

IS SMALL SCALE IRRIGATION AN EFFICIENT PROPOOR STRATEGY IN THE UPPER LIMPOPO BASIN IN MOZAMBIQUE?

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Summary

In Sub Sahara Africa, there is evidence that households with access to small scale irrigation are significantly less poor than households without access to irrigation. But private motopump tend to be unequally distributed. This paper investigates the success of explicit pro-poor intervention with emphasis on small-scale irrigation in the semi-arid Limpopo Basin in Mozambique. It highlights that the high irrigation cost are progressively excluding the poorest who do not have the mean to derive from other activities the cash to fund for irrigation functioning. Besides the functioning of collective scheme where they had been included is jeopardized by the development of private irrigation supported by hidden subsidies which are being appropriated by local elite. This unequal mode of access to irrigation can contribute to stir resentments at community level, weakening community cohesiveness and consequently its margin for collective action and coordination capacity which are crucial for collective irrigation.

Highlights

- Small scale irrigation has recently been increasing due to drought relief interventions or funding from local development fund which in practice is subsidizing private irrigation.
- Poorest families tend to drop-off from collective irrigation while they have no access to local development fund due to the bias of the allocation mechanism
- The fragile land tenure arrangements of collective irrigation are jeopardized by the development of private irrigation
- A proper analysis of the economic profitability of small scale irrigation is needed

1. Introduction

With the adoption of the strategic plan for the reduction of absolute poverty (PARPA I) and its sequels, the Government of Mozambique has put officially poverty alleviation in the center

of its preoccupation. In the semi-arid part of Mozambique small scale irrigation (SSI) is being promoted either as a poverty alleviation or food security mechanism. This is notably the case in the Mozambican upper part of the Limpopo Basin where SSI has been expanding rapidly in the last decade. SSI refers here to irrigation scheme of less than 50 ha with the use of low cost technologies such as small motopump to lift water.

Initially promoted to counter the failure of large scale irrigation, SSI has largely spread in Africa thanks to the development of cheap motopumps (Fraiture and Giordano, 2014; Kimmage, 1991). Irrigation contributes to poverty alleviation through different direct or indirect mechanisms such as higher food production and income, higher and stabilized labor demand, increase of agricultural productivity and decrease in food price (Hanjra et al., 2009). SSI is often considered as pro-poor by essence by permitting a fairer development and management of the scheme (World Bank, 2006) and at micro-level different studies have underlined that farm households with access to SSI were significantly less poor than households without access to irrigation (Bacha et al., 2011; Dillon, 2011). But the distribution of private ownership equipment tends to be unequal. For example in Ghana pump owner tend to be the better offs male farmers (Namara et al., 2013). Thus the question is whether explicit pro-poor oriented interventions with focus on SSI contribute to correct unequal access to irrigation.

This paper investigates the success of SSI program in addressing poverty at community level in the context of Mozambique. It argues that the very high cost of irrigation are progressively excluding the poorest who do not have the mean to derive cash to fund fuel cost from other activities. Beside collective scheme functioning are jeopardizing by the development of private irrigation supported by the hidden subsidies of the local develop fund which is being appropriated by local elite. It also can contribute to stir resentments at community level which can weaken community cohesiveness and its margin for collective action.

2. Context

This study was developed in the district of Mabalane located in the upper part of the Mozambican Limpopo basin. This little populated and mostly agro-pastoral district enjoys a semi-arid climate with a total rain amount varying between 361 and 470 mm a year (INGC et al., 2003). The rains mostly occur between October and March. As part of the most risk prone areas of Mozambique Mabalane district faced two major floods (February 2000 and January 2013) and one major drought (2004/2007) and in the last 15 years. There are indications both in data and perceptions that the region is already impacted by climate change including delayed onset of rain and an increase of the rain falling in heavy events. (Parkinson, 2013; Ribeiro and Chaúque, s.d; Sacramento et al.)

Two third of the communities and population are located on the riverine area along the Limpopo river. The left side of the Limpopo River is part of the buffer zone of the Limpopo National Park (LNP). This area has no direct road access to the district center except when the river dries up. The district had no tarred road but is on the train line connecting the Zimbabwe border to Chókwè the informal Northern Gaza capital and the main market of the region, located one hundred kilometer away.

With 72 % of its population below poverty line Mabalane is part of the 4th quartile of the poorest districts of Mozambique according to official ranking based on nutrition, food security and access to public good indicators. Livelihood relies on agriculture (maize, groundnut, and cowpeas), animal breeding (poultry, pigs, small ruminants and cattle), small trade, migration remittance and increasingly charcoal production. Traditionally agriculture is

being practiced in two main areas with different soil types: sandy plot of the higher ground and the fertile foamy soil of the alluvial terraces. The rain fed crop season extend during the wet hot season. Rain-fed agricultural productivity is low with average yield of maize between 0,5 and 0,7 t/ha. Approximately one third of the 5400 families is not food sufficient and suffers from a hungry gap period varying between 3 and 5 months following years and zone (FEWSNET, 2012).

The river dries up approximately three months a year (between September and December) due to upstream uptake and basin management. There is no access to superficial water away from the Limpopo River as all other water bodies in this area follow an ephemeral regime which only allows for filling a few small reservoirs, non-of them being permanent. Groundwater uses for irrigation is restricted by its depth and salinity risk (FAO, 2004). Thus irrigation is only possible along the Limpopo River.

There used to be two middle size irrigation scheme (600 ha in total) producing rice in Mabalane but the infrastructures had been destroyed during the civil war and they are no longer operating. Since the return of the population to their villages, the development of SSI has been permitted by two types of external initiatives (i) Drought relief and/or food security interventions promoted by the government through the National Institute of Social Action (INAS) or by NGOs and (ii) individual or collective projects funded by the newly created Local Development Fund (LDF). INAS is in charge of the development of social security programs and activities in relation with absolute poverty alleviation: although its intervention mode has recently evolved, it has in the past supported SSI either by rehabilitating small reservoirs through food-for-work scheme and/or funding small irrigation schemes. The LDF - also called Investment Budget for Local Initiative (*Orçamento de Investimento de Iniciativa Local* (OIIL) - was introduced in 2006. It aims to reduce poverty by funding projects of food production and income or jobs generation by offering a credit opportunity to people excluded from the formal credit system. The interest rate is 5 % but there is no strict rule for reimbursement. The fund is being allocated by the Local Consultative Councils (LCCs – *Conselhos Consultativos Locais*). Institutionalized in 2005 the LCCs gather coopted members from the local state administration, the organized civil society as well as village and local economic elites. LCCs are principally involved in the approbation of the district plans and their implementation. There is one LCC at each administrative level (District, Administrative Post and Locality). In Mabalane these councils are fully functioning, gathering at least twice a year at least and elaborating sessions minutes.

3. Methodology

This investigation did not study small-scale irrigation as such but the interaction between small scale irrigation and poverty alleviation schemes. We followed a three step approach. The institutional frameworks of the different interventions were first characterized by literature review and key-actors interview at national and provincial level. Then local implementation was investigated using a public policy analysis (PPA) approach, in order to characterize and analyze the gap between the level of official declarations and the reality as it appears in actors' practices. PPA allows for describing the "state at work" or the "politics from below" and focuses on various governance levels. It emphasizes the necessity of considering the broader context both historically but also horizontally (interactions across policy sectors) and vertically (multi-level interactions). It thus analyzes the different formal and informal institutional and policy arrangements around which both public and non-public

actors interacted in the implementation of the program as well as some unexpected interactions between several policy sectors.

In this aim, different members of the district government and administration were interviewed (administrator, district permanent secretary, administrative post and some locality post chiefs) as well as the head of district services (notably agriculture and social services but also from the water and planning district services) and some technicians. Water use, access and management were then explored in twelve communities between November and December 2012. This village level survey included: (i) an interviews of leaders (ii) focus groups with water and irrigation committee members (iii) focus group with women (2 villages only) (iv) Transect walk and visit of village water infrastructure and irrigated scheme accompanied by member(s) of the related committee (v) Private motopump owners were also interviewed when present. In total five private irrigators and seven irrigation associations (two of them non-functioning) were investigated.

In three riverine villages a quantitative survey (119 interviews in total) was carried out to analyze water uses and access to pro-poor interventions. The three villages were selected to have various sources of drinking water, have irrigation scheme(s), a comparable number of households and be located in different area along the river (Table 1). There were discrepancies between the district documents used to select villages and the effective number of households or irrigations systems: the third village located in the LNP buffer zone had a significantly lower number of households than official numbers indicated.

In each village, the leaders were asked to group each households in four wealth groups (*Poorest, Poor, Middle and Better-Off*) according to their own perception. Twenty percent of the households in each package were them randomly selected and interviewed.

TABLE 1: SOME INFORMATION CONCERNING THE THREE VILLAGES STUDIED

	Village 1	Village 2	Village 3
Households number	175 (360 on paper)	334 (492 in paper)	69 (226 on paper)
Interviews number	36	67	16
Water sources	River and 3 boreholes (1 old, 2 new)	River, 1 lagoon, 1 reservoir, 4 boreholes (1 new, 1 nonfunctioning)	River (20 mn walking), 2 borehole (1 new)
Infrastructure	Health center, Movitel aerial, small solar system INAS intervention (older people) School building in medium state	New health center School building in bad state	Extremely precarious "school" (traditional material)
NGOs project support	One research-action project focusing on small animal breeding (2008-2010)	Long term intervention of one NGO which is no longer intervening (tank cistern, irrigation, conservation agriculture etc)	No intervention
Associations	Goat breeder association Charcoal making association (non- functioning)		1 irrigation association (non – functioning)
Irrigation	There used to be an irrigation association no longer functioning 3 private farmers with moto-pumps	One irrigation association 4 privates farmers with moto-pumps	One irrigation association after independence using the equipment left by a Portuguese colon but was lost during civil war The village created an association and received a motopump through FDD project but it was not implemented for lack of skills

In this sample, 71 % households were headed by men (Table 3) but 54 % of the interviewees were women. Thirty-two percent of the households had at least one member away (in migration for example). Fifty one percent reported having at least one member with chronic disease¹ and 32 % at least one member above 65 years. In average households held 8,9 persons with 3,7 children under the age of 15. Village 3 had slightly younger households with consequently smaller family (Table 2). The group “*Poor*” represented 42 % of all interviewees of our survey and the group “*Poorest*” 21 %.

TABLE 2: DESCRIPTION OF THE SAMPLE

	Village 1	Village 2	Village 3	Total sample
Age of head of households	50,2 (13,5)	49,2 (14,3)	44,1 (12,7)	48,8 (13,9)
Total family size	8,5 (4,0)	9,3 (5,2)	7,9 (3,5)	8,9 (4,7)
Children less than 15 years old (yo)	3,7 (2,4)	3,7 (3,3)	4,1 (2,9)	3,7 (3,0)
% household reporting people with chronic disease	44 %	57 %	44 %	51 %
Nb of people above 65	0,4 (0,8)	0,5 (0,8)	0,2 (0,4)	0,4 (0,7)
% household reporting people above 65	31 %	36 %	19 %	32 %
Head of household is a women	27,8 %	32,8 %	18,7 %	29,4 %
interviewee is women	63,9 %	43,3 %	75,0 %	53,8 %
% household reporting member in migration	33,3 %	29,8 %	37,5 %	31,9 %

Average (standard deviation)

The questionnaire included a card exercise aiming at characterizing perception concerning equity and priority interventions at village level : Interviewees were asked to select and justify their choice concerning three preferred development options and three least preferred options in a set of eighteen options presented on cards (Box 1). The different options proposed had been or were on the verge to be experimented by different programs/projects in the area. Three options dealt with irrigation.

BOX 1 : THE DIFFERENT OPTIONS PROPOSED IN THE CARD PREFERENCE EXERCISE

- A A new borehole even with saline water , monthly payment following on-going tariff
- B A new borehole only if water is not saline, monthly payment following on-going basis
- C A small water system with good (non-saline) water payment on container basis (50 ctv/container)
- D Rehabilitation or building of a reservoir
- E Demonstration of cistern in 5 families
- F Upgrading of the school
- G Motorized maize mill / grinder
- H Subsidy for irrigation (1 moto-pump and 1 year input) to an association (40 families cultivating 5 ha)
- I Subsidy for irrigation (1 moto-pump and 1 year inputs) to 1 farmer for 15 ha - commits to engage 5 villagers
- J Subsidy for irrigation (1 moto-pump and 1 year inputs) for farmer for 20 ha – partnership with 9 other farmers
- K Subsidy in the form of 20 goats for 20 families on a rotating scheme: off-springs are given to other families
- L Subsidy in the form of 7 cows for 7 families on a rotating scheme
- M Subsidy in the form of one pair of oxen and plough to one family
- N Food for work program allowing to engage 30 families
- O Monthly subsidy 5 vulnerable families or old people : 50 MT/monthly
- P Subsidy to 100 families in the form of vouchers to buy input in agricultural fair
- Q Demonstration of innovation agricultural techniques developed in the plot of 1 farmers (but attended by village)
- R Demonstration of improved pit latrine in 2 families
- S Authorization of making charcoal making on a quota system (Village 3 only)
- T Authorization of making charcoal with no conditions attached (Village 3 only)

¹ With a strong likelihood to be AIDS related

4. Results

4.1. Small-scale irrigation in Mabalane District

4.1.1. SSI extension is uncertain

There is very limited information on irrigation in the Northern Gaza region. The (District Service for Agriculture and Economic activities – SDAE- is supposed to provide the agriculture statistics but the reliability of their data is questioned even by LCC meeting minutes. There is no other information source as water users registration is not compulsory along the non-regulated water bodies of the Limpopo Basin (Alba et al., 2014).

According to the SDAE agricultural campaign report for 2011/2012 the district officially counted 82 motopumps, 25 irrigation schemes, 19 irrigation associations and 19 private irrigators. The district also reports an increase by 60 % of the number of irrigation schemes in one year. This is much higher than the number provided by technicians (table 3) which partially differentiates between operational and non-operational schemes. Indeed field visit underlined that many privately or collectively owned motopumps were not operational and when operational were not systematically used.

TABLE 3 : IRRIGATION SYSTEM BY ADMINISTRATIVE POST (2011/2012 CAMPAIGN)

	Private moto-pumps	Collective system/moto-pumps
Combumune	6	3
Ntlavene	25	6 + 1 construction 2 non operational
Mabalane-Sede	15	9
TOTAL	46	19

(source: technicians interviews. Mabalane data do not refers to operational motopump)

All associations of more than 2 years had between 8 to 4 farmers irrigating while initial number was above 20 members.

There was no information referring to manual irrigation but small garden can be found along the Limpopo River in nearly all villages and in the rain-fed area around some reservoirs in the Plateau areas. Neither was there information on the cumulated irrigated surface at district level. Most of the scheme visited were small (4/8 ha) and two of the private irrigators met reported irrigating around 15 ha.

The schemes visited were precarious. Only one of them had some concrete channel (one canal). As all plots by the riverside, the schemes were generally fenced to avoid cattle incursion. In many case, irrigation timing depended of the availability of fuel which was all the more expansive than until September 2013 the closest fuel station was in Chókwè which mean a fuel price between 25 to 50 % higher than normal

4.1.2. Moto pump ownership is not necessarily associated with irrigation

Four reasons were mentioned to explain motopump underuse: (i) equipment maintenance (ii) the high irrigation costs (iii) use of irrigation as a coping mechanism in case of drought, (iv) animal incursion (cattle and/or elephants) risks.

Maintenance of equipment is often considered as a key limiting factor and many studies underline the challenges to maintain infrastructure in private or collective small scale irrigation (Colenbrander and van Koppen, 2012; Giordano and Fraiture, 2014). In the villages

visited, non-operational motopumps were mostly old ones (some dating from the pre-independence period). Few farmers referred to maintenance issues for new equipment except in one case when the motopump was undersized compared to the area irrigated. At association level, members complained more from water shortage due to fuel shortage than breakdowns of the motopump, although the latter could generate longer delay in irrigation timing. This could be explained by the existence of well know mechanics operating in the area and availability of most spares in Chókwè which possesses large irrigated areas.

Some private farmers reported irrigating only in bad years to compensate for low rain-fed production. In the local context of labor shortage, high irrigation cost, limited productivity and confined market this is probably a rational strategy. There has been no systematic economic assessment of irrigation in the area and there are very little data available on the economic and technical performance of SSI or its effective contribution for food security at village or household level at individual or collective level. The only data available comes from an economic survey initiated by the PNL project which is summarized in the following table.

TABLE 4: SOME ECONOMIC RESULT OF SMALL IRRIGATION SCHEME SUPPORTED BY PNL

	Non irrigated Maize	Irrigated Maize	Irrigated bean
Gross margin (MT/ha)	550	2 350	73 310
Work day payment (MT/Ha/jour)	22,4	18,8	505,0
Cash need (MT/ha)	250	4 770	10 550

Source: CPWF IWEGA - adapted from PNL data, kindly provided by Mr T Meque, PNL. No reference to the number of plot monitored or irrigation season. Data collected in isolated LNP buffer zone villages where inputs price are probably higher than in other area of the district.

This table underlines that if irrigated crop could be more profitable than non-irrigated ones, the need for cash was also very high, especially in the villages of the left margin. A more systematic economic analysis is necessary to explore the profitability and efficiency of irrigation in the area.

Animal incursions are a real threat in the area as underlined by the many complaints reported in the LCC minutes. Irrigation productions are particularly at risk: after July the remaining water pools tend to be sparse outside from the riverbed. Cattle or elephants herds tend then to concentrate close to the river – consequently close to the irrigation areas. In 2013, an elephant-proof fence isolating the LNP buffer zone from the core part of the park was finalized which could however minimize the problem in future. But conflicts with cattle will remain an issue as it has a strong cultural value and one of the main placements for money.

4.1.3. SSI involves different types of governance model

Our survey identified four main models of governance of small irrigation system using motorized equipment (Table 6). A fifth one, based on partnership between commercial farming and an association of small farmer was reported in the neighboring Massingir district but has not been investigated (Praagman com pers).

Association has a connoted meaning in the Gaza province. It designs a collective scheme where part of the land (a plot) is allocated to the association as a group and the rest divided between members with individual management. The association plot is meant to be cultivated collectively and its outcomes to be used for a collective purpose for example paying for the scheme functioning. There is consequently no water fee but members can be requested to pay a supplementary quota to buy fuel and spares if necessary. The irrigation committee generally

includes a president, a secretary in charge of monitoring expenses and incomes of the association and a production chief in charge of the management of the motopump. He is generally the only one authorized to deal with the motopump.

Partnership is a more traditional governance system, where various farmers aggregate around equipment and land, which remains privately owned. Each member is given the right by the owner of the land and infrastructure to cultivate under certain condition which generally refers to participation in irrigation costs and sometimes labor. This model has been described by Manjate and Magaia (2010). Partnership does not involve a collective plot and the repartition of land and cost can be unequal between owner and members. Solidarity mechanisms targeting irrigation during drought follows this governance model.

TABLE 5: THE FOUR GOVERNANCE SMALL IRRIGATION MODEL IN MABALANE

NAME	The “irrigation heir”	The “new comer “	“Association”	The partners in irrigation
Ownership of equipment	Individual	Individual	Collective	Individual
Development pathway	The family has been involved in irrigation for a long time and the owner has developed technical and managerial skills	Uses existing opportunity to start irrigation (FDD, appropriation of unused association moto-pump)	Developed with external support (NGO, PNL) – although local initiative through FDD can be found	To be assessed
Land tenure	Stable: Family access to suitable areas (close to remaining pools)	Has normally family access to suitable area but the area might have been let to other people/association and might need to be renegotiated	Suitable area had to be negotiated with community; unstable tenure right. One area of the scheme is collective (association plot) other area divided in individual area	The owner provides the plot and owns the moto-pump
Workforce	Family + hired permanent external workers (2/4)	Family based: occasional workers	Family only	The owner creates partnership with other families of the community of his choice. They divide the plot, cost and work on an unequal basis
Production	Horticulture market oriented	Horticulture market oriented + subsistence	Subsistence farming + market of surplus Struggling with a diminution of membership around time (from 10/30 member to 4/6 irrigators). Operational functioning is only possible by other resources.	To be assessed
Outcomes	Quite successful especially if owns his own motorized transportation which allows him to access distant market	In a learning curve and still struggling for economic sustainability		To be assessed

Technicians are ambiguous on the role and potentialities of small scale irrigation: While they often presented it as food security mechanisms they tended to focus their attention to the most successful private small irrigators. They tended to underestimate the skills and resources mobilized that allow for the (fragile) economic success of this well-connected and experienced farmers. They entertained a false representation of irrigation limited to its technical dimension at the most, rarely including its economic one and never the social and political dimension of collective irrigation. Project supports focused on technical aspects (building and technical functioning of irrigation) sometimes including managerial dimensions such cost monitoring and water fee collect and management but never coordination issues.

Market opportunities and competition between cropping systems varies strongly between seasons and trade-offs has to be made between income generating activity, production of supplementary food or coping strategy. While traditionally two cropping seasons (rainy wet hot season between October to march) and the cold dry season (April to September) are generally considered for irrigation, the changing pattern of rain is opening space for a third season (table 13).

TABLE 6: TRADE-OFF BETWEEN WATER, MARKET AND LABOR FOR IRRIGATION IN MABALANE

	Rainy (wet hot) (Nov to march)	Dry Cold (march to July/August)	Hot dry season (July – October/November)
Water	Low irrigation cost except during drought year Easy access to water	Medium irrigation cost Medium access to water	Very high irrigation cost Limited access to water
Market	High market price Locally high to moderate demand for staple food	Low market price Locally limited demand for staple food	moderate to high market prices locally high demand for staple food
Labor	Competition with rain-fed system in normal and rainy years	Competition with flood recession crop more or less	Limited competition with rain-fed or flood recession crop unless rainy season is early

4.2. Poverty and equity at village level

4.2.1. Characterization of poverty at village level

Leaders used the number of people in the household, the number of cattle heads and the existence of migration remittance or regular income such as small shops or other remunerated activities (bread making etc) to determine wealth groups. But a factorial analysis underlined that other variable were associated with wealth determination notably tillage equipment, poultry or small animal (goats, sheep, and pigs), the quality of housing (assessed through a score depending of the existence tin roof, electricity panels, cemented wall and/or floor, latrines) (Table 6).

Significant differences existed between the poorer groups (Groups 1 and 2) and wealthier groups (Groups 3 and 4) concerning household workforce, poultry and heads of cattle (Table 4). Other variables were not significantly different or their difference could not be quantitatively explored as they were qualitative (housing score for example or cash income from other activities) or with an uncertain estimation (area cropped).

TABLE 7: QUANTITATIVE VARIABLES WITH SIGNIFICANT DIFFERENCE BETWEEN WEALTH GROUPS IN THE VILLAGES STUDIED IN MABALANE

	Group 1 Poorest	Group 2 Poor	Group 3 Middle	Group 4 Better off
Size of family	6,8 b	7,4 b	12,1 a	11,3 a
Workforce (> 15 y.o)	4,2 b	4,4 b	6,5 a	6,5 a
Size of families excluding solarized children and chronically sick (workforce)	4,2 b	4,7 b	7,5 a	7,5 a
Number of cattle heads (excluding oxen)	0,8 c	1,7 c	8,4 b	18,6 a
Poultry heads	2,8 b	3,3 b	2,8 b	5,8 a

(source CPWF Mabalane interviews)

Thus wealth as perceived by leaders was determined by the capacity of the family to cultivate a large area (that is availability of labor and tillage equipment), and the ability to benefit from non-agricultural cash income (remittance, charcoal selling, local business). Excess income if any is principally invested in cattle and limited housing improvement. *Better-off* households have also higher mean to take care of their animals and they experienced lower mortality rate and/or higher reproduction rate with evidence in poultry very sensitive to new-castle disease in the area and goat (FEWSNET, 2012).

As in other part of Mozambique (Vuma, 2004) and the north Gaza province (Brouwer, 2006; Osbahr et al., 2008) farmers engaged in reciprocal exchanges connecting the different households at village level. Participation in occasional mutual exchanges (principally *Matsimo* or occasional weeding work in exchange of small gift – for example alcoholic drink - and *Kurimela/kurimelissa*, working in other's plot in exchange of money) tended to increase in the lower wealth group; 71 % of all interviewees reported having used occasional mutual exchanges but only 38 % did it on a regular basis. This concerned mostly *Kukashela/kukashelissa* that is the exchange of workday against tillage equipment the main way by which under-equipped household get their *machamba* ploughed. But the efficiency for the most vulnerable of these exchanges network is limited as they the least able to reciprocate due to their limited workforce (Brouwers, 2006). Besides the type of exchange involved points out to the very limited monetization of the villages which probably constraints monetary exchanges and wages payment.

4.2.2. Perception of equity and irrigation at village level

Contrary to technicians who prefer to favor people that are the most able to take advantage of the support provided -for instance households with higher resources level-, villagers globally favored “blanket” approaches (intervention that reaches all village households) or development options that benefited the community as a whole such as public services or equipment. There were a clear preference for school upgrading (chosen by 71 % of interviewees), maize grinder (46 %), small animals breeding (37%). Irrigation options were never prioritized except for the partnership model which has been selected twice on the justification of solidarity between users. Globally breeding (goat notably) or vouchers for agricultural inputs (around 21 % of favor) was more valued for food security mechanisms than irrigation. Options that minimized labor mobilization or need also received attention which underlies the importance of labor issues at household and village level.

But 46 % of interviewees selected at least one of the irrigation options as one of their least preferred (and 6 % chose two irrigation options). And the private irrigation system (I) was among the three least preferred options along with the demonstration of pit latrine (41 % of interviewees), the building or rehabilitation of small reservoir (39 %), and the subsidy of tillage equipment to one family (32 %). There were variation by village with a strong rejection of pit latrine and the private irrigation option in Village 3 with a higher rejection of the I option by upper half wealth group. Although less rejected than the private irrigators model the association

Globally villagers tended to reject interventions that benefited a very small number of people or could be controlled by a few families as they generated envy and internal conflicts in the village. This included “demonstration” scheme for new technology (agricultural demonstration, tank cistern etc) which was perceived as a favor toward beneficiaries. They

stressed the importance of options or arrangement that could enhance village cohesiveness and trust and/or limit distrust and envy with its delete effect on village functioning.

TABLE 8: PERCENTAGE OF INTERVIEWEES FROM EACH WEALTH GROUP HAVING SELECTED AN IRRIGATION OPTION IN HIS LEAST PREFERRED INTERVENTIONS

	H (association)	I (private irrigator providing 5 jobs)	J (partnership involving 10 farmers)	More voted least preferred option
Poorest	12 %	16 %	4 %	R, D
Poor	16 %	26 %	16 %	R, D
Middle	9 %	45 %	9 %	I, D
Better Off	0 %	36 %	11 %	M, I/R

TABLE 9: MAIN JUSTIFICATION FOR REJECTING IRRIGATION OPTIONS

Option	Selection %	justification
I Private farmer (15 ha, 5 jobs)	29 %	Very small number of beneficiaries It can create conflicts due to envy because a small number of people are involved The area has elephants, if they come and it the production, the pump' owner would have still to find money to pay the worker It benefits few people, and may generate conflust . Although we all work in the association, when will come the harvest the division will not be equal
H Association (20 ha, 40 farmers)	11 %	There may be conflict between members and not be OK There are already an irrigation system in the village which is not functioning I do not see the point (Village 3)
J Partnership (1 owner, 9 partners)	11 %	The owner of the motopump could be witchcraft, there is a lot of envy here It is difficult to get 9 members (socios), thus project is not adapted

4.1. Access mode to moto-pumps

4.1.1. Poor farmers proportionally pulls out more from collective irrigation scheme than wealthier villagers

As highlighted, irrigation was initially promoted as drought relief mechanism through the development of small scale collective schemes. NGOs often started by promoting manual irrigation on a food-for-work basis. Selection was based on willingness to participate and sometimes poverty status. Most of farmers (generally women) dropped manual irrigation when NGOs retrieved their support: There is no real interest in labor intensive scheme in these communities. But although particularly labor short, the poorest groups tended to maintain manual irrigation, probably because they have limited other opportunities and food security constraints.

In some cases, manual irrigation schemes were upgraded with moto-pumps. NGOs now demand a monetary participation of the community (generally one quarter or one third of the price of the motor) and the development of collective irrigation have slowed down except for the development of 10 SSI in the buffer zone funded by AFD as part of a project supporting LNP communities.

In the 3 villages studied, 14 % of all interviewees were currently irrigating either manually or with a moto-pump. But the proportion varied by village (Table 10). In Village3 irrigation was manual. The “*Poorest*” group was proportionally less involved in irrigation than other groups (Table 11).

TABLE 10: IRRIGATION IN THE SAMPLE STUDIED (N = 119)

% of interviewees	Village 1	Village 2	Village 3	Total
Currently irrigating	8	18	13	14
Have already practices irrigation	36	45	31	
Have never irrigated including manually	69	81	75	76
have stopped irrigating with a motopump	22	24	0	15
Have stopped to irrigate manyally	3	7	22	8

TABLE 11: IRRIGATION IN THE SAMPLE STUDIED (N = 119)

	Poorest	Poor	Middle	Better Off	Total
Currently irrigating	4	18	14	18	14
Have already practiced irrigation	16	52	27	32	
Have never practiced irrigation including manually	84	48	73	68	76
Have stopped practicing irrigation with motopump	12	28	5	0	15
Have stopped practicing irrigation manually	4	8	9	14	8

If a majority of households had never tried irrigation, many of those who tried have pulled out. Thus numbers also underline that poor people were included in irrigation interventions although the most vulnerable were proportionally less involved. But farm households from the two poorest group tended to pull out more than from the two wealthy groups (Table 11).

For the poorest, exclusion was generally voluntary and due to the difficulty to contribute to fuel quota. Wealthier households tended to drop out because of coordination problems in the association. According to the PNL assessment (Table), the cash needed to cultivate one hectare of maize corresponds to the price of a couple of small animal (goats) or a small head of cattle for irrigated bean. Interviews underlined that cash was only available by selling charcoal or small animals (goats etc). Irrigation is thus only an option for the wealthier families that are able to derive cash on a regular basis either through charcoal production or migration remittance. This explains why in most associations 2 to 5 years of autonomous functioning only a few families (4/8) are still involved.

4.1.2. A subsidized private irrigation which benefit mostly the better-offs

Small-scale motorized irrigation is not an innovation per-se as local elites and Portuguese settlers were already using motopumps before independence in the area. But private irrigation development has been boosted in the last years by the LDF credit system. It supports different types of project (Agriculture food production, Animal breeding, Fishing, Small Industry and carpentry, Agro-processing business, Commerce/small business, Tourism) and in the three years of LDF implementation, 30 agricultural food production projects have been funded. In Mabalane, agricultural food production projects deal with irrigation and the amount requested aim to cover the cost of motopump, tubes, some fuel, seeds and sometimes fertilizer up to a limit of 200 000 MT (67 000 USD). Collective projects were initially encouraged but individual projects are now prioritized.

TABLE 12 : AGRICULTURAL FOOD PRODUCTION PROJECTS FUNDED BY LDF IN MABALANE

	2011	2012	2013
Nb irrigation project funded	16*	3	11
Total number of projects	65*	42	34

*partial data : 1 AP out of 3 is missing

Although there is an increasing pressure to reimburse, the main issue of the LFD in Mabalane – as in all Mozambique - remained its limited reimbursement rate. In 2013, the cumulative payment between 2007/2010 corresponding to the first round of projects of 18.894.140,00 MT amounted to only 968 407 MT or 5,1 % of the sum due (including interests). Thus the LFD scheme has been basically subsidizing projects.

The LCC are in charge of assessing project promoter's trustworthiness but there is no formal assessment of the quality of the project. Project submission is simple and although a request form is available, a letter explaining the type of project and the total amount requested is sufficient. There seem to be little competition locally between projects except in the main *vilas*: the most rural AP even reported difficulty to fully allocate his share which is being reverted to district level which concentrates the larger number of civil servants and elites. Indeed as underlined by an independent anticorruption organization district elites such as business people and public servants are the one that benefit the most of the scheme in Mabalane as in other district (CIP, 2009; CIP and LMDH, 2011, 2012). Besides allocations reports also showed that most local beneficiaries came from the same few communities. In our sample only one household mentioned having benefited from LDF funding (for small business).

Many poor farmers claimed to be reluctant to engage in a credit scheme due to the many risks involved in rural activities that could derailed even the most trustworthy and hardworking beneficiary. But the bias toward local elites and civil servants can be mainly traced to LCC functioning: as participants are coopted LCC were controlled by the administration, the dominating political members and elites. In this sense Mabalane LCC functioning is not surprisingly different from other districts (Forquilha and Orre, 2011; Lagrosse, 2012).

4.1.1. The development of private SSI is affecting collective irrigation

In Mozambique, land is globally not restricted and labour shortage is more limiting than land. But in the area finding a suitable site for irrigation that minimizes irrigation costs and labour for construction can be challenging: the land closest to the river are also the most fertile areas. Permanent access to water in the river is limited to the remaining pools in the river bed and because these areas are the most fertile and interesting they have long been occupied and appropriated by powerful members of the communities.

As most countries in Southern Africa Mozambique is characterized by the existence of a dual system of customary and statutory land tenure. Smallholders and communities rely on customary tenure regimes where the traditional chief allocates land to families. This land can be inherited. In the family sector and community security of tenure is guarantee by occupation. But users may further protect their land right by getting a formal right to use and exploit the land (DUAT – *Direito de Uso e Aproveitamento da Terra*) which can be attributed to individual or community. Private investors usually use this statutory system to get access to land which includes the negotiation of compensation to the community (Tique, 2002a).

At village level there are two main ways of securing land suitable for collective scheme: (i) the plot of an absentee landowner (e.g for example having migrating in South Africa) is

attributed by the leaders (ii) negotiation with the landowner, which may include specific entitlements in land share in the scheme. This is however not systematic as irrigation developed by an association with a food security objective can be perceived as a collective activity contributing to the development of the village. In this case, the negotiation is generally mediated by the leader and the landowner may accept to let the association use his land without any conditions attached. In two villages of the district however land conflict or negotiation failure had blocked the development of a collective irrigation scheme supported by external intervention.

These are unstable land tenure arrangements which can be submitted to renegotiation. Various case of moving the location of collective scheme has been reported during focus groups. Competition on irrigable land have increased with the development of LDF subsidies: Changes in village leadership or district government district and consequence changes of power networks offers the opportunity for the landowner to claim back his land and develop his own individual irrigation system.

In one case one association had to move because of a large area of land was allocated to commercial farming by the government. Indeed the land attribution mechanism state than the private investor has to compensate the community, generally in the form of investment in the village (building or equipment of school, hospital). In both villages where such compensation had been negotiated, the communities were still waiting for the commitment to be fulfilled a couple of years after the investor had started his operation. These difficulties concerning the relationships between private investors and community are not rare (Tique, 2002b).

5. Discussion - conclusion

LDF credit system is in practice subsidizing private irrigation. Due to the mechanism of allocation these subsidies are mostly benefitting district elites, although their economic viability in the local context characterized by high inputs cost and confined market remains to be assessed.

There are little opportunities for indirect impact of SSI in the area. It remains to be assessed whether the development of SSI on a larger scale could significantly contribute to jobs generation. Locally only well managed private irrigation system of more than 15/20 ha mentioned external recruitments with a limited number of beneficiaries (3/4). In area where the labor market is inexistent, irrigation can fail to contribute to jobs and wage (Van Den Berg and Ruben, 2006). While 8000 ha are being irrigated in the close Chókwè district there is no real organized labor market although local farmers are reporting labor shortage during the peak period of implantation and harvest, probably because wages opportunities and value are not sufficiently attractive or regular to compete with better opportunities (for example migration to South Africa): Interestingly South African small motopump owners of the other side of the Kruger Park (which extend the LNP on the South African Park) mentioned recruiting (illegal) Mozambican shangaana farmers during harvest time, probably coming from the Limpopo Basin districts.

The economic and technical performance of the scheme are further impacted by coordination issues which is also reported as a reason for pulling out irrigation. Coordination issues that are organization between members to share water and maintenance have rarely if ever being tackled or even considered by project intervention. There are all the more important that there have been only rare previous experiences of collective work, and a tradition of top down functioning. External intervention often assumes than collective action capacity is an intrinsic quality of community. But In Southern Africa collective action revolved more around the

quality of local leadership and autonomous self-help group or association are rare (Cammack, 2012).

Dillon (2011) points out the role of small scale irrigation in traditional solidarity system in Mabalane. Indeed in Mabalane *better-offs* farmers occasionally invited poorer households to join and irrigate during a drought. But only a very small number of households were included and specific conditions concerning sharing cost and workforce were often attached. Mutual aid groups play a key role during extreme events (Brouwers 2006) but these arrangements are very fragile and limited in time, social extend and impact (Eriksen and Silva, 2009; Brouwers, 2006)

The development of subsidies for irrigation through the LFD funds is also contributing to changing the status of irrigable land from a public good (for collective food production during the hungry gap period) to an economic resource (income-generating activities). In many villages the development of small scale irrigation is thus accompanied by the renegotiations of land tenure arrangement which benefited associations further jeopardizing their functioning. Irrigation project are perceived are not really equitable. Individual irrigation is actually one of the most rejected interventions. In these communities, badly implemented previous external intervention have pervasive cumulative effect on community cohesiveness and trust (Ducrot 2014) as in forest management in Malawi (Kamoto et al., 2013). Collective action capacity is required in many natural resources management activities which are at the heart of local livelihoods, including vital domestic water supply and forest management. The development of private irrigation through the hidden subsidies of the LFD mechanism is thus a potential threat to the social capital of the community and natural resources management.

It is now well acknowledged that irrigation, inclusively small scale irrigation is contributing to poverty alleviation. In the local context studied characterized by difficulties of access, confined market, labour and cash shortage, there is strong indication that poverty alleviation mechanism based on small scale irrigation is missing the target. Indeed packaging irrigation development with other measure (credit, market, education and training etc) would help to lift some of the local constraints (Namara et al., 2013). But this work also underlines that it should be accompanied to targeted measure to the poorest such as safety nets. Some interventions are locally being experimented by INAS which plans to expand it direct targeted subsidy program for the most vulnerable in all villages of the district. Other argues than a universal blanket subsidy for aged people or children would not only alleviate poverty but increase village monetarization and thus economic development opportunities at village and district level (Hanlon, 2009).

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