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Performance Evaluation of Smallholder Irrigation Schemes in the Usangu Plains, South-West Tanzania

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Abstract
Irrigated agriculture is important to Tanzania's economic and social development goals espoused in the Tanzania Development Vision 2025. However, there has been a tendency of farmers using water in excess of what is needed for productive purposes, leading to conflicts among water users and hindering the expansion of irrigated land. This paper addresses the performance evaluation of the existing traditional and modern/improved smallholder irrigation systems in five villages in Usangu plains of south-western part of Tanzania. The evaluation is based on both physical and socio-economic aspects of the current irrigation system. The implication indicates that if the current system is improved it will lead to sustainable increases in small farmer's productivity and income, thus alleviating rural poverty and enhancing environmental management objectives. For example, improving irrigation management to tail-enders could make irrigated farming a less risky and more viable option to the poor. However, it would have to be linked to interventions to ensure better access to labour at particular times of the year to guarantee that poor people benefits.

Introduction

Irrigation is defined as the artificial control of water to meet crop water requirements. This definition includes the use of residual moisture from flood recession, drainage systems, the capturing of runoff in rainwater harvesting systems, as well as the canal irrigation systems that most people think of as irrigation. The other forms of irrigation are found in the project area, but this paper will focus on canal irrigation. This is because it is very extensive and has significant implications for both rural livelihoods and downstream flows. The areas of flood recession agriculture, drainage and rainwater harvesting are relatively limited (Punmia, 1985).

An irrigation system is defined as both the physical infrastructure of works, and also the social infrastructure of rules and procedures that ensures the operation of technology and the delivery of water. An irrigation scheme is defined as a formal, externally sponsored (either by government and/or donor) project to build new irrigation systems, or to upgrade existing systems. Throughout East Africa, irrigation canals are generally referred to as 'furrows'.

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About 70% of worldwide water diverted from rivers or pumped from underground is used for irrigation (Bower et al., 1999). Irrigated land is far more productive than rainfed land, and the expansion of irrigation acreage over the past 30 years has contributed to gains in food production (World Resources, 1995). Agricultural experts expect continuous growth of expansion of irrigation agriculture to meet future food requirements in developing countries. The Word Bank (1991) has pointed out that irrigation has fundamentally influenced not only agricultural productivity, but also incomes, employment, and subsequently development.

According to the World Bank (1994), Tanzania has approximately 150,000 ha of irrigation land. However, development potential for sustainable irrigation is large, with almost 900,000 hectares (URT, 1994). Over 50 % of this total is in the Rufiji River basin where water allocation conflicts are already evident. In addition, some 80,000 hectares are located in the Ruvu basin, which is the current source of water for Dar es Salaam city. Some other 85,000ha are located in the nearby Wami basin (Word Bank, 1994).

Irrigated agriculture is important to Tanzania's economic and social development goals espoused in the Tanzania Development Vision 2025 (TDV) for several reasons. First, studies by the World Bank indicates that about 50% of Tanzanians can be defined as poor (URT, 2000 & 2001) because they have a per capita income of less than US$1 per day. The studies also conclude that over 80% of the poor are in rural areas, and depend on agriculture for their livelihood. In addition, 82% of the population live and eke out a living in rural areas, with agriculture as the mainstay of their living. This implies that improvement in farm incomes of the majority of the rural population is a precondition for reduction of rural poverty in Tanzania. Irrigated agriculture can improve production as well as incomes.

However, apart from potential of irrigated agriculture in Tanzania, traditional irrigation practices carried out by smallholder farmers have been deteriorating since 1960, although their agricultural products remain to be the main supplier to the local market (Burra, 1999). The World Bank (1994) pointed out that, the tendency to use water in excess of what is needed for productive purposes lead to conflicts among water users and hinder the expansion of irrigated land.

Usangu plains have high potential for irrigated agriculture in south-western part of Tanzania (Mwakalila, 2000). However, there has been concern over rising conflicts over water for irrigation and access to other sectors. Among other reasons the conflicts arise due to poor irrigation management in Usangu plains upstream of the Great Ruaha Basin (Kikula *et al,* 1996; Lankford, 2000; SMUWC, 2001; Sokile *et al,* 2002).

The Study Area

The study area is located in Mbarali District about 55 km from the Mbeya Municipality (see Figure 1). The altitude ranges from 1000m to 1100m above sea level, with temperatures ranging from 10-33^{0}C. The mean annual rainfall is 600mm decreasing north eastwards. The growing season is four months from December to March. The soils are mainly dark grey and prismatic cracking clays; and are generally slightly sodic. Farmers in this area have good access to water through local rivers including Lunwa (Liosi), Mswiswi, Mambi, and Meta. These rivers originate from the Uporoto highlands in southern highlands of Tanzania which form the main catchment area of the Usangu plains.

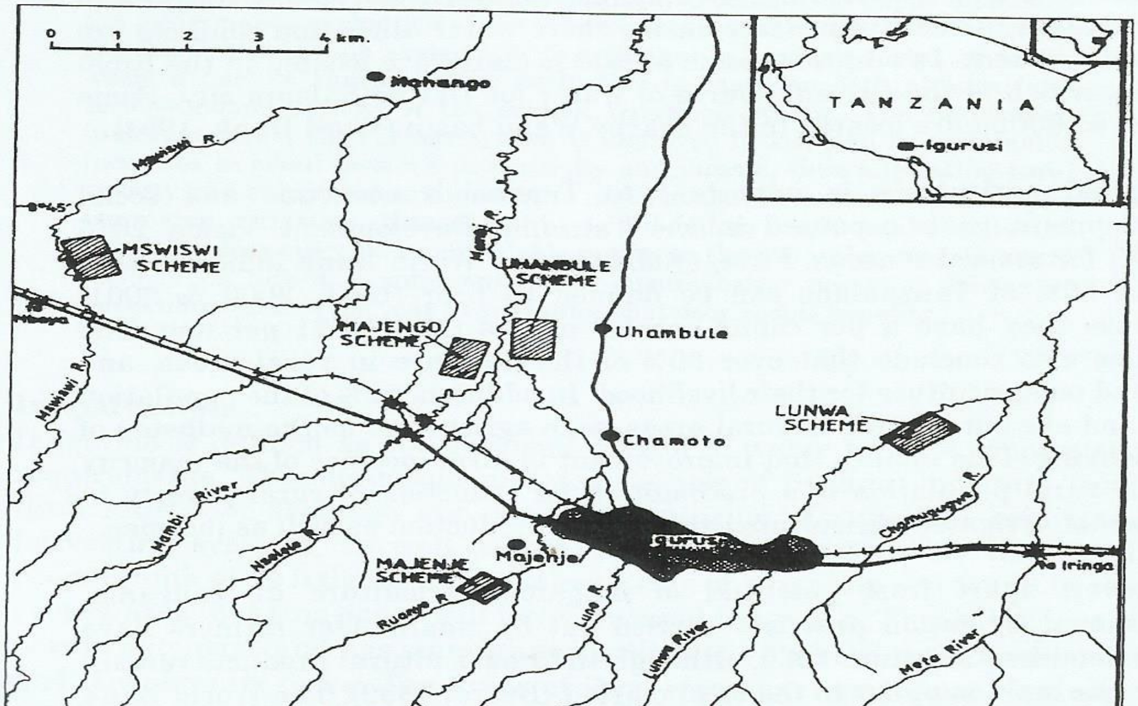

Figure 1: ***The location of study villages and irrigation schemes***

The study villages that were selected to represent different irrigation systems found in the study area included: Majenje, Igurusi, Chamoto, Uhambule, and Mahango. These villages are selected basically to study the three basic irrigation management systems that are based on traditional, improved, and modern ways of water management. The systems are represented by the following smallholder irrigation schemes: Kalanzi, Lumwa (Luanda Majenje), and Majengo Irrigation Schemes. The rationale for selecting this particular area was based on the fact that the area has a good representation of irrigation systems practised in the Usangu plains.

The changing patterns of land use in the Usangu plains are driven to a large extent by two forces: population increase, and the exploitation of economic opportunities. The human population has grown naturally, and has been augmented by in-immigration. The immigration has been stimulated by the perception of economic opportunities in the plains, mainly in irrigation and in stock-keeping. These two forces have accelerated the pace at which land and water resources are used to a point where competition and conflicts have become a serious problem. Institutions to regulate the use of water resources and reduce the scale and severity of the conflicts have not developed at the same pace.

Traditional Smallholder Irrigation System

The Kalanzi Smallholder irrigation scheme is a good example of traditional irrigation system. The system has been built and is managed by the local people themselves, and there have been no external interventions to modify it. Usually locally available materials such as stones, grass, wooden poles and earth are used to build intake structures and aqueducts (Plate 1).

Plate 1: ***Intake of Kalanzi traditional irrigation scheme***

The building and maintenance of these systems is labour-intensive, with the earth canals dug and cleaned by hand. The systems are found in both the upper catchment (where they are used for dry season cultivation), and in the lower catchment (where they are used for a mix of rainy season paddy cultivation and dry season cultivation). Water for irrigation is abstracted from Mambi river.

The amount of water diverted is not controlled because of the absence of gates. It was noted that the intake is subject to frequent damage, and is often washed away by floods during rain periods, leading to unreliable water supplies and repeated construction of new intake every year. Also it was learnt that there is a possibility of diverting excessive water, resulting into floods big enough to cause damage to properties, crops, and life; or may lead to the river changing its course to follow the dug canal.

Water is conveyed to field through traditionally hand-dug canals/channel that are not properly designed, and thus with no definite shapes for good conveyance efficiency. These channels lack control devices for effective conveyance and distribution. The channels are also unlined, thus having higher conveyance losses through seepage, evaporation, etc., resulting into water scarcity and low crop production and household income. The main canal is dug by hand, and is therefore relatively narrow and shallow with low water carrying capacity. A typical main canal is 0.5–1m deep, and approximately 0.75m wide. Secondary canals are approximately 0.5m wide, and 0.5–0.75m deep. Water is diverted from the main canal to secondary canals using temporary mud dams. These systems do not usually have tertiary canals leading to individual farmers' fields, but water passes from one farmer's paddy basins to another farmer's paddy basins. This through flow results in water being recycled between several farmers. This kind of arrangement creates conflicts between upstream and downstream farmers.

Once water reaches the field, it is diverted from the main channel by blocking across the canal using logs, stones, etc. Due to poor land leveling, the application of water in the fields is inefficient, implying that more water is wasted in the fields since no water comes back to the main streams. As a result water users downstream experience water scarcity, consequently resulting into low crop production.

Most irrigated fields have no drainage systems, hence a lot of water is wasted as tail water which results into formation of swamps downstream and raising of water table, formation, of salinity. This process lowers soil fertility, leading to poor crop production and low household income. Irrigation mis-management, therefore, deters alleviation of poverty in the study area.

It was observed from interviews and discussion that in the maintenance of traditional irrigation system, farmers are informed when cleaning will take place by someone walking around the village calling out the information. For farmers living far from the furrow, a meeting is held at harvest time -- when most people are present -- to set out a date when cleaning will begin before the start of the next cultivating season. If a user fails to turn up or send a representative, they are fined. Both men and women can attend furrow work, and therefore female-headed households are expected to send a representative to undertake the work. Similarly, if emergency repairs are required, all water users are called to the intake to undertake the necessary repairs.

There is no specific financial cost of maintaining the furrow with the traditional system, and therefore water users are not expected to make any financial contributions beyond turning up with the relevant agricultural tools in order to assist with the maintenance work. However, if there is some specific work or repairs that will incur a financial cost, money is collected from the water users.

The irrigation practices in traditional systems have effects on the production per unit area and household income. To start with, as farmers divert water, this can occasionally results into floods big enough to cause damage to properties, crops, people's and livestock lives, and soil erosion since a river may change its course and follow the hand-dug canal. Also, traditional canals are shallow and narrow and so they flood easily. These canals also cause loss of water through seepage and evaporation. The flood damage causes households to repair or rehabilitate of whatever family property is damaged. This subsequently involves selling of some of the remaining family properties, including stored food and livestock, to get money. Eroded soils also remain poor for the coming season, implying that, without application of inorganic fertilizers to recover the lost soil fertility, crop production per unit area will be poor. All these lead to low household income and hence poverty.

Improved Smallholder Irrigation System

Luanda Majenje is an example of an improved smallholder irrigation scheme. This is a system that has had external interventions, for example, building a concrete intake with control gate, realigning the canals, and levelling the ground (Plate 2). In this scheme, water for irrigation is obtained from the source through the intake, which was built in the Lunwa river by funds from the UNDP. From this intake, there is a main canal that takes water by gravity downwards, and is followed by a secondary canal that conveys water to the fields. A farmer can then drain water from the secondary canal using small drenches.

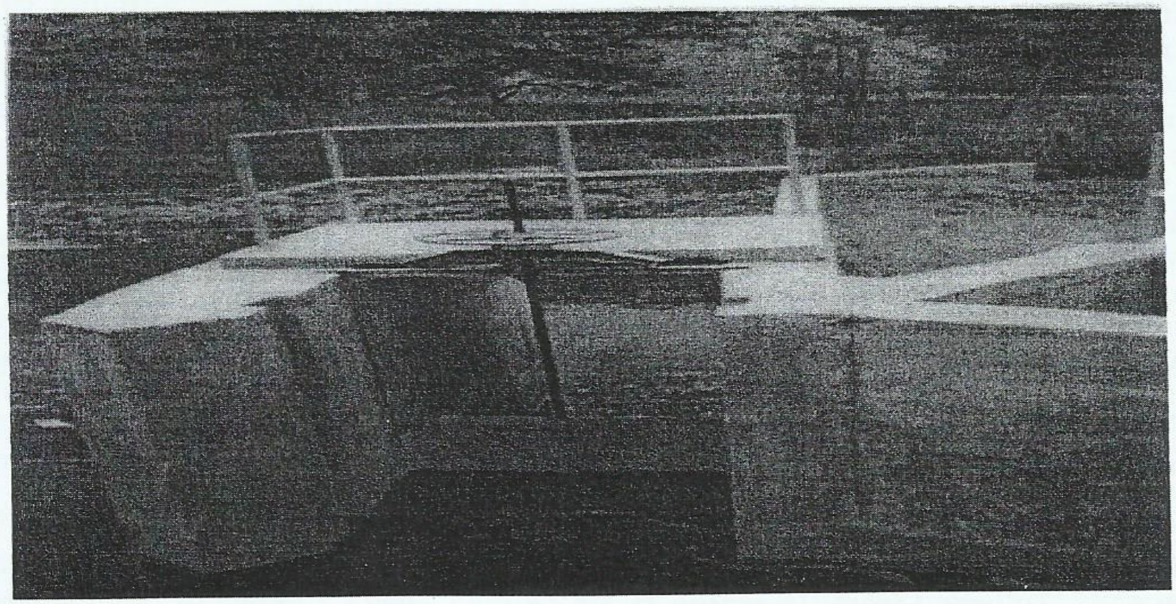

Plate 2: ***Intake of Luanda-Majenje improved irrigation scheme***

The improved main canal in Luanda Majenje smallholder irrigation scheme is widened and deepened using excavating machinery. The main canal is up to 2m wide and 2m deep. There are a series of concrete diversion structures along the main canal with control gates. The drainage systems are put in place so that once water has passed through the fields, it drains directly back to the river.

The system has a permanent concrete intake structure that does not require rebuilding each year; nor does it require constant maintenance throughout the cultivation season. However, there may be a need to de-silt the structure from time to time. Because the main and secondary canals of these schemes have often been dug by machines, equipment is also required to clean and dredge the canals because they are too deep and too wide, and would take too long to be cleaned by hand. Therefore, machinery, as well as manpower, is used to maintain the furrow, making the maintenance process capital rather than labour intensive. Furrow users are usually expected to contribute money to meet the cost of hiring machinery and paying labourers, while the users are expected to clean narrower secondary and tertiary canals themselves.

However, it was noted that, the improved irrigation scheme have not achieved their aims of increasing agricultural output or the efficiency of water use due to the following key problems:

1. Infrastructure is capital intensive to maintain, and there is a lack of ownership of the new infrastructure by the furrow users. As a result, furrow users are unwilling to contribute to furrow maintenance.
2. The institutions introduced to manage the scheme are often too complex, represent the interests of influential people within the user group rather than the majority of farmers, and because they now handle money rather than just organise labour, leaders frequently embezzle funds. Many of the institutions introduced are co-operatives, and there is a historical distrust of these organisations by farmers. Finally, the tasks leaders are required to undertake are often to onerous for an unpaid position, so many tasks are not fulfilled.
3. The aims of the projects are often different to the aims of the farmers themselves: farmers aim to minimise risk, while the projects aim to maximise yields.

There are a number of lessons that can be drawn from the examples of improved irrigation schemes in the study area:

1. The objectives of the project need to be the objectives of the furrow users themselves. If the project fails to meet the water users' needs then they have little incentive to co-operate or sustain project activities once the project itself is finished.
2. Furrow users need to have the capacity to actually meet and sustain the objectives of the project. For example, as discussed above, the objective of increasing yields through increased use of agricultural inputs is useless if farmers cannot afford them.
3. Any physical interventions need to be carefully planned with the water users, ensuring that the alterations are not beyond the water users' technical, financial and labour capacity.
4. Capacity building and institutional development needs to be based, if possible, upon existing institutions and the tasks they undertake. New institutions and new tasks should not be created if the water users do not see any value in them and cannot support them once the project is finished. If the water users identify a need for new institutions and new tasks (such as the allocation of water), these have to be developed by the water users themselves with checks to make sure that they are sustainable in the long-term. There then needs to be long-term follow-up of these institutions to assist with any difficulties that might occur.

Crop Cultivation and Production

Normal plot size for paddy is between 0.5 and 2ha. Each plot is divided into a series of basins, or '*vijaruba*' in Swahili. Basin size varies between 1.5m^2 and 10m^2. Basins are constructed to control the flow of water through the plot, and to keep water levels at a constant depth. Keeping water level is very important as an uneven field can result in some of the paddy drowning while other paddy plants suffer from drought, resulting into a decline in yields. Once constructed, the farmers use the same basins each year. They reinforce the bunds each season when they are puddling the basins. The basins and good control of water levels essential in maximising paddy yields. Therefore, these basins are a form of landesque capital, the bunds representing an investment of time and labour that increases the value of the land.

Many farmers own their own plots, but as land suitable for paddy irrigation has been allocated, new arrivals and young people rent land. The cost of hiring a paddy plot varies according to the location of the irrigation system, and relative location along the furrow (top-end or tail-end). For example, a top-end plot in Mwanavala village, which is close to the urban settlements of Ubaruku and Rujewa, can cost Tsh 30,000 per acre, while a tail-end plot costs Tsh 20,000. A top-end plot in the Kapunga Smallholder Scheme, which is over 20km from the main settlement of Chimala, can be hired for Tsh 20,000 per acre at the top-end , and for Tsh 10,000 per acre at the tail-end.

Farmers often live far (up to 30km) from their paddy plots, preferring to live on the higher, upper alluvial fans. This is because of the humidity, mosquitoes, malaria, and other water-borne diseases found close to the paddy cultivation areas. During the growing season they build temporary houses close to their paddy plots, and stay overnight at times of peak labour demand (transplanting and harvesting).

Farmers clear their paddy fields prior to the onset of the rains. This is often done by burning, which is the most effective way of removing the thorns that have grown up during the dry season. Once they receive some irrigation or rainwater, they prepare the nursery fields. This involves first dampening the soil to soften and make it easier to work. A fine seed bed is prepared by hand using a *jembe* (an axe-hoe). The seeds are planted (either by broadcasting or by planting individual seeds), and the nursery fields covered with straw to maintain soil moisture. The fields are lightly irrigated as and when necessary. The paddy is left in the nursery fields for four weeks before transplanting.

A few days before transplanting, the farmers will irrigate their plots to soften the soil. The land is then ploughed, usually using an ox-plough. After ploughing, the farmers will try to get about 6cm of water onto the land, and then begin to puddle, building up the basin bunds as they do so. From this point until two weeks before harvesting, farmers will try to keep 6–10cm of water in their fields. After puddling and before transplanting, the farmers will go through each basin checking that the water levels are constant within each basin, and make any adjustments necessary. Once the water levels are good, transplanting begins. This can take one to two weeks, depending on the size of the plot and the amount of labour available to the individual farmer. After transplanting, the main tasks are to check on water levels in the fields once or twice a week, and weeding. Keeping more than 6cm depth of water in the basins helps to prevent weed growth, but at the tail-end of irrigation systems water levels tend to drop if there is a lack of rainfall, increasing the weed problem. Six weeks before harvesting, bird scaring is essential. Farmers use scarecrows and flags to keep birds away. They may also send their children to the fields to scare birds away. Two weeks before harvesting the basins are drained. Once harvested, the paddy is threshed and then sold.

The men in a household usually do the ploughing and puddling work, while women transplant and weed the paddy. Both sexes do the harvesting, although it is the male head-of-household who usually sells the crop and decides how the money should be spent.

Very few inputs are used apart from labour and irrigation water. Most farmers prefer the traditional Kilombero variety, which has a good flavour and fetches a good price. A small proportion of each year's harvest is kept as next year's seed. Some farmers use improved varieties such as India Rangi and Subermart, but these are relatively expensive, and new seeds need to be purchased at the beginning of each season, by which time farmers have little capital remaining. The use of fertilisers, pesticides, herbicides, or manure is rare because they are expensive. Where a farmer can afford these, the extra financial investment involved exposes him/ her to greater economic risk should the rains, and therefore their paddy crop, fail. Manure is not used because it is difficult to carry sufficient quantities to distant paddy fields. It is interesting to note that the three farmers interviewed who were found to use fertilisers were all at the top-end of the Kapunga Smallholder Irrigation Scheme, where supplies of irrigation water are very reliable, and each farmer has a 1ha plot, which is slightly larger than average. These farmers felt more confident investing in their rice crop because they were certain of a return. They also used improved varieties

(India Rangi), and hired machinery (tractors and combine harvesters) to plough and harvest their 1ha. All three were using nitrogen fertilisers, but were using only about 50% of the amount required for paddy.

Farmers who have the capital will hire cattle for ploughing, and labour to do puddling, transplanting, and harvesting. Farmers who do not have the money use their own labour and plough their fields by hand. It costs approximately Tsh 12,000 per acre (Tsh 30,000 per ha) to hire cattle and/or labour for ploughing or transplanting. Hiring labour for harvesting costs less; at around Tsh 8,000 per acre (Tsh 20,000 per ha).

Average yields for smallholder farmers are between 3t/ha at the top-end and 2t/ha at the tail-end. Yields at the very top-end are usually slightly less than 3t/ha because farmers try to harvest early to fetch a good price for their paddy. Tail-end yields are relatively low because of inadequate water supplies and late planting. Because of low use of fertilisers and manure, farmers reported that yields are falling. Despite this, they continue to cultivate their land every year. If they leave their fields fallow at all it is because of lack of water rather than a desire to restore soil fertility. Some farmers reported that they had acquired newly cleared land at the tail-end of a system in the hope of higher yields. However, they had not left their fields further up the system fallow, but were hiring them out to people who do not own a paddy plot.

Once harvested, paddy is sold by the sack-load to independent traders, who usually come to buy the paddy directly from the field. One sack is between 80–85kg. At the beginning of the harvesting season, producer price for one sack can be as high as Tsh 25,000, but by the end of the harvesting season this can fall as low as Tsh 6,000. Some traders are local people, while others come from Mbeya and Dar es Salaam. Most own lorries and send the crops to big urban centres such as Dar es Salaam and Mbeya. Very few farmers are able to store their paddy until prices rise again at the end of the dry season.

Once the paddy has been harvested the plot is left until the beginning of the next rainy season. It is not used for any other crops during the dry season partly because of the lack of water, and the clay soils that are very hard to work without a good supply of water to soften them. Also, farmers are concerned that if the basins are ploughed and furrowed for dry season crops, it will take a long time to restore the basins at the beginning of the next paddy season.

Dry season crops such as maize and beans are grown around perennial rivers that provide a constant supply of irrigation water. Dry season plots are usually very small – about 0.1–0.2ha. Many farmers in the upper alluvial fans rent these plots as they only have paddy plots, and do not own land that is in a suitable location for dry season crops. Dry season plots are rented for between Tsh 10,000–15,000 per acre (Tsh 25,000 – Tsh 37,500 per ha).

Dry season crops are often grown on ridges of soil. When the crops are irrigated, water is passed down the furrows between the ridges and allowed to infiltrate into the soil. This is done slowly, carefully controlling the amount of water used to maximise infiltration and minimise soil erosion. The crops are irrigated until the soil is saturated. This is done once or twice a week, depending on the crop (mature maize requires water once a week, while tomatoes need water twice a week and prevailing weather conditions (the hotter it is, the more frequently irrigation is required). It takes up to 90 minutes to irrigate 0.1ha. Farmers try to irrigate dry season crops in the late afternoon and evening. This is when evapotranspiration levels are falling, and it minimises stress on the plant. If they are unable to irrigate in the evening, farmers will irrigate in the early morning, when evaporation rates are also low. Only if they are very desperate will they irrigate in the middle of the day.

For dry season crops, there is greater use of inputs such as manure, fertilisers, and pesticides. This is because the crops are of high value, the inputs are only required over a small area, much of the land is continually cropped in both dry and wet season, and it is easier to get manure to these places. The crops are sold to independent traders who come to the fields with bicycles to collect large baskets of tomatoes, maize, onions, and so on. They then take the produce to the nearest market centre for sale. One farmer with 1.8ha of land claimed that he makes nearly Tsh 3,000,000 (US$3,750) per year from his dry season crops. Another farmer renting 0.2ha of land claimed to obtain a net income of Tsh 178,000 (US$222) after the cost of inputs from dry season crop sales.

Formal irrigation institutions and arrangement

Irrigation institutions can be defined here as the collective arrangements through which irrigation infrastructure is constructed, rehabilitated, maintained, water is derived from streams and allocated and distributed, and resources for these purposes are mobilized.

Irrigation institutions play a great role in the sustainability of irrigated agriculture towards poverty alleviation among farmers. Researchers have observed that some forms of irrigation committees organize tradition irrigation systems. These committees usually have a chairman and a number of other ordinary members. The number of members usually depends on the size of the furrow and secondary canals, but it usually varies between 3 and 15. In theory, an irrigation committee is a part of a village government, being a sub-committee of the Village Social and Economic Development Committee. However, although many of the committee members are also part of the village government, the irrigation committee for a specific furrow tends to act independently, and rarely needs to refer to the village government. The committee is elected, with the regularity of elections varying between places. The members of a furrow user group are all those farmers who own land in the command area (whether they own it or rent it), and who contribute labour or money towards the maintenance of the system. Those who rent land within the system on a regular basis and who live in a village neighbouring the system are expected to attend maintenance work on all occasions. They can also attend furrow meetings, but may not be allowed to vote when new leaders are being elected. Those who come from far distances and rent land only occasionally are expected to attend any maintenance work that takes place while they are there, but otherwise the land owner is expected to contribute to furrow maintenance on their behalf.

Water users in the improved irrigation system have been formally registered with the government as either an association or a co-operative. Associations are registered under the Ministry of Home Affairs, while co-operatives are registered under the Ministry of Agriculture and Co-operatives. A condition for being granted a statutory water right is that the holder of the right be a legally registered body. The establishment of an association is simpler than establishing a co-operative.

The leadership of these associations or co-operatives is more extensive than with the traditional system. There is usually a chairman, a secretary, an accountant, and a number of ordinary members. There may be a number of sub-committees, usually with a sub-committee for every secondary canal. There may also be sub-committees that deal specifically with finance and maintenance. As with the traditional system, leaders are elected and membership of the co-operatives or associations depends upon owning land within the command area, and contributing to furrow maintenance. However, furrow users also have to officially register as a member of the co-operative or association, and have to pay a joining fee.

For both traditional committees and formally registered organizations, there is a similar set of responsibilities for system leaders. The first and main task is to organize the cleaning and maintenance of the system. The second is to ensure equitable distribution of water, especially in times of water scarcity. In this respect, furrow leaders are responsible for resolving water-related disputes between water users. Generally, furrow leaders are not remunerated for their work, and therefore their tasks need to be kept as short and simple as possible, which is why allocation schedules are only rarely used, people preferring the more informal practice of staggering crop production according to the availability of water. The third task of leaders is to enforce by-laws and rules relating to the use of furrows.

By-laws and water rights for irrigation management

The study noted that many villages have by-laws that address the use of irrigation furrows within the village. The village government may set them, but more often the by-laws are set at the ward level. Typical by-laws relating to the use of irrigation furrows cover the following issues:

- *Maintenance of the irrigation system.* Maintenance is to be undertaken regularly by all members, and those who fail to attend maintenance work or contribute the specified amount of money will be fined a certain amount for every day they fail to attend (usually Tsh 500 per day).
- *Allocation of water.* Improved and modern irrigation by-laws give some system for rotating water between secondary canals and those who fail to follow the allocation sequence will be fined.
- *Expansion of the system.* Farmers should not cut new secondary or tertiary canals without the prior permission of the leaders. Failure to ask for permission will result into a fine.
- *Use of water.* People should not wash their clothes in the furrow or river, or foul the water in any other way.
- *Watering of livestock.* Cattle should not be allowed to trample in the furrow or damage the infrastructure in anyway. Those found watering their cattle in the irrigation furrow will be fined.

The number of by-laws and rules tends to be greater and more complex in improved and the modern irrigation systems when compared with those of the traditional system. The extent that they are actually known and enforced varies between systems, according to the point of time in the agricultural cycle, and the scarcity of water. In many villages it was not possible to get a copy of the by-laws relating to irrigation. Leaders could summarize the most important laws (suggesting that these are the ones that are actually used and enforced), but often stated that there were more complex by-laws that they could not remember off-hand (suggesting that they are rarely used or enforced). By-laws about maintenance are the most strictly enforced and followed because maintaining the system is crucial to ensuring an adequate water supply, and therefore a successful crop. Therefore, all water users have an interest in ensuring that the system is well maintained. Because maintaining the system is labour intensive (and relatively expensive where cash contributions are used), there is a strong dislike of 'free-riders' who use the system without contributing to its maintenance, so fines are also strictly imposed. As mentioned earlier, generally by-laws relating to the allocation of water are only imposed at times of great water scarcity and conflicts.

As far as water rights are concerned, it is a legal requirement for all people who are abstracting water from rivers and springs to hold a statutory water right. Only one water right is granted per abstraction, so a user group of an irrigation system own the water right as a group, rather than as individuals. Water rights and concomitant annual water user fees are one of the main instruments used by the Water Office to manage water abstractions. For this reason, it is important to carefully consider the relationship between smallholder irrigators and statutory water rights with water user fees.

Water rights were first introduced in colonial times. Colonial legislation gave all pre-existing traditional furrows a traditional water right, which was held on their behalf by the relevant district authority. All new abstractions were to apply for a water right, including abstractions for traditional furrows. However, in the post-independence era, enforcement of water right legislation was weak and many new abstractions, such as the numerous furrows found in Usangu, were built without any application for a water right. Water users believe that their right to abstract water is based on a combination of two things. Firstly, that they have used their own labour to build the intake and furrow. Related to this is that within a furrow system, an individual's right to use furrow is based on him or her contributing labour to maintain the system. Secondly, water is seen as a gift from God, free for all to use so that they can meet their basic needs.

In 1994 the 1974 Water Act was revised, requiring that all abstractions, including indigenous furrows, to have a statutory water right. Through the revision of the water law and the establishment of water basin offices in the Rufiji Basin (established 1993) and the Pangani Basin (established 1991), the government is attempting to revitalize the system of water rights. The River Basin Management and Smallholder Irrigation Improvement Programme (RBMSIIP) support this policy.

Under the 1994 legislation the concept of Water User Fees (WUF) were introduced. Once a water right has been granted, the water right holder is charged an annual water fee in addition to the one-time payment of the application fee.

In terms of the economic value of water, the less water a user abstracts, the less the user has to pay. The idea is that users will monitor the amount of water they are abstracting, and reduce the amount that they are taking when they do not need it. If a user can prove that s/he is abstracting less than the allocated water right, s/he can obtain a rebate on her/his WUF.

Conclusion

From the performance evaluation of the current smallholder irrigation systems, it can be concluded that the potential implication of the current irrigation systems indicates that, if managed properly, irrigation can lead to sustainable increases in small farmer's productivity and income, thus alleviating rural poverty and enhancing environmental management objectives. It is recommended that all traditional intakes be improved in to obtain an optimum water management. Community participation is important at all stages of intake improvements to come up with realistic design requirements that lead to sustainable irrigation management.

Conceptually, it is also recommended that irrigation development should be under the control of one institution so as to achieve efficient management, control, minimal duplication of efforts and better allocation of resources. As goals or benefits are multisectoral, there is a great need for cooperation or participation of all relevant ministries/departments. Representatives from these institutions should work as a team at regional, district, division, or ward levels (if any). In this way expertise and cooperation from several sources could be solicited. Yet, only the Ministry of Water or Agriculture alone should have the overall responsibility for irrigation development.

References

Bower, Blair, T. & M.N. Hufschmidt. 1994. A Conceptual Framework for Analysis of Water Resources Management in Asia. *Natural Resources Forum*, United Nations.

Burra, P. 1999. *Ideas for Restructuring the Future Management of Tradition Irrigation Improvement Program*, TIP, Tanzania.

Kikula, I., Chamley, S., & P. Yanda. 1996. *Ecological changes in the Usangu Plains and their Implications on the Down Stream Flow of the Great Ruaha River in Tanzania*. Dar es Salaam: University of Dar es Salaam, Institute of Resource Assessment.

Lankford, B., & T. Frank. 2000. The Sustainable Co-Existence of Wetlands and Rice Irrigation. A Case Study From Tanzania. *The Journal of Environment and Development*, Vol.19, No.2, 119-137.

Mwakalila, S. 2000: Land Evaluation for Some Irrigated Crops in the Usangu Plains of Sothwest Tanzania, *Journal of the Geographical Association of Tanzania*, No. 29, pp. 39-48.

Punmia, B.C. 1985. *Introductory Irrigation Engineering*. Delhi: Standard Publishers Distributors.

Sokile, C.S., J.J. Kashaigili, & R.M.J. Kadigi. 2002: Towards an Integrated Water Resource Management in Tanzania: The Role of Appropriate Institutional Framework in Rufiji Basin. In the 3rd Waternet/WARFSA Symposium: Water Demand Management for Sustainable Use of Water Resource; 30-31 October 2002.

United Republic of Tanzania (URT). 2001: *Agriculture Sector Development Strategy (ASDS)*. October 2001.

—. 2000. *Tanzania's Poverty Reduction Strategy Paper (PRSP)*. October 2000.

—. *1994: The National Irrigation Development Plan. Main Report*. Ministry of Agriculture, Irrigation Department. Dar es Saam, October 1994.

World Bank. 1993: *India Irrigation Sector Review*. Vol. I&II, Agricultural Operations Division, India Department, India.

—. 1994. A Strategy for Managing Water in the Middle East and North Africa. *The International Bank for Reconstruction and Development*, USA.