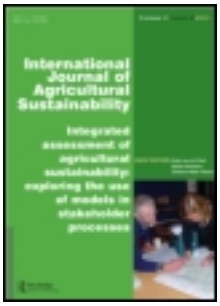

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Drivers of cooperative choice: canal maintenance in smallholder irrigated rice production in Benin

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Drivers of cooperative choice: canal maintenance in smallholder irrigated rice production in Benin

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Rice production in inland valleys in Southern Benin was initiated by the public sector. The subsequent devolution of responsibility for maintaining the collective irrigation infrastructure to farmers created an opportunity to study the factors that affect cooperation in canal maintenance. We used a social dilemma perspective to compare three rice production areas that differed in the extent of cooperation, based on focus group interviews, surveys, and archival research. The findings draw attention to the nature of the resource, the characteristics of the user group, and farmer-based institutional arrangements as explanatory variables. Specifically these include (1) the balance between water demand and availability, (2) the existence of inequities and privileged positions within the group, and (3) the strength of group organization and the ability to sanction uncooperative behaviour. The existence of alternative sources of livelihood also influenced cooperation. Contrary to our expectations, the largest and most diverse group of producers appeared best organized and equipped to engage in cooperation. Size and diversity might actually allow (1) the emergence of institutional arrangements that can overcome social dilemma situations and demotivation emanating from customary privileges and exemptions and (2) better use of Africa's irrigation potential.

Keywords: collective action; canal cleaning; water management; inland valleys

1. Introduction

Rice production in inland valleys is a relatively recent phenomenon in Benin. Starting in 1976, irrigation schemes for small-scale farmers were constructed with the help of Chinese projects. The Marxist–Leninist regime of the day all over the country organized farmers into various kinds of 'revolutionary' groups and cooperatives, but these were not responsible for the maintenance of irrigation infrastructure; that was the responsibility of the Ministry of Agriculture. The government also set up public companies to provide production and marketing services. Meanwhile, most farmers continued their customary un-irrigated crop production. Rice production was an add-on to the traditional farming system.

The structural adjustment policies imposed by the International Monetary Fund between 1988 and 1992 led to restructuring of agricultural services to reduce public sector costs (Ahmed and

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Lipton 1997, Sodjinou *et al.* 2008). When the socialist regime came to an end in 1990, farmers were asked to take responsibility for the maintenance of the infrastructure in their command areas and for solving the related water management and agronomic problems. The food crisis in 2008 led to a 50% increase in retail rice prices in Benin, and this has stimulated farmers' interest in rice production (WFP no date).

A recent exploratory study conducted in 18 rice production areas in Benin showed that many of the problems relating to farmers' insufficient or variable access to water are caused by faulty maintenance of irrigation canals (Saïdou and Kossou 2009). A diagnostic study in 3 (Koussin-Lélé, Bamè, and Zonmon) of these 18 areas explored technical and institutional factors that hinder the effective use of irrigation water (Totin *et al*. 2012). It revealed that not all farmers contribute to the maintenance of irrigation canals that serve them all. Faulty cleaning and sediment accumulation in the canals mean that the water requirements of many farmers cannot be satisfied. In all three cases, more effective water management would allow the expansion of the rice production area and permit more farmers to increase their living standards. To reduce current yield losses and increase total production, rules have been enacted that require all farmers to contribute to maintaining the infrastructure.

As this paper will show, differences exist in the extent to which these rules are followed in the three areas. In Koussin-Lélé, participation in the maintenance of the irrigation canals is moderate. To escape sanctions, farmers do clean the canals, albeit too slowly and not very thoroughly. In Bamè, farmers do not contribute at all to the maintenance of canals. In Zonmon, farmers do not always comply with the rules, and canals are often insufficiently cleaned. Similar differences between the three areas were observed with regard to the maintenance of collective machinery and the payment of fees. At the same time, other forms of organization exist that seem to function reasonably well. For instance, farmers cooperate to collectively purchase inputs, make collective credit requests, and sell their harvested rice. Why is the collective maintenance of the irrigation infrastructure so problematic?

The case study reported here seeks to answer this question and, by comparing the three production areas with a focus on canal cleaning, improve our understanding of the factors that affect cooperative action.

2. Theoretical framework

2.1. *Collective action*

The literature on collective action is extensive (e.g. Olson 1965, Wade 1988, Ostrom 2000, 2003, 2009). Collective action may occur when the contribution of more than one individual is required to achieve a common goal (Ostrom 2004). Most definitions of collective action feature the involvement of a *group of people* who take *coordinated and distributed action* in pursuit of a *shared interest* (Ostrom 2003).

In the case of irrigation infrastructure maintenance, we are essentially dealing with a public goods dilemma: the individual farmer is faced with the choice of whether or not to contribute to the maintenance of a public service or good, from which all may benefit, regardless of whether they have helped provide it (Brewer and Kramer 1986, Kollock 1998, Leeuwis and van den Ban 2004, p. 73). Implicit is the temptation to enjoy the good or service without contributing to its maintenance (Leeuwis and van den Ban 2004, p. 329). In the longer term, such free riding may undermine the willingness of others to cooperate and eventually lead to the collapse of the public good. Willing co-operators may fear that not enough others will cooperate, and they consequently choose to defect (Kollock 1998; Eek and Biel 2003, Holzinger 2008, p. 14). A public goods dilemma is characterized by tension between short-term individual interests and the public interest (Leeuwis and van den Ban 2004, p. 73). The short-term individual choice

often prevails, although in the longer term, all would have been better off if all had made the cooperative choice.

The failure of collective action can thus be regarded as emerging from non-cooperative choices of individual farmers, including non-participation in group work and disregard of established community rules.

2.2. *Factors influencing cooperative choices*

Several studies deal with the factors that contribute to successful cooperative action (Wade 1988, Ostrom 1990, 2003, 2011, Fujiie *et al*. 2005, Gopalakrishnan 2005, Araral 2009, Hanatani 2010, Woodhill 2010). Sandler (2004, pp. 25–36), Gopalakrishnan (2005), and Ostrom (2009) identify three main categories of factors relating to participation in collective action: (1) physical and technical characteristics of the resource around which the group work is organized, (2) characteristics of the user group (number, homogeneity, and so on), and (3) attributes of the institutions that govern the interaction among the different users of the resource (e.g. rules that govern collective well-being). We discuss each of these in turn.

2.2.1. *Resource characteristics*

Wade (1988) demonstrated that the availability of a given resource affects the way people cooperate for its maintenance. In the case of irrigation, for instance, if water supply is abundant relative to demand, there is no incentive for users to undertake cooperative action to augment the supply or economize on consumption (Fujiie *et al.* 2005). When water is moderately scarce, cooperative activities that aim to increase water supply at plot level (e.g. de-silting of canals) will generate the highest perceived direct economic benefits, and people are, therefore, more likely to contribute to these activities.

2.2.2. *Characteristics of the user group*

On the basis of the social–psychological literature, Koelen and Röling (1994 cited in Leeuwis and van den Ban 2004), Velded (2000), Dayton-Johnson and Bardhan (2002), and Poteete *et al.* (2010) have all argued that a small, socially homogeneous community (e.g. in terms of caste or ethnic group) and economic similarity increase the likelihood of successful cooperative action. Conversely, people are less likely to act in the collective interest when communities are large or heterogeneous. Olson (1965) suggested that cooperative action is more difficult to organize in larger groups. As group size increases, individuals will argue that their marginal contribution does not significantly affect the likelihood that the good will be provided and, therefore, refrain from making such contributions. Fujiie *et al.* (2005) concluded that this theory applies to irrigation systems and that group work is hard to manage in water user associations with a large number of members.

2.2.3. *Institutional arrangements*

Group members will pursue a collective goal only when they expect other members to contribute as well (Eek and Biel 2003). In these conditions, effective leadership and experience of fair enforcement of rules is crucial. When exploring the causal mechanisms of cooperation for sustainable resource management, Hanatani (2010) found that people are able to successfully participate in group work when institutions (e.g. the possibility of agreeing on rules, surveillance of compliance, and fair sanctions) exist, even when some of the facilitating conditions, such as the size

and the homogeneity of the user group, are absent. We regard institutions as including formal and informal rules, implicit cultural norms, and shared values and symbols that influence farmers' cooperative choice.

Among the conditions associated with successful cooperative choice, institutions such as local rules and controls can, therefore, play an important role (Ostrom 1990, 2004, 2011, Lustiger-Thaler *et al*. 1998, Hargrave *et al*. 2006). Hill (2000) added that the existence of rules and controls is effective in reducing the rate of non-cooperative choice. The various factors reviewed are synthesized in Figure 1. A further analysis of the way institutions influence cooperative action suggests that they do not directly restrict or shape people's behaviour as external conditions but provide incentives (positive and negative) for individuals and groups to behave in particular ways (Figure 2, Woodhill 2008).

This paper addresses the following questions: (1) How and to what extent do the farmers in the three areas cooperate in the maintenance of the irrigation infrastructure? (2) What are the characteristics of the irrigation water supply systems in the three inland valleys? (3) What are the characteristics of the groups involved in the maintenance of irrigation infrastructure? (4) What are the (dis) incentives created by the existing institutions and to what extent do farmers comply with, ignore, or go against established rules? and (5) To what extent do differences among the three areas explain the divergent degrees of cooperation?

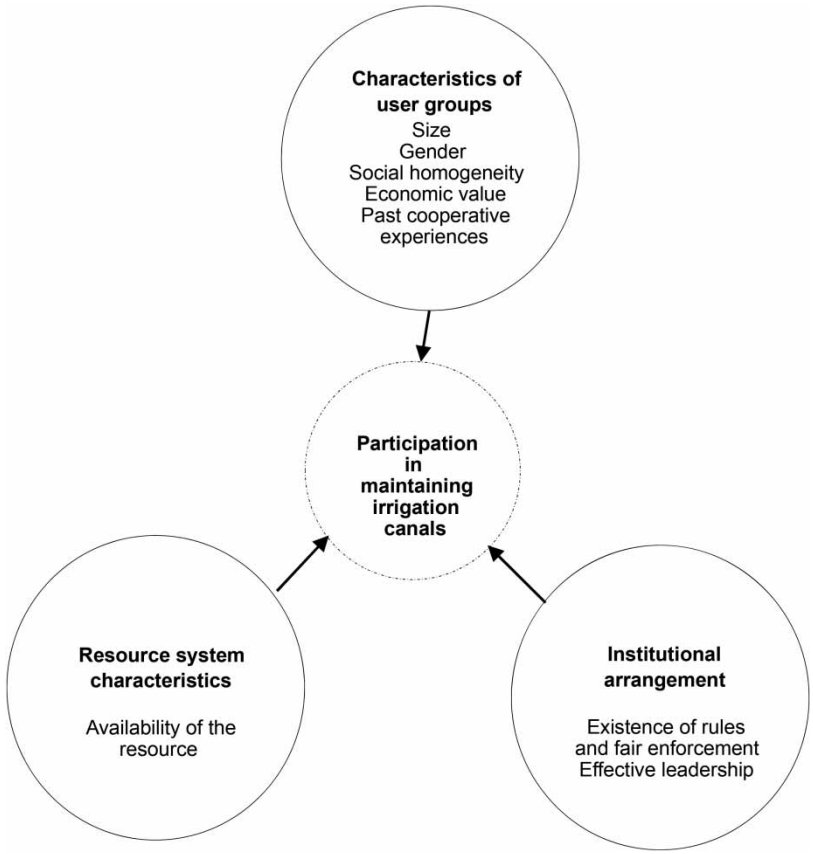

Figure 1. Clustering of factors influencing farmers' cooperative behaviour in maintaining irrigation canals.

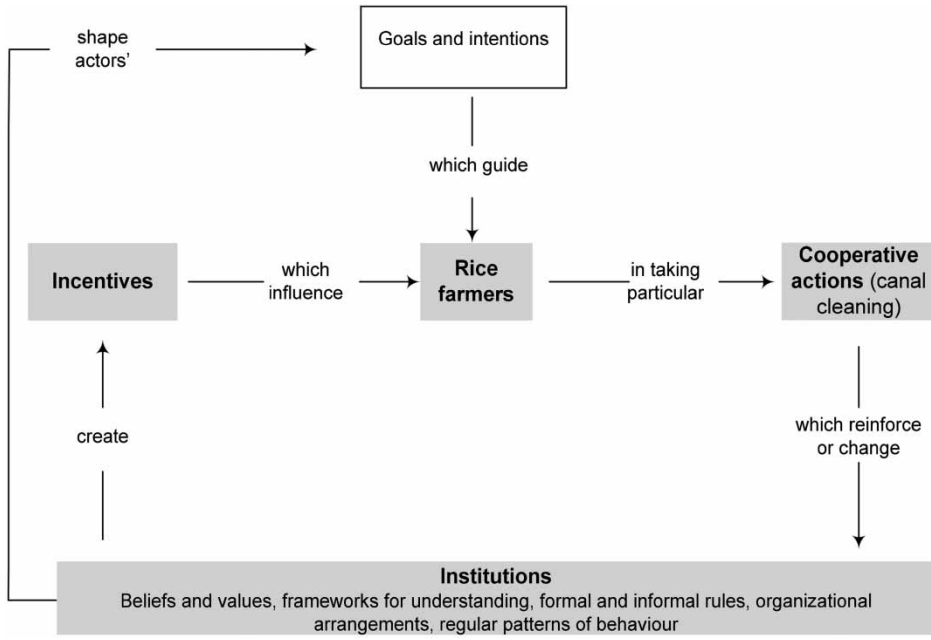

Figure 2. Institution and action model: cooperative action as the result of incentives created by institutions. Adapted from Woodhill (2008).

3. Methodology

Three areas on the Agonlin Plateau (Koussin-Lélé, Bamè, and Zonmon) were selected on the basis of an exploratory study that screened 18 rice producing villages located throughout Benin (Saïdou and Kossou 2009). The areas were chosen because (1) the issues around water use were found to be persistent, (2) they offer contrasting water-use practices that promised fruitful comparison across the areas, and (3) respondents in these areas considered the maintenance of the irrigation infrastructure a critical issue. In the three areas, the farmers have long experience in irrigated rice production.

Koussin-Lélé is a production area in which farmers work during the day and return to their respective communities in the evening. In Bamè and Zonmon, the irrigation command areas are located within the village boundaries (Figure 3). When we refer to irrigation infrastructure maintenance, we refer mainly to farmers' individual participation in canal cleaning and to farmers' contribution to operations undertaken to maintain agricultural equipment, for example, in the form of paying fees.

The research reported here followed a comparative case study design and used qualitative methods to gain information about the three cases. Data were collected using focus group discussions (FGDs) (Kitzinger 1994), a survey, and archival research.

In total, 10 FGDs were held (6 at Koussin-Lélé, 2 at Bamè, and 2 at Zonmon). These discussions were recorded, translated, and transcribed as literally as possible. We distinguished two social status categories, as follows: (1) privileged farmers, such as the (original) landowners (who were expropriated to develop the rice production areas), the traditional chiefs, and the leaders of farmer associations and (2) non-privileged farmers. Assuming that status might be an important factor in determining willingness to contribute to canal cleaning, we organized separate FGDs for each category. The allocation of farmers to categories was decided with the help of

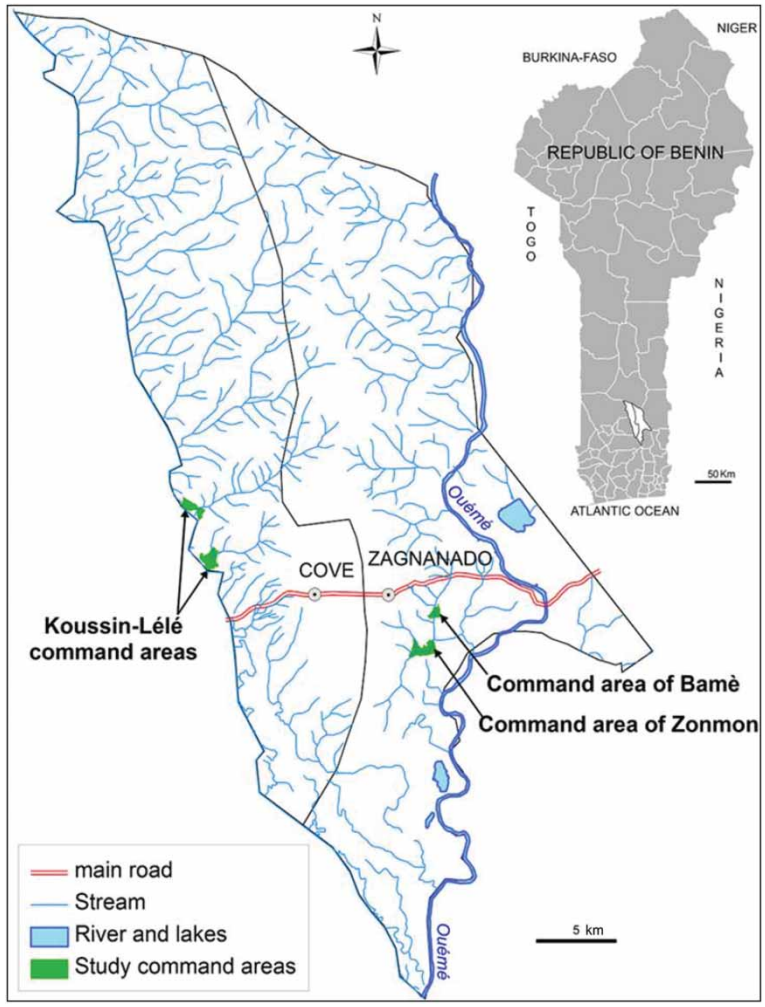

Figure 3. Map of Covè and Zangnanando districts showing the irrigation command areas. Source: Djagba et al. 2013.

extension officers who assist the farmers in their everyday activities. In total, 73 farmers including 62 males and 11 females were involved in the FDGs. To allow for in-depth discussion, no more than eight farmers participated in each discussion. During the FGDs, the farmers reflected on their maintenance activities, the local rules, and the incentives (positive and negative) created by the existing rules.

Together with our direct observations of canal cleaning during the field visits, the FGDs helped us form a picture of the conditions under which rice farmers cooperate in canal cleaning and understand how and to what extent farmers cooperate in maintaining infrastructure and machinery, what local rules are in place, and how the three areas differ.

In addition to the FGDs, 64 farmers were randomly selected from the 2 categories (16 privileged and 48 non-privileged rice farmers from sampling frames constructed for each area) and individually interviewed using semi-structured questionnaires. Interviews with key informants, participant observation, and archival research completed the methods used to (1) gain an

Table 1. Description of the data collection steps.

Data collection methods	Numbers of farmers involved (*N*)	Area	Focus
FGDs	48	Koussin-Lélé	(1) The way and the extent to which farmers cooperate
	15	Bamè	(2) Characteristics of farmers' groups
	10	Zonmon	(3) Characteristics of irrigation water supply systems
			(4) Institutions that lead to (dis) incentives
Survey	40 farmers (including 2 landowners, 1 traditional chief, 4 farmers' leaders, and 33 non-privileged farmers)	Koussin-Lélé	(1) Farmers' maintenance practices
	15 farmers (including 1 landowner, 1 traditional chief, 3 farmers' leaders and 10 non-privileged farmers)	Bamè	(2) Various existing institutions relating to irrigation canal cleaning
	9 farmers (including 1 landowner, 1 traditional chief, 2 farmers' leaders, and 5 non-privileged farmers)	Zonmon	(3) Influence of the existing institutions on farmers' cooperation (or not) choice about canal cleaning
Field visits and archival documents check			(4) (Dis) incentives created by the existing institutions

insight into the existing institutions, (2) explore in-depth the (dis) incentives created by them, and (3) gauge differences and similarities between the three communities. The data collection methods are summarized in Table 1.

4. Major findings

We now describe the irrigation schemes from three angles, as follows: (1) the characteristics of the water supplies, (2) the characteristics of the groups, and (3) the institutions. We then discuss how these elements are translated into maintenance practices, including fee payment. To assist the reader in capturing the information per research area, an overview of the key characteristics per area is presented in Table 2 ahead of the findings.

4.1. *Characteristics of water supplies*

The apparent success of the Green Revolution in Asia led to attempts to repeat it in West Africa (Issaka *et al.* 2008). Supported by Chinese projects, the Government of Benin made major investments in large irrigation systems on expropriated lands. By 1980, the Chinese had built nearly 2236 ha of irrigation schemes, including those in Bamè (33 ha), Koussin-Lélé (106 ha), and Zonmon (88 ha) (Sodjinou *et al.* 2008). The three command areas are located in inland valleys that appeared to have sufficient year-round water for gravity irrigation (Abe *et al*. 2009). Designed and managed exclusively for rice production, the command areas were placed under the responsibility of the Ministry of Agriculture. Soon after the Chinese left, management no longer

Table 2. Overview of the characteristics per research area.

	Koussin-Lélé	Bamè	Zonmon
Characteristics of water supplies	Water supplied by 2 streams	Water supplied by 2 streams	Water supplied by 1 stream
	Rice produced only in the lowlands	Rice produced in lowlands and uplands	Rice produced only in the lowlands
	Only 63% of all plots are sufficiently irrigated during dry season	Seemingly a year-round abundance of water in lowlands	Use of pump irrigation to supplement the gravity system during the dry season
	All the command area inundated from July to September	75% of the command area is flooded from July to September	All the command area inundated from July to September
Characteristics of rice farmer groups	Almost 200 rice farmers organized in 11 groups	20 rice farmers (in 2010) organized in 3 groups	21 rice farmers producing individually
	Each group is led by a committee of 3 elected farmers	All 3 groups coordinated by a president and a treasurer	No executive committee
	Farmers are from different villages	No clear executive committee in place	Farmers are all from the same village
	Rice considered as a primary income source	Farmers are all from the same village	Rice is not major income source
		Rice is a major income source	
Institutions	Existence of a formal rule intended for canal cleaning and payment of fees	Agreement of farmers to all contribute to the canal cleaning and to pay a fee after each harvest	No rules set for collective canal cleaning, or for payment of fees

functioned properly, maintenance levels dropped, to a varying degree yields as well as the areas under production declined, and farmers increasingly abandoned the schemes. Traditionally, farmers cultivated rice in the most favourable season only and did not face water scarcity. Because of increasing demand, production was intensified, with farmers also planting in unfavourable seasons, leading to complaints about water availability. The areas differ considerably in the extent to which this happens.

In Koussin-Lélé, the water supply comes from two streams: *Koussingo* and *Lelego*. Rice growing resumed slowly after 1984 and gained prominence after 1989, following the renovation of the command area with the help of a Chinese project. In the dry season from December to March, the discharge capacity of the canals and the velocity of water flow decrease and water becomes scarce, irrigating only 63% of all the plots sufficiently (Totin *et al.* 2012), as illustrated by the following quote:

> We hardly get water in our rice plots during the dry season. During this period, we usually come late in the night to close the water gates of other farmers so that the water can reach our plots in the tail of the canal. We know this is not allowed because there are rules that organise the water allocation, but we have no other means to get water on our plots, especially in the dry season. (Farmer from Koussin-Lélé, field interview, August 2011)

In Bamè, the inland valley in which the command area was created is divided into the following two areas: (1) a low-lying part, which allows gravity irrigation and (2) an upland part where no

natural source of surface water is available and a groundwater pump is required. Originally, 33 ha were irrigated: 15 ha in the lowlands and 18 ha in the uplands. Since the collective pump broke, the 18 ha are no longer used. Of the 15 ha under gravity, nowadays the farmers cultivate only 4.5 ha, but an additional 12 ha are being used in the uplands with the help of individually owned pumps. Farmers moved there because of the availability of more suitable land.

The lowlands get water from the *Ahoho* and *Agluiglu* streams, which flow year-round, albeit with variable discharges. The migration of 12 of the original 20 farmers to the uplands allows the 8 remaining in 2011 to have sufficient year-round access, as a farmer from Bamè noted on this point:

> I do not produce rice in the upland area because I do not have a pump for irrigation. Somehow I am happy that some of my fellows left the command area for the uplands. We are now eight farmers producing in the command area, and we can more easily get access to water than in earlier years. (Farmer from Bamè, field interview, August 2011)

The Sawah Rice Management System in an Inland Valley trial that AfricaRice (formerly WARDA) at the time of writing was conducting in the area shows that lowland plots receive between 300 and 500 mm of irrigation water per season from the two main streams (A. Danvi, personal communication, 13 Oct 2011). The Sawah experiment aimed to demonstrate to farmers that different agricultural practices might generate higher yields. Given the additional annual average rainfall of 900 mm, it seems that the water requirements for irrigated rice, estimated at 500–1200 mm per cropping season (Renault 2004), are met.

In Zonmon, the command area is irrigated by the *Somètè* stream. The length of the canal is an estimated 1.8 km. Close to the water gate at the head of the canal, some farmers are producing vegetables. The rice plots are located in the tail area. As a result of intensifying production, water demand there is now higher than supply. To increase water delivery to their plots, the rice farmers have to clean the total length of the canal – a job that is not easy if not all farmers cooperate. From January to March, the water level in the stream is often lower than the level of the intake. During this critical period, the farmers use small individually owned motor pumps to get water from the river into the main canal. Of the 88 ha formerly developed for rice cultivation, fewer than 8 are currently being used. More than 20% of the command area is used for vegetables and maize because these crops are less demanding, and the available water is sufficient to cover their needs.

All in all, the areas differ in the balance between supply and demand, and farmers do not feel the need to enhance the supply to the same extent. In Koussin-Lélé and Zonmon, farmers suffer from lack of water, whereas in Bamè, there is seemingly a year-round abundance of water in the lowland area, given the small land size under rice cultivation in this part (4.5 ha). Because of the topography of these areas, the command areas are frequently inundated, mainly from July to September. During this period, farmers from Koussin-Lélé and Zonmon are not able to produce rice at all, and in Bamè, almost three-quarters of the area is flooded.

4.2. *Characteristics of rice farmer groups*

This section looks at the characteristics of the groups in terms of (1) group size, (2) homogeneity, and (3) past experiences with cooperative activities.

4.2.1. *Group size*

In Koussin-Lélé, more than 200 farmers are now engaged in rice production, which is the major source of income for 85% of them. The farmers' association is headed by a *Comité*

d'Administration and is organized in 11 groups with about 15 members each. A committee of three leads each group. Farmers elect their leaders. The *Comité d'Administration* is responsible for the allocation of irrigable land and facilitates access to credit, fertilizers, and seed. The organization in place obliges farmers to cooperate, as the following quote illustrates:

> We are organised in such a way that each group of farmers is supervised, and the fact that the whole command area is under the control of a coordination committee represents an advantage for us. This organisation obliges most farmers to cooperate. (FGD, Koussin-Lélé, September 2011)

Since production resumed in Bamè in 2008, the number of rice farmers keeps increasing. In 2008, 10 farmers cultivated rice in the command area. In 2009, the number increased to 19 and, currently, there are 20. They are organized in three groups coordinated by a president and a treasurer. There is no clear executive committee comparable with that in Koussin-Lélé.

In Zonmon, rice production is a relatively recent activity. Farmers resumed in 2009 in the context of Benin's Emergency Support Programme for Food Security (PUASA), initiated to mitigate the effects of the floods in 2007 (de Schutter 2009). Initially, there were only 10, but, since 2010, 21 farmers are producing rice in the area. Rice is not the major crop, and all farmers also produce other crops. There is no executive committee in place.

4.2.2.Homogeneity of groups

All the farmers in the study areas belong to the same ethnic group (*Mahi*), but, within this homogeneity, many categories and factions can be discerned.

Farmers differ a great deal in their access to land. In general, large plots are allocated to farmer leaders and former landowners. In Koussin-Lélé, for instance, each leader uses an average of 1.5 ha, whereas regular farmers cultivate an average of 0.30. In Zonmon, because rice production is a recent activity, farmers are not yet very active and only one leader uses more than 2 ha, whereas the others use an average of 0.25. In the lowland area in Bamè, each farmer leader has 8 plots (of 0.2 ha each), whereas regular farmers use an average of 5. Beyond this differentiation in land size, many of the regular farmers complained that the poor land is allocated to them and leaders keep the well-irrigated and fertile land for themselves, as a farmer noted:

> We are five farmers to whom they allocated the poorest part of the command area. Look at my soil, it is only sand, no clay in it! If you have time, go check around, you will not see such poor soil in other farmers' plots. When the command area is inundated, we expect to get sediment that fertilises the soil, but this part is not inundated. We hardly harvest two tonnes per ha of rice in these plots, whereas some farmers located in the downstream get three tonnes per ha. (Farmer from Bamè, field interview, August 2011)

Rice does not have the same importance in the three areas, and farmers' expectations and interests are different. In Koussin-Lélé and Bamè, rice is a vital source of household revenue. In Zonmon, however, farmers have many other income-generating activities.

A difference between Koussin-Lélé and the other areas is that the production area is not tied to a specific village. The fact that it is used by farmers from different villages adds an extra element of diversity. Koussin-Lélé is also the only area where women are engaged in rice production. Two of the groups are entirely composed of women. Men and women produce separately; there are no mixed groups. In the other areas, women provide labour only for specific field activities, such as planting, bird scaring, and harvesting, and do not own rice plots.

4.2.3. *Past experiences*

Farmers frequently referred to experiences with cooperative activities in the past. During the revolutionary era (1972–1989), many facilities were given to farmers as encouragement to produce more rice (access to fertilizer, seed, and marketing facilities). Public companies (e.g. SONIAH, *la Societé National pour l'Irrigation et l'Amenagement Hydro-Agricole*) contracted with rice farmers' groups to supply a fixed amount of rice at harvest against a guaranteed purchase price. The company provided seed of high yielding varieties and fertilizer. The input support and purchase guarantee offered major incentives to farmers to contribute to the cooperative activities, such as collective production and marketing and collective input purchase Currently, no such facilities and services exist; farmers have to fend for themselves in finding inputs and market outlets. These conditions and the uncertain markets for local rice do not motivate farmers to cooperate. Other bad experiences affect farmers' current behaviour.

In Koussin-Lélé, farmers used to produce and sell the harvest together. Their association opened a shop to sell milled rice directly to consumers. They shared the returns according to the contribution of each farmer. Farmers reported that these experiences ended in frustration, as the following quote shows:

> Until 1999, we all produced together and each farmer had to scare birds for five days each season and had to harvest for half a day in the communal plots. Because of our leaders' poor management, this initiative failed. The leaders did not contribute to the cooperative activities like the other farmers and, when they sold the harvest, they kept an extra profit for themselves. Because of these fraudulent practices, we all were de-motivated. (Farmer from Koussin-Lélé, field interview, August 2011)

In Bamè, in 2008, when collective production was resumed, farmer leaders did not purchase fertilizers in a transparent way. Farmers reported that the leaders had overcharged the group. A bag of urea, for instance, was charged at 17,500 FCFA[1] instead of 12,500 FCFA, the market price. At the end of the season, regular farmers each received 42,500 FCFA, whereas each leader, claiming that they had used their own money to buy the fertilizer and, therefore, needed to be repaid after the harvest was sold, pocketed 104,800 FCFA. The next growing season, all regular farmers decided to produce individually on their own plots.

In Zonmon, farmers also have experience with cooperative initiatives. Until 2002, they engaged in collective fishery, the returns on which were shared among the community members, but the leaders were mistrusted and farmers turned away from this cooperative activity.

We conclude that experiences with farmer leaders' corruption in all three areas have negatively affected willingness to choose to cooperate.

4.3. *Institutions: rules, control, and sanctioning arrangements*

In Koussin-Lélé, the extension service has helped the association to formulate rules for equitable water distribution and for cleaning canals. All farmers who produce in the command area have to follow the established planning for water allocation and distribution and have to participate in canal cleaning. These rules are formally included in the association's regulations. Each farmer is supposed to clean a number of canal segments, depending on how dirty the canals are. For example, at the start of the first growing season, the canals are grassed and silted as a result of deposits by the annual floods. For that season, each farmer is expected to clean a segment of 10–12 m. In the second season, each farmer is responsible for cleaning 15–20 m as the canals now are less dirty. Also, not all farmers produce rice during this period to avoid the risk of flooding that often occurs before the harvest. According to the Koussin-Lélé rules, farmers who do not

participate in cleaning the canals are not allowed to work in the command area for two to three seasons.

In Bamè, the earthen canals require frequent maintenance to facilitate efficient water delivery, and farmers have agreed to cooperate in cleaning and dredging the principal canals whenever they are silted. Formally, the *chef du village* allocates land for rice cultivation in the lowland as well as in the upland areas and summons the farmers to perform canal cleaning. Any member who does not participate in the group duties must pay the equivalent of 1000 FCFA per day missed.

In Zonmon, neither a written document nor any other tangible form of agreement among farmers exists with respect to canal maintenance. Rice production is a very recent activity, and as yet no organization has emerged to regulate it. Before the growing season, farmers themselves decide when and how they clean the canals.

In addition to rules regulating canal-cleaning duties, two of the areas also have rules regarding the payment of fees. These fees are used to repair canals and/or maintain collective equipment used for rice production, such as cultivators, tractors, and rice mills. In Koussin-Lélé, each farmer is required to pay 10 kg of milled rice per plot of 200 m^2. In Bamè, the amount has changed over time (e.g. 2000 FCFA per plot of 250 m^2 in 2008, 500 FCFA in 2009, and 1000 FCFA in 2010). In Zonmon, farmers do not pay any fees.

4.4. *Infrastructure maintenance practices*

This section provides information about how farmers organize for the maintenance of irrigation infrastructure and about the extent to which they pay fees.

4.4.1. *Maintenance of irrigation canals*

In Koussin-Lélé, although according to the rules, all farmers are supposed to contribute to the canal cleaning at the beginning of each growing season, it appears that privileged farmers such as leaders, landowners, and traditional chiefs have not contributed (Totin *et al*. 2012). What is more, they have not been sanctioned, and this unfair contribution to the collective canal cleaning induces frustration, as noted in discussions with farmers and reported by the quote below. As a result, farmers at the tail of the canal hardly receive water.

> I always participate in the canal cleaning because I think that we should all contribute to improve the irrigation water delivery. I feel disappointed that our leaders, who should lead by example, do not worry about this task. It is frustrating! (Farmer from Koussin-Lélé, field interview, November 2011)

The regular farmers (80% of association members) clean the canals twice a year according to the rules. However, they deliberately take more time than the one day set for cleaning a specific segment, taking two or three days instead, reportedly because of frustration with the way privileged farmers escape their responsibilities. Furthermore, they clean less well than they are supposed to do. Grass and silt remain in the canal.

Sanctions are effectively administered to defaulting regular farmers. A farmers' group that was assigned to harvest in the *Yovoglé*[2] did not perform the job as requested, and the whole group had to pay a fine of 20,000 FCFA. It seems that regular farmers participate in canal cleaning mainly to escape sanctions.

In Bamè for the first year (in 2008), the PUASA programme provided money for cleaning the canals. The following year (2009), only eight farmers participated in cleaning now that funding was no longer available. Since the end of 2010 when AfricaRice started to conduct agronomic experiments in the command area, the farmers have managed to off-load primary canal

maintenance onto AfricaRice. AfricaRice maintains the irrigation canal to guarantee efficient water delivery in the experimental plots. The stretch of the canal that is not supported by AfricaRice has not been cleaned for the last two seasons. Respondents indicate that the lack of maintenance is related to alleged fraudulent behaviour and corruption on the part of the *chef du village*:

> Things are not going well in this group because of the deceitful behaviour of our leaders. For example, last year AfricaRice gave the rice harvested in the experimental plots to the community. Normally we should all share it, but it is the chef du village who sold all the harvest and kept the money. He promised to share it with us, but till now none of us has received anything from him. With such a practice, if there is group work they ask for our contribution, but when it is time to share the outcome, we are excluded. (Farmer from Bamè, field interview, August 2011)

Interestingly, the leaders do not consider as unfair their non-participation in the collective canal maintenance. As noted in the following quote, they purposely choose not to participate in the canal cleaning because of their responsibility in the community.

> If I could have used in my own fields the time I spent on behalf of the association attending meetings and arranging facilities for the members, I would have produced three times what I have harvested this season from my rice plots. Being a leader is a lot of responsibility. For me, it is a sacrifice. Some of the other members of the association do not see the hard work I accomplish each day in their name, and they required from me to always participate in the canal cleaning. (A leader from Bamè, field interview, August 2011)

In Zonmon, only some farmers contribute to canal cleaning. Here, the PUASA programme paid for the maintenance costs of the irrigation canals when farmers resumed rice production in 2009. In 2010, 6 of the 21 farmers had cleaned all the canals by themselves. The following season, a farmer who also uses the irrigation water for his fish nursery paid labourers to clean all the canals, as reported in this following quote:

> Last year I paid labourers to clean all the canals. None of the other farmers contributed. I am struggling to let our village be known as a rice producing area because, if we produce more, we can get many facilities such as agricultural equipment. Here we do not have any material, and we are obliged to do everything by hand. I hope that, with time, the other farmers will understand, and more farmers will be involved in rice production. (Farmer from Zonmon, field interview, November 2011)

4.4.2. *Payment of fees for irrigation infrastructure maintenance*

According to the individual interviews, all farmers managed to pay the fee in Koussin-Lélé. The registers kept by the association confirmed this. However, in Bamè, not all farmers paid the fee, and 40% of respondents expressed their frustration about this during in-depth interviews:

> Many farmers did not pay the fee last year. Because they are cultivating large plots now, they disagreed with the rules because they know they have to pay a large fee. I cultivated five plots and I paid 5000 FCFA, but those who have 50 plots should pay 50,000 FCFA. They found that too much, so they did not pay any fee to the group. The leaders who have to collect these fees and control the payments do not pay either. (Farmer from Bamè, field interview, August 2011)

In Koussin-Lélé, association leaders use the fees for the restoration of the canal lining and broken irrigation gates, as well as for the maintenance of collective equipment in readiness for the new season. The Bamè association supports only the maintenance of a rice mill. When minor restoration is needed for the cultivator, farmers individually fix it so that they can plough their fields in time. In Zonmon, farmers do not pay any fees; maintenance of machinery is not an issue because

Table 3. Overview of farmers' participation to cooperative maintenance.

	Koussin-Lélé	Bamè	Zonmon
Maintenance of irrigation canals	Moderate participation	No participation	Poor participation
Payment of fees	Large participation	Poor participation	No participation

Note: This table shows the relative extent to which farmers participate in canal cleaning and payment of fees in the three areas. It is not compiled on the basis of any statistical information.

farmers do not own any collective equipment. They till their fields using hand hoes and collaborate with farmers from Koussin-Lélé and Bamè to process the harvest. These differences are summarized in Table 3.

5. Analysis and discussion

Figure 4 pulls together the findings, focusing on incentives and disincentives for individual farmers to engage in cooperative behaviour. These are further discussed below.

5.1. *The significance of the wider socio-economic context*

It appears that, in addition to the resource characteristics, user-group characteristics, and institutional arrangements, a fourth factor influences cooperative behaviour. This factor includes variables relating to the wider socio-economic context, for example, the 50% increase in the retail price of rice since 2008, and the extent to which people have alternative livelihood options, access to irrigable upland, or money to buy pumps that allow them to avoid working in collective production arrangements. Clearly, farmers' dependence on rice production as the primary source of income affects their contribution to canal maintenance. In Zonmon, rice production is relatively recent and not the main source of income, hence, farmers there have little motivation to participate in group activities. This contrasts with Koussin-Lélé where rice has become the main income source. In Bamè, farmers have the opportunity to produce rice individually in the uplands of their valley, and 60% of them have moved away from the collective lowland command area. These findings confirm earlier analysis of the conditions for collective action in the case of irrigation water management (Fujiie *et al.* 2005).

5.2. *The limited relevance of group size and diversity*

We saw earlier that several scholars support the hypothesis that cooperative action is more difficult to organize in larger groups. Our study in Southern Benin found that the group of more than 200 farmers in Koussin-Lélé has a more effective water management system than the group of only 20 in Bamè. In Zonmon, where 21 farmers regularly produce rice, canal cleaning is not performed well, and not all farmers contribute. These findings concur with Gautam's (2007) conclusion that a clear relationship does not always exist between engaging in cooperative behaviour and group size. They contrast, however, with the findings of Fujiie *et al.* (2005), who explain that cooperation is difficult to mobilize where the size of the group is large.

An unexpected pattern was also observed with respect to group diversity. It is commonly assumed that people from heterogeneous communities are less likely to cooperate (Olson 1965, Dayton-Johnson and Bardhan 2002, Fujiie *et al.* 2005). Although the groups in the three areas are ethnically quite homogeneous, differences in social status that lead to inequitable access to land and other resources hinder the readiness of individuals to cooperate. In addition,

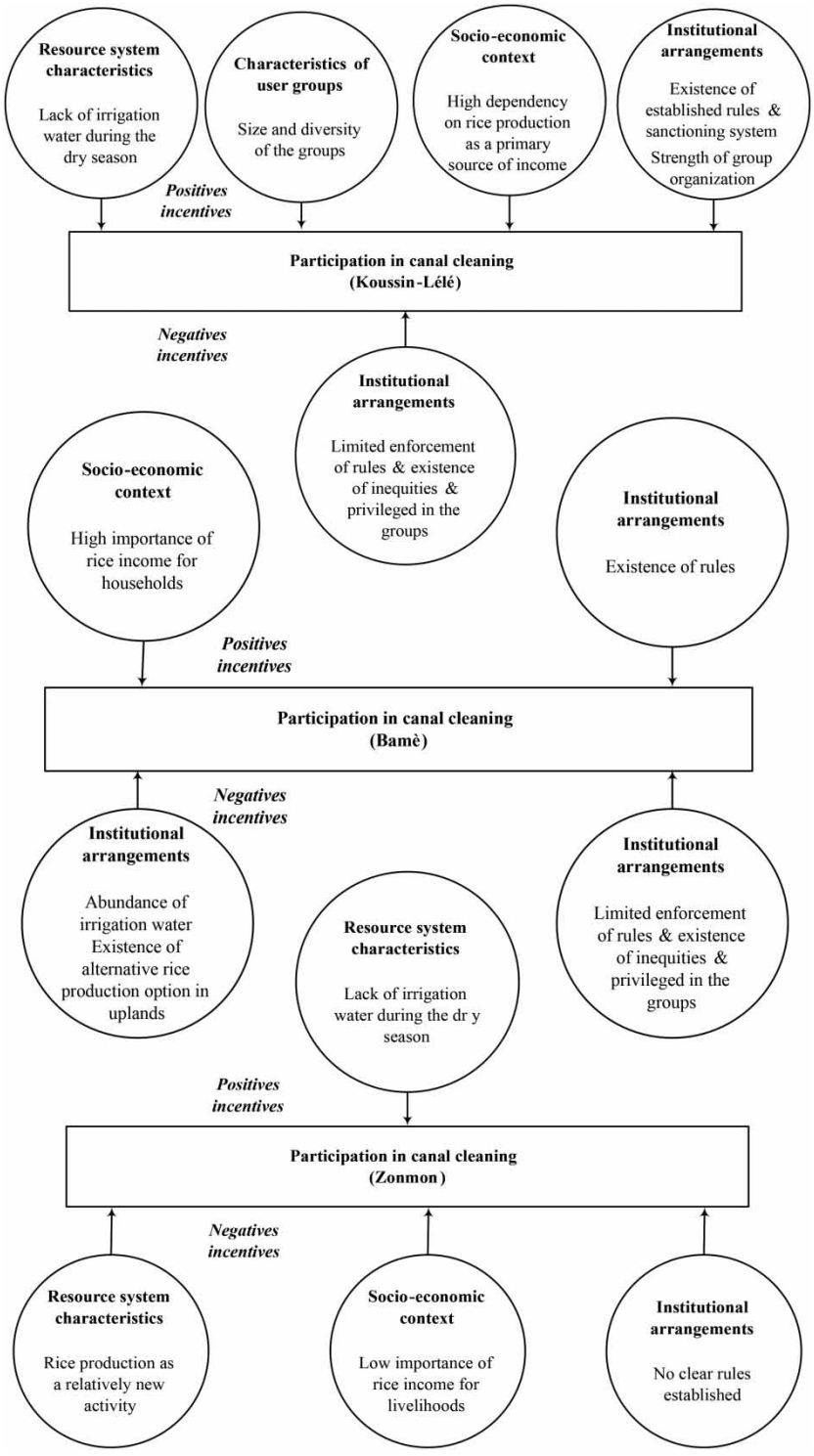

Figure 4. Synthesis of incentives affecting farmers' canal cleaning practices and payment of fees.

the privileges of leaders, village chiefs, and other elites are a clear source of frustration. Whereas this kind of diversity indeed seems to undermine cooperation, we see that another form of diversity actually seems to be conducive to cooperation. Despite the fact that Koussin-Lélé includes farmers from different villages, we see that the degree of farmer organization and discipline is strong in this irrigation area, resulting in relatively high levels of cooperation. A possible explanation is that the very fact that the Koussin-Lélé farmers hail from different villages creates an urgent need for organization and institution building. Bamè and Zonmon can and do fall back on their traditional *chef du village* and other governance structures, which are less suited to the collective discipline required for irrigation self-management. In Koussin-Lélé, it is perhaps more difficult for traditional leaders to abuse or circumvent the rules. Put differently: when the command area overlaps with community boundaries, it may be more difficult to set up parallel structures and bypass or correct the conventional leadership. In Koussin-Lélé, decisions are not made by the traditional chiefs (as is the case in Bamè) but by the group committees and the association board.

5.3. *The significance of rules and sanctioning*

Institutional arrangements, and especially rules and their enforcement, have considerable influence on readiness to engage in cooperative behaviour (Ostrom 2004, Sandler 2004).

In Koussin-Lélé, because of the rules and their enforcement, the regular farmers do clean canals at the established periods, even if they do not keep to the prescribed length of canal or honour the intention to clean it well because they want to show their frustration with the privileged farmers who escape their duties. They clean to escape sanctions. As mentioned, Koussin-Lélé is not a traditional village like Bamè and Zonmon, but a production area with farmers from different communities. It has a relatively strong organization with such effective leadership that it can and does enforce the sanctions. The decentralization of control and decision making to groups seems to contribute to rules being followed. Nevertheless, in Koussin-Lélé also, we see that traditional leaders get away with violating the rules and that the rules do not sufficiently compensate the power of traditional norms and values (Arowolo 2010).

The privileges of traditional chiefs, landowners, and farmer leaders contrast with the legal transparency and shared compliance expected by the extension workers who helped set the rules for canal cleaning. In *Mahi* culture, the traditional chiefs are the guardians of ancestral beliefs and rituals. They cannot be punished as regular farmers even though they do not follow the rules. Their traditional responsibilities prevent them from being sanctioned. According to respondents, an example is an *Adjina*, the leader of a secret society, who was not punished even though he did not participate in canal maintenance because of his informal power in the community. In the collective understanding of those who belong to the secret society, it is normal that the *Adjina* was not sanctioned, but it frustrated farmers who do not belong to it. Thus, there is a conflict between the rules set by extension workers and the traditions that coexist in the irrigation schemes. The embedded traditional norms and values were ignored when the extension workers formulated the rules for canal cleaning (Vodouhè 1996). Although it is often suggested that traditional and formal rules can facilitate the implementation of good resource management decisions (Kwesi 2007), this study shows that such institutions are not a panacea. However, institutions, especially rules and their enforcement, have considerable influence on effective cooperation, and institutional arrangements cannot be made without a combination of both the formal and the sociocultural capital in which the communities are embedded (Cleaver 2002). The question now is how to achieve a proper *bricolage* (integration of traditional and formal institutional arrangements) to stimulate cooperation (Yemadje *et al.* 2014).

5.4. *The resource system: abundance and underutilization*

This study has shown that farmers in the three areas are not equally affected by lack of irrigation water. In Bamè, the overall abundance of irrigation water in the command area explains why farmers are hardly motivated to perform canal cleaning. Collective canal cleaning is seen as a wasted effort because farmers receive enough water to cover their needs. The farmers' cooperative behaviour in Bamè confirms the earlier assumption of Araral (2009), according to which the scarcity of a common pool resource creates a positive incentive for cooperation. In the other two areas, water shortage is indeed a serious issue for the farmers whose plots are further away from the water source.

In all three areas, we see that limited cooperation in canal cleaning reinforces underutilization of the irrigation potential and hence negatively affects the total production by the schemes (Table 4). Valley bottoms remain underused. Improved cooperation will provide additional opportunities for growing rice and other crops.

In summary, our case study on the factors that explain why rice farmers fail to cooperate in cleaning canals has revealed that factors influencing farmers' choice to cooperate differ in several aspects in the three areas. In Koussin-Lélé, farmers are more compelled to contribute to canal cleaning than farmers in Bamè and Zonmon because (1) the rice crop is one of the main income sources for farmers' households, (2) there are seemingly strong rules that are partially maintained to force association members to cooperate, and (3) farmers are more affected by water scarcity because of the intensification of rice production in this area. These factors explain why farmers from Koussin-Lélé contribute the most to canal cleaning. This is, however, still not very effective from the perspective of some farmers and the potential for rice production in this inland valley. The privilege of elites is a source of frustration that affects farmers' readiness to contribute fully to canal cleaning. In Zonmon, farmers hardly contribute mainly because (1) rice production is a relatively recent activity and not a major income source and (2) there is no clear regulation in place to organize the cleaning task. In Bamè as well, farmers fail to clean the canals because there is enough irrigation water to cover the water demand for rice farming in the lowland area, especially since a number of farmers have moved away from these lowland areas and started rice production in the uplands.

Table 4. Potential for irrigation in the three areas.

Command area	Total area developed for rice cultivation by the Chinese (ha)	Total area used for rice production in 2011 in the lowlands (ha)	Total area devoted to other crops in the command area developed by the Chinese (ha)	Percentage of irrigable land not used
Bamè	33	4.5[a]	8	62%
Zonmon	88	8[b]	18	70%
Koussin-Lélé	106	150		Farmers have access to 200 ha suitable for rice production that are not being cultivated

[a]Originally, 33 ha were irrigated, including 18 with pumped groundwater and 15 irrigated by a gravity system. Since the pump that irrigated the 18 ha broke, this area is no longer used and, of the 15 ha under gravity irrigation, nowadays the farmers cultivate rice on 4.5 ha, sugar cane on 3 ha, and maize on 5 ha.
[b]Although 88 ha are irrigated, currently farmers use 8 ha to produce rice and almost 18 ha for mainly maize and vegetables; the remaining 62 ha are lying idle because the primary canals have deteriorated severely over time, and there is no functioning irrigation facility in these areas.

5.5. *Policy implications*

This research identifies the conditions in the three areas that create positive or negative incentives for farmers to contribute to collective canal maintenance. In this section, we discuss policy interventions that could facilitate and strengthen cooperation for effective maintenance of the irrigation infrastructure.

Overall, the limited cooperation depends on the disincentive factors synthesized in Figure 4. Several of the incentives/disincentives were influenced by the rapid transfer of maintenance responsibility to the farmer associations, without sufficient support to ensure that they could adequately execute the maintenance tasks. The farmer associations could have been effective in enforcing rules if they had been trained about building their organizing capacities, in the earlier stages of the transfer. A gradual implementation of the maintenance reforms could have helped to induce sustainability in the re-organization. That could have allowed farmers to gradually take over their new maintenance responsibilities (Mehmood *et al.* 1999). A gradual implementation of the maintenance reform could have created space for the farmers to negotiate their management responsibility with the public actors and also to learn from other associations' success stories. This, in turn, could have contributed to improving their cooperation and maintenance practices.

The study shows that, when the importance of rice production is high and farmers' incomes increase, farmers are motivated to participate in collective canal maintenance. Thus, by creating enabling conditions such as market outlet incentives and low interest loan facilities, state agencies could enhance the cooperation among the farmers in the research areas.

6. Conclusion

This paper shows that the extent to which farmers choose to cooperate in the face of a public goods dilemma depends on a number of factors that appear to differ significantly across three communities, although they are located close to one another in what at first sight are seemingly similar environments. These factors include resource system characteristics (e.g. water availability), user-group characteristics (e.g. size, diversity, and past experience), institutional arrangements (e.g. existence of rules and organizational capacity to sanction), and wider socio-economic conditions (e.g. dependence on rice production and access to alternative production areas). The case studies suggest that these factors are not independent of one another. The availability of alternative production areas and the relative abundance of water clearly influence the intensity of use of lowland areas. Similarly, and contrary to our initial expectation, a relatively large and diverse group size may support the emergence of a relatively strong organization, institution building, and sanctioning capacity. The study confirms that institutions play an important role in explaining the productivity of smallholder farming (van Huis *et al*. 2007, Hounkonnou *et al.* 2012). The existence of rules to regulate the maintenance of irrigation infrastructure, and their effective enforcement, are key drivers of cooperative behaviour. Institutions can create incentives (positive/negative) that motivate or demotivate individual farmers to contribute to the collective maintenance of irrigation infrastructure. In Bamè and Zonmon, the limited degree of cooperation is at least partially linked to a lack of rules and/or rule enforcement. In Zonmon, in particular, as canal maintenance is totally voluntary, many farmers who would have contributed are not doing so because there are no sanctioning rules for non-participants. In Koussin-Lélé, reasonably effective enforcement of rules contributes to the fact that most farmers in this area participate in canal cleaning. However, the rules for maintenance of the irrigation infrastructure are counteracted by incentives provided by other institutions, namely, the social status and privileges that allow elites to free ride and evade sanctions. Thus, we see that institutional arrangements can contradict and compete with one another and that there continues to be tension between formal institutions established by extension workers and communities' traditional values.

This study shows that the lack of cooperation affects rice productivity. In the three irrigation schemes, the actual rice output remains far below the estimated potential of the command areas, given the water and land available in Benin's inland valleys. There is scope for a considerable increase in rice production and associated incomes by redesigning and renegotiating the institutional arrangements and integrating the best of both traditional and formal rules to govern the utilization of inland valleys. Further research might be relevant to explore and compare the institutional *bricolage* in place in other irrigation areas and the extent to which they are effective in facilitating and enhancing cooperation among water users.

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Notes

1. The exchange rate during the study was fixed at 655 FCFA for 1€.
2. Collective land farmed for the account of Chinese experts who assist the farmers in machinery maintenance. All the farmers work on this collective farm in rotation.

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