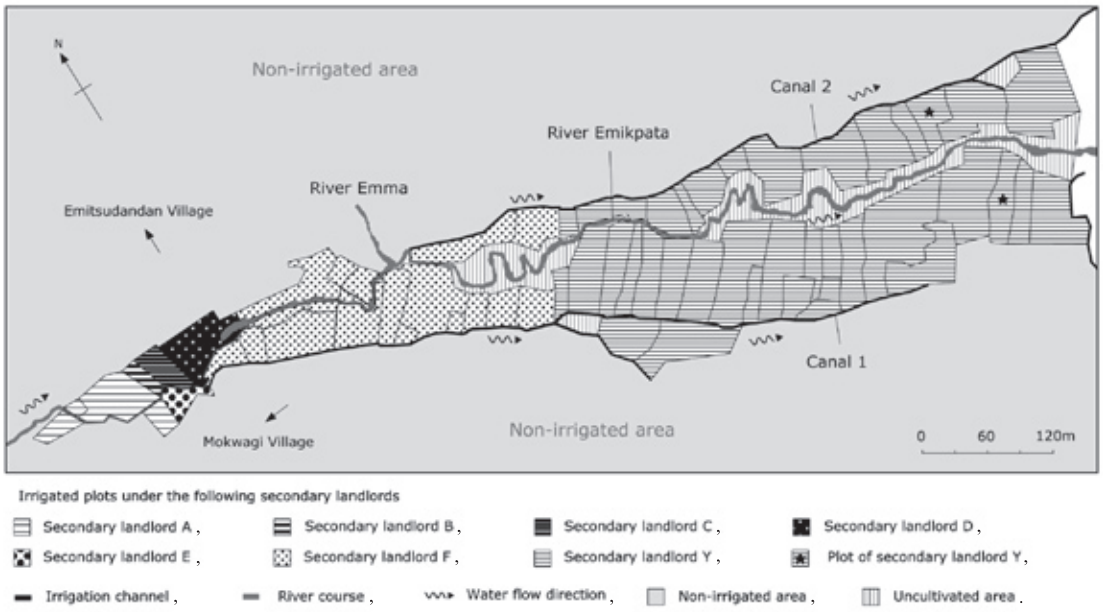

Fig. 4. Secondary landownership of the system surveyed

The second feature is that irrigation communities are organized informally and are not organized into tiers of nested organizations. There is no formal rigid organizational structure for irrigation communities. Formal positions for community leader and system monitor do not exist, although some highly respected elders and the secondary landlords are assumed to have the power to lead and monitor system users. In the region, farmers belonging to the same village usually farm close to each other. This tendency is clearly validated in Fig. 2. It is natural that farmers from the same village form a work team together to maintain the portion of the canal adjoining their fields. Neighboring work teams cooperate occasionally for maintenance tasks that cannot be handled by a few farmers and for water rotation during periods of water shortage. However, there is no higher layer of organization for irrigation management that coordinates the cooperation of each work team. There is neither an organization for farmers using the same canal nor an organization for farmers using the same irrigation system. The secondary landlord may coordinate some tasks in case of emergencies but his power does not go beyond the land under his control. The lack of higher layers of organization makes the coordination of large-scale and long-term activities among several work teams difficult.

The third feature is that there is no clear definition of water rights in the region. The Water Resource Decree promulgated in 1993 approved "riparian rights" for all Nigeria, in which anyone whose land is alongside a river or a stream owns half the riverbed and is entitled to use half of the water on his land. Nevertheless, this concept is not well acknowledged by Nigerians[12]. Bida area is dominated by Islamic values so farmers regard water as a gift from god. The main concept is that a farmer can use as much water as he needs when water is abundant, provided that he let any extra amount of water return to the flow for the use of others. In times of water shortage, water should be shared although in practice it is always difficult to prevent farmers from scrambling for water. Water rotation during the dry season is decided informally most of the time and in an impromptu manner. Farmers constantly negotiate for water with neighboring farmers and with top-enders of the system. The second concept is that, when a farmer participates in the community maintenance of the system, he should have a claim to the water and nobody should block his inlet without consulting him.

The main community maintenance task is the weeding and cleaning of streams and canals at the beginning of each irrigation season, which is around September for the irrigation of rice and late January for the irrigation of off-season crops. The task in September is considered to be the most tedious and is supposed to be compulsory for all system users to participate. If a farmer is repeatedly absent from the community work, he is supposed to be at risk of being deprived of irrigation water and even his plots. However, in reality no farmer has ever been punished severely despite some violators that may have had to beg for forgiveness from community leaders. The collective weeding usually requires work for at least a few days, and farmers gather once a week to clean out the canals and/or river course together for at least a month. The chief maintenance problems reported in

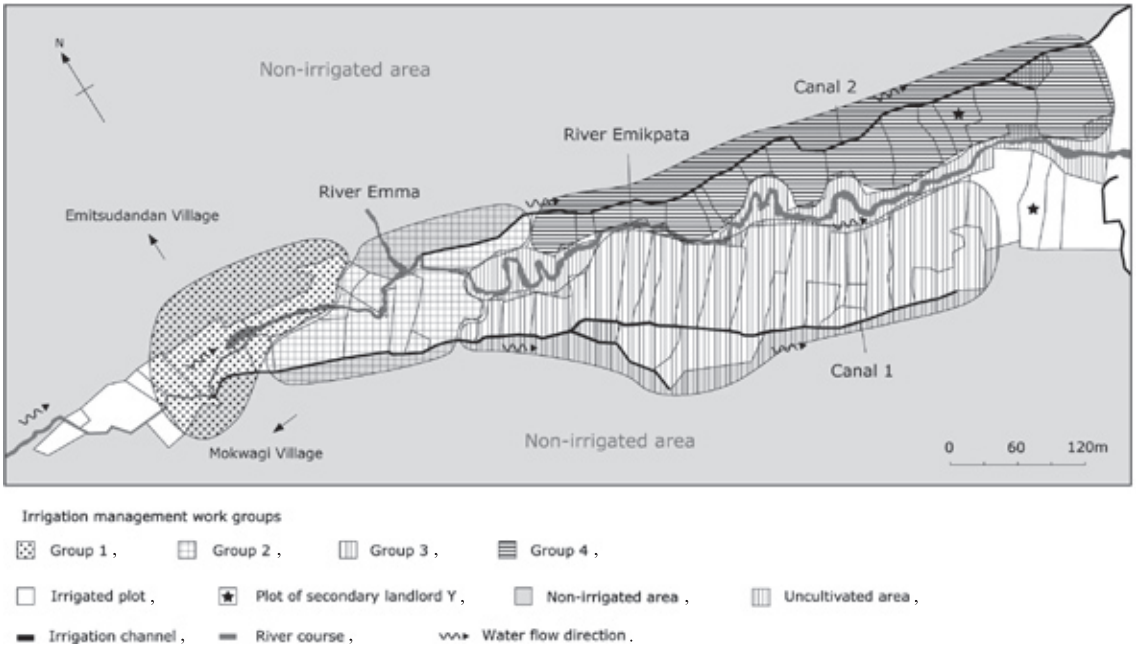

Fig. 5. Four work groups of irrigation management for the system surveyed

the survey were channel damage caused by encroachment of Fulani cattle and destruction of diversion modules due to flooding. The financial burden of canal maintenance is minimal because construction materials such as rocks, branches and vegetation are available locally. Community members will share the burden in case money is needed to buy materials.

(3) Irrigation management community

As mentioned, the land system of the area is characterized by a three-layered structure and the landownership of the area is fragmented. Meanwhile, it was identified that the management of the surveyed system is carried out by four farmer communities (Fig. 5). These communities are often composed of farmers from various villages. Therefore, it is difficult to regulate the behavior of members when the secondary landlord, the only person who has power over land at the community level, does not directly participate in the community. When the time for community work approaches, community leaders would fix a schedule and deliver messages to request system users to join. In case of group 3, farmers indicated that it is less easy to mobilize all users as the community is composed of farmers of eight villages while the secondary landlord is not involved. Bardhan & Dayton-Johnson[3] demonstrated that heterogeneity among users of a community-based natural resource is associated with a poor commons performance and it may partially explain this situation. In addition, although leaders of group 3 are highly respected elders for their diligence and commitment to canal management, they lack legitimacy to impose any graduated sanctions on those who do not participate in community work as they are not the landlords. This factor largely weakens their leadership and the performance of the community.

On the contrary, informants responded that the leadership of group 4 was much stronger as the group leader was the secondary landlord Y. All interviewed farmers of canal 2 mentioned that they were afraid of his power to take over their lands so they did not absent themselves from community work. The role of the secondary landlord is important because his presence largely increases the sense of obligation of community members which leads to better management of canals. Nevertheless, secondary landlord Y was not concerned about the management of canal 1 which he did not benefit from and his absence adversely affected the performance of group 4. He also did not have power over farmers whose plots were not under his management; therefore he could not stop the free-riding of groups 1 and 2 further upstream from group 4.

The conflict between farmers with plots nearer to the head of canals, the top-enders, and farmers with plots at the end of the canals, the tail-enders, has always been a concern of irrigation management. In this research, the correlation coefficient between the distance of the plot to the water source and the gross incomes were derived from all available samples. It is -0.33 for gross production of rice and -0.03 for gross income from off-season crops. The results show that increasing the distance from the water source has a negative impact on farmers' gross income. Top-enders enjoy a natural advantage in water distribution and obtain higher benefits compared with tail-enders. The impact on gross income from off-season crops is weaker. It is probably because during the dry season the amount of water that a farmer can get depends mostly on how early he begins the off-season plantation and how hard he works to channel water into his basin. Farmers with other occupations during the dry season were also less involved in off-season plantations. Table 4 shows the degree of participation in community maintenance of farmers of the four groups. The participation rate was the highest for group 4 under the strong leadership of secondary landlord Y. The results indicate that top-enders tend to contribute less to the community maintenance of the system while farmers with plots on the latter part of the system have to work harder in order to secure water. As shown in Fig. 4, most of the top-enders of the system surveyed were themselves the secondary landlords, their incentive to contribute to irrigation management was low because even if they did not participate in the community management of the canals they could still benefit from the water and they were not going to be punished. For tail-enders to secure water, they have to better organize themselves and contribute more

Table 4. Degree of participation of the 4 work groups of the irrigation system surveyed

Work group	Count	Degree of participation in community tasks*
1	12	0.83
2	6	1.17
3	18	1.61
4	5	2

Source: Farmer survey.

*: Degree of participation is categorized as follows; No participation = 0, Low participation = 1 and High participation = 2, based on the number of community meetings and weedings that an informant attended, and his sense of involvement in the irrigation community.

in community weeding so that water can flow to their plots. This unfairness between top-enders and tail-enders cannot be solved unless there are higher layers of organization and institutions that coordinate management tasks and water distribution among different communities of a more extensive area.

Conclusion

The traditional irrigation system presented is an important case study in that it exhibits characteristics typical of many spontaneously developed systems in the region. Farmers were able to organize themselves for the collective maintenance of the irrigation system without any external assistance although a formal organizational structure did not exist. Water allocation was flexible as farmers could constantly adjust and negotiate for water in accordance to different circumstances. The cost of maintenance was low as materials were available locally. On the other hand, the management of the irrigation system in the region was highly linked to the local land tenure system. The multi-layered and fragmented land ownership was the major obstacle to improve efficiency of irrigation system management. In the absence of a higher layer of organization for irrigation management, it is difficult to avoid free-riding of top-enders with natural advantages. Tail-enders have a greater incentive to contribute more in collective maintenance in order to secure water. With greater competition for water due to increasing demand for off-season crops, disputes over water distribution between top-enders and tail-enders may increase. Moreover, coordination for large-scale maintenance work and water distribution for a broader area among various groups is difficult. Community leaders apart from those who were also landlords lacked the legitimacy to impose graduated sanctions on those who did not participate in communal work and this adversely affected the effectiveness of community management. For further agricultural development of inland valley bottoms in the region, institutional arrangements for irrigation management should be enhanced otherwise existing management capacity may not be able to meet higher water demand in the future.

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Note

* Elinor[5] emphasized the importance of institutional arrangement for long-enduring, self-organized irrigation systems.

† Apart from the system chosen for detailed case study, systems located in Nasarafu village, Emisheshinatsu village, Gadza village, Kpatagi village, and Makwa villages were briefly studied by interviewing farmers and secondary landlords.

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