Experiences with Micro Agricultural Water Management Technologies:

Swaziland

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An input to the Study on Agricultural Water Management Technologies for Small Scale Farmers in Southern Africa: An Inventory and Assessment of Experiences, Good Practices and Costs

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1. INTRODUCTION

1.1. Purpose

The study was carried out in selected countries in the SADC region to develop an inventory of agriculture water technologies and practices. Swaziland was one of the selected countries and this report focuses on Swaziland.

This study aimed to document the practices and technologies used in irrigation especially at micro levels in the region particularly those aimed at improving the livelihoods of the rural poor. It also sought to document the impact, success, adoptability and failures of initiatives of the different approaches by different organization with special reference to those initiatives linked to USAID.

1.2. Methodology

Information was gathered about irrigation technologies and practices in Swaziland through interviews conducted and questions asked using the questionnaire in Appendix A as a basis for the interview. Vegetable and sugarcane farmers were visited. Efforts were made to sample from a wider range of technologies and practices to ensure that there would be good representation. Verification was also carried out through interviews with Government Officers in the Irrigation Department of the Ministry of Agriculture and Cooperatives and Out-grower Development Manager for Sugarcane at Royal Swaziland Sugar Cooperation (RSSC).

1.3. Limitations

The main limitation to this study was the lack of documented data. A lot of the information on small scale irrigation schemes and initiatives is available only from the organizations involved in the schemes and can only be extracted through interviews with those individuals directly involved in the schemes. In the case of Swaziland an added limitation was time since only three days were spent in the country by the study team. As a result it was not possible to visit all the important sites and interview the relevant people. It should be noted that the resource peoples used in the study were mostly from the sugar industry and could have been biased in their selection of field sites.

1.4. Report structure

This report gives an overview of the water resources and water use in Swaziland, analyses the technologies and practices used for micro irrigation in the country, outlines the programs undertaken in the promotion of micro irrigation and describes the main players in micro irrigation development in the country as well as discusses the potential

for scaling up the most promising technologies and practices before giving some general conclusions and recommendations.

2. OVERVIEW OF FOOD SECURITY, HUNGER, AGRICULTURE AND WATER

2.1. Background to the country

Swaziland is a land locked Southern African country sandwiched between South Africa and Mozambique. The total land area is 1 736 km^2 and the total population was estimated at 1.2 million people in 2005 of which more than 25% live in urban centres. The main towns are Mbabane and Mancini. The population growth has been declining from a high of 3.2% in 1994 to a low of 1.9% in 2002.

Cultivated land accounts for 191 500 ha or 11% of the total land area of Swaziland. Irrigated land is 47% of the total cultivated land.

The average annual rainfall is 788 mm. Rainfall is not evenly distributed in the country. The low lands receive around 500 mm whilst the highlands receive close to 1 500 mm.

2.2. Water resources and water use

Swaziland shares all its rivers with South Africa and Mozambique. In the recent past there was common belief that Swaziland had more than sufficient water mainly because of its low population then and the low demand placed on the resource within the country and by its neighbours. Over the years, the growing urbanization, changes in agricultural practices, industrial and to some extent mining activities have not only increased the demand on fresh water but have also increased pollution of water bodies resulting in less fresh water being available. The increased abstraction of water from rivers as a result of the increased demand, the requirements of the New Water Act of 2003, and the increasing loss of quality as a result of effluent have made it necessary to review technologies and practices in irrigation in Swaziland.

Water resources

The country's total water resources are estimated at 4.5 km^3/yr. Only 2.6 km^3/yr (25% of total renewable resource) are renewable and the per capita availability is 3 125 m^3/yr.

Swaziland is drained by five major rivers, Komati, Lomati (Mlumati), Usuthu (Lusuftu), Umbeluzi (Mbuluzi), and Ngwavuma. The boundary of the area drained by each river has been designated a unit of management according to the New Water Act (Water Act 2003) to enable decentralization of management of rivers to stakeholders or water users. According to the Water Act of 2003 the recognized water uses in Swaziland include domestic (primary), industrial, agricultural, and environmental (including in-stream flow requirements). Mining is not considered a major user of water in Swaziland.

The Water Act 2003 defines primary use as water used for domestic requirements, sanitation, the watering of animals not exceeding 30 cattle or the irrigation of land not exceeding one-quarter hectare adjoining or occupied with homestead of not more than 10 inhabitants but does not include the water use by a local authority for distribution to the inhabitants of the area.

While environmental use is not defined but there is a common understanding that there should be sufficient water to the environment to maintain aquatic life, wetlands, etc. It is also understood that defining this amount of water is a complicated exercise, which requires scientific information and research. Efforts

Industrial use has been defined as "The use of water by an individual or corporation for any industrial, commercial, manufacturing, mining or processing purposes and any other use which will or may alter the chemical, physical or biological quality of the water or surrounding ecosystem"

Water use

Water withdrawals are estimated 1 200 m^3 per capita per year. Agriculture accounts for 96% of all withdrawals, industrial use for 2.4% and domestic uses 1.6%.

Agriculture water needs are directly related to population as well. Dry-land farming in Swaziland is popular but due to unreliability of rainfall most farmers prefer to increase their assurance through irrigated agriculture. This will continue being the trend as periods of extended drought are also being experienced at a relatively higher frequency than in the past.

The irrigation potential in Swaziland is estimated at 90 000 ha while the actual irrigated area stood at 67 000 ha which is 74% of the potential and just below 35% of the total cultivated land. Most of the irrigated land in Swaziland is under sugarcane. Of the 67,000 more than 10% of the area is now under the responsibility of indigenous people who are farming in different communities as Farmers Associations, or individuals. The growing inclusion of new entrants into irrigated farming has further increased the need to manage the water resources to ensure efficient water use. Such efficient use naturally requires improvements in both irrigation technologies and practices.

2.3. Food security, health, HIV and AIDS.

Agriculture and food production

The staple food in Swaziland is maize but the country does not produce sufficient quantities to meet domestic demand and has to rely on food imports mainly from South Africa. Maize is grown mostly by subsistence farmers on Swazi Nation Land which occupies 54% of the country. The other 46% of land is Swaziland is privately owned and is dedicated to sugar cane and other commercial crops.

Micro irrigation schemes in the country consist mostly of communal smallholder projects that are characterized by individual family holdings of less than 0.5 ha in typically 20 ha schemes. Water supply is mostly from small dams. The most common irrigation systems include short furrow and basins, drip kits, commercial drip lines and gravity fed hosepipes.

Food security

Swaziland is affected by the persistent droughts that have been afflicting the SADC region of late. The situation is made worse by the fact that country is a net food importer even when there is no drought. World Vision reported that close to 230 000 people, or 19% of the total population, needed food aid in 2005.

The government of Swaziland, through the Ministry of Agriculture and Co-operatives, has been advising farmers to plant more drought resistant crops. The use of fertilizers in the more water rich middle and high velds is reported to have significantly improved crop yields.

3. ANALYSIS OF GOOD PRACTICES IN MICRO IRRIGATION AND RWH

3.1. Overview

A number of irrigation technologies have been introduced and modified in Swaziland. Two approaches towards irrigation development can be recognized in the country. One approach has been driven by commercial interests to address water losses and reduction in labor. The second approach has been driven by the government and NGOs with an overall objective of poverty alleviation. Of late there seems to be a convergence of these two approaches in an effort to ensure sustainable development. One of the main features of this convergence is the promotion of small holder outgrower schemes by the main sugar estates.

The commercial approach has over the years promoted irrigation systems that include:

i) Drip Irrigation (line systems).
ii) Micro jets.
iii) Center pivot irrigation.
iv) Sprinkler irrigation (semi-portable sets and dragline systems).

The poverty alleviation approach has tended to promote the following systems:

i) Short furrows
ii) Direct applicator hose-pipe
iii) Drip kits.
iv) Sprinkler irrigation (semi-solid sets and dragline systems)
v) River bed suction systems for drip irrigation.

A general observation from the field visits is that Swaziland promotes small-scale irrigation by conventional means rather than micro irrigation technologies. On average Swaziland's commercial irrigation sector is relatively advanced in comparison to other SADC states. The various types of technologies and the institutions promoting them are highlighted in the Table 1 below.

Table 1: Technologies and practices in small scale irrigation in Swaziland.

Technologies /practices	**Source of technology**	**Source of water & access**	**Energy requirements**	**Service provider**	**End user**
Drip irrigation	Imported through local agents mainly from South Africa.	Surface water (run – of river and dams)	Electric power	Swaziland Electricity Board. Spares are available through local agents but not maintenance.	Community groups such as Farmer Associations and lately individuals.
Center Pivots	Imported through local agents mainly from South Africa.	Surface water (run – of river and dams)	Electric power	Swaziland Electricity Board. Repairs and Maintenance are non existent in Swaziland is sourced externally.	Community groups such as Farmer Associations and lately individuals.
Water harvesting (dams) Feeding direct application and short furrow systems.	Local driven by government	surface	Non	Government mainly the Ministry of Agriculture and Cooperatives (the Land Development Section)	Community
Drip irrigation Promotion and provision of drip kits to farmers in community gardens.	Imported mainly from South Africa through the Donor Funds	surface	Manual (Treadle pump)	Community	community
Bucket irrigation	Self design	Surface	manual	-	Community and individuals and schools.
Sprinkler system	Imported from South Africa through local dealers.	Surface Water (run of river and dams)	Electricity	Swaziland Electricity Board only for power. Local dealers provide backup but not much.	community
Treadle pumps	imported	groundwater	manual	NGO and Ministry of Agriculture and	community

Technologies /practices	Source of technology	Source of water & access	Energy requirements	Service provider	End user
				Cooperatives (through the Irrigation Section)	
Floppy Irrigation System	Imported from South Africa mainly for corners in center pivot irrigation.	Surface	Electrical	Swaziland Electricity Board. Maintenance non- existent.	SWADE Areas
Direct application	Locally developed technology using imported parts.	Surface (gravity)	None	Ministry of Agriculture and Cooperatives.	Women's scheme.
River bed suction system	Locally developed using technology from the mines.	Surface	None	Kwasa Farmers Association.	Farmers Association

Sources of technology

The technologies used in Swaziland are imported mostly from South Africa through local agents. Successful attempts have been made to assemble 'hybrid' systems that couple parts from different irrigation systems such as the so called 'direct application system' described in greater detail later in the report.

Discussions with ministry officials reveal an enthusiasm by the officials for the country to be self reliant in the provision of technologies. However the capacity of the country to economically manufacture these technologies remains subdued given it level of development and the size of the national economy. The reliance on South African technological manufacturers is to remain for a considerable time to come. Consequently, all poverty alleviation attempts through technological advancement in Swaziland will have to rely on the south African market or beyond.

Water sources

All irrigation water in Swaziland is drawn from the run of river and most schemes are naturally located in the river valleys. Swaziland's rivers are semi-perennial allowing farmers to irrigate for most of the year. Partly because of this apparent abundance of water groundwater is not accorded high priority in irrigation development in Swaziland. There is need for a rethink of this position primarily because the country has reasonably good groundwater resources, groundwater being in-situ has the potential to benefit more households than those in surface based irrigation schemes and lastly because ground water is ideal for micro irrigation technologies such as the drip kits that are usually promoted in poverty alleviation initiatives.

Rainwater harvesting, particularly from rooftops, is not promoted enough in Swaziland. Given the proliferation of modern dwellings in the rural areas of the country (the Swazis favour big buildings) rainwater harvesting and complementary household gardens should be encouraged in the country.

Service provision and back up support

All irrigation schemes for communities are designed and approved by the Ministry of Agriculture and Co-operatives. Back-up support for high tech technologies such as drip is not formally organized and the communities have to rely on maintenance from local agents who operate on behalf of South African based companies. This arrangement results in down times of between 2 and 12 weeks and total loss of crop for some farmers.

Maintenance of the electricity supply system and pumps is usually provided by the Swaziland Electricity Board or their designated agent.

It does appear as if the issue of back-up support is not given due consideration by both the government and the NGOs that promote irrigation for poverty alleviation. For

example, only one official from the Ministry of Agriculture and Co-operatives is recognized by the people on community based irrigation schemes. Such a situation arose because insufficient manpower is allocated to communal irrigation schemes by the ministry and no capacity building plan has been put in place for both the ministry's staff and the communities themselves. This scenario threatens both continuity and viability of the projects since extension services are virtually non-existent.

It is the recommendation of this study that more effort be put in capacity building for both the ministry and the community members to improve the management of the micro irrigation schemes as well as the operation and maintenance of the irrigation infrastructure.

Performance

The low tech technologies such as the direct application and short furrow are reported to perform within their design specifications with minimal breakdowns. The drip systems have higher failure rates. The officials reckon they observe blockages in between 20% to 40% of drip lines at every annual re-commissioning.

The study noted that there are no systems for documenting the performance of trhe various technologies. The figures quoted for water use efficiency are the design estimates that are not derived from the system operation. It is imperative therefore, that proper monitoring systems be put in place to document the performance of the irrigation technologies in use. Judging from the experiences of Zimbabwe, NGOs and other donor agencies in micro irrigation in Swaziland will benefit immensely from the use of academic institutions such as the university which can offer their students for research projects.

Costs

Micro irrigation development in Swaziland is spearheaded by government, NGOs and private business. Usually the government or donor provide funds for irrigation infrastructure and major capital outlays as soft loans. The communities bear the full burden of operations and maintenance costs. Because of this arrangement some community schemes send some of their members to be trained by the local agents in the maintenance of their irrigation systems.

The issue to be addressed is how much the government/donor subsidy should be for the capital outlay of a communal irrigation project. Whilst the government. AND donor philosophy has always been that communities cannot afford so more has to be provided for free officials operating on the ground report that those schemes were the community monetary contribution is significant tend to be better managed and maintained whilst the members develop a greater sense of ownership of the project.

Level of use

Water use in micro irrigation schemes in Swaziland is single purpose, i.e., only crops are grown and the water is used for nothing else. Schemes are managed as communal associations or as communal groups and individual holders within the scheme.

Plot sizes vary from 0.06 ha to 10 ha for individual holdings. On average each scheme covers between 10 to 250 hectares of land.

The study could not carry out an audit to determine the optimum plot size for maximum benefit at the household level. However, the issue needs a thorough investigation so as to assist government/donors to channel resources for maximum economic benefit.

An area that has not yet gained prominence in Swaziland is multiple use of water. The thinking in both the government and irrigators is that irrigation water has a single purpose.

Contribution to welfare

That micro irrigation schemes contribute towards income generation is not in doubt. However, the contributions depend on the type of scheme, the socio-economic status of the beneficiaries before the scheme is introduced and how the scheme is run. In a majority of the cases beneficiaries usually do not have a reliable source of income before the scheme is introduced. In the more successful schemes the original members employ others and become only board members.

Whilst no hard facts could be obtained as to how welfare has improved because of the irrigation schemes, it generally agreed by both government/donors and the beneficiaries of the irrigation schemes that there is some improvement in the people's lives. Perhaps at a moral plane what needs to be addressed is at what level should poverty alleviation interventions leave the beneficiaries – should they just have enough to survive without a change in their economic status or should they break out of their poverty cycle completely and become financially independent?

Environmental impacts

Though no environmental impact studies have been carried in Swaziland it is generally accepted that the small scale nature of the schemes mean little damage is done to the environment.

3.2. Communal use of commercial drip – out grower schemes

The sugar industry has been promoting the use of commercial drip in community owned and managed sugar growing schemes.

Technical description

This is a standard drip irrigation system in which water is supplied to the plant directly from buried PVC pipes of diameter range from 6 to 12 mm. Drip lines can be as long as 150 m.

Extent of use

The commercial drip is used in the so-called out grower schemes for sugar cane production in the lowveld of Swaziland. In the out grower system land is availed by a large sugar estate to a group of farmers and start-up capital is provided by a financing institution in the form of a loan often payable over four years. The group of farmer operates as a co-operative and is obliged to sell their produce to the estate owners. Often the group of farmers employs permanent staff and hardily work the fields themselves.

Operation and maintenance

The back-up support for the out grower schemes is normally provided by the estate management at a nominal fee. The farmers' employees carry out routine maintenance. These employees do not have any formal training and only use the experience gained during their employment to operate and maintain the system.

Level of community involvement

The farmers often work elsewhere and leave the fieldwork to their field workers. The Chairmen of the farmers group doubles up as the general manager and is the point person for any given out grower scheme. Family involvement in the schemes is minimal. Often the scheme locations are away from settlement areas as they are part of former estate land.

Costs

Costs vary from scheme to scheme and may differ by as much as 25% to 40% for the same scheme size. The general range of capital costs is E25 000 to E30 000 per hectare. Energy costs average E0.37 per kWh while labour costs were given at between 12 and 17 man-days per hectare.

Effectiveness of technology/practice

Yields on the out grower schemes using drip range between 98 and 102 t/ha as compared to the estates that produce upwards of 110 t/ha.

Suitability

The use of commercial drip by communities still needs to be evaluated. The out grower schemes seem to be an extension of the estate system which fosters an employer-employee relationship rather than group growth and communal benefit. The institutional arrangements associated with the out-grower schemes seem to favour and are too

dependent on the chairman – a weak chairman results in poor scheme performance whilst a strong chairman may result in better performance and direct personal gain to himself. Naturally, organizational conflicts are prevalent in the out grower schemes.

Environmental benefits
This still needs to be evaluated.

Advantages
The main advantage is that more people benefit from profit sharing and that more people are employed as compared to the estate system.

Disadvantages
This is an extension of the estate system. Institutional arrangements are weak. Production is less than on the estates.

Cultural acceptability
The system tends to alter the traditional power dynamics. In cases were the chief is not the chairman the later can have and even exert influence equal or surpassing that of the chief. As a result social tensions are easily created. The employer-employee nature of the schemes creates new social hierarchies that may not be in tandem with traditional authority.

Potential for up scaling
With better organization, institutional arrangements and infield management the out-grower system may be ideal for commercial sugar production in Swaziland. The system can be replicated in countries were estate crops are grown. Examples of countries that may take the system up are Zimbabwe for sugar, tea, coffee and fruit orchards; Mozambique for sugar cane, tea and cashew nuts and Malawi for tea.

3.3. Semi-portable sprinkler

This sprinkler system has been promoted in small-scale group managed irrigation schemes in Swaziland.

Technical description
In this sprinkler system the supply and main lines are permanently buried in the ground whilst the laterals are fed from hydrants and can be moved from one place to another. With this arrangement it is possible to irrigate a large area with few laterals as long as the design specifications are met.

Extent of use
The practice is promoted in most of the World Vision supported community irrigation schemes in Swaziland. Such schemes are common in the high and middle velds in the country.

Operation and maintenance

High wear and tear of the laterals is common because the lateral are transported and shifted in position manually and are laid and connected/reconnected frequently. Sights of deformed or twisted and abandoned aluminum pipes are not uncommon. More still needs to be done in managing the semi-portable sprinkler system.

Level of community involvement

Because of the manual nature of lateral changes, labour is required. As a result all family members can participate in the irrigation practice. The main issue is management of the many people who will be participating. It was reported that arguments do arise on irrigation frequency and cycles especially in cases were farmers operate their fields as individuals.

Costs

A 10 ha scheme costs about E30 000 to establish including pump, mainline, laterals and sprinklers. O&M costs vary from scheme to scheme. The major costs for O&M are energy (electricity) and labour.

Effectiveness of technology/practice

The semi-portable sprinkler system has been very effective in terms of changing the people's lifestyles were it has been used. Some schemes have reported revenues of up to E40 000/ha and have markets as far afield as the UK. The users of the sytem have testified to the positive change in their economic status brought about by the use of such systems.

Suitability

Swaziland is high rainfall country and the rivers flow for long periods of the year (between 9 and 11 months). The country is therefore suitable for the run of river schemes. What requires more attention is the management of the systems.

Advantages

The systems can be established without the need for a lot of laterals and sprinklers when compared with permanent systems. Water efficiencies are generally higher than for surface systems. The system combines features for commercialization as well as poverty alleviation through communal operation.

Disadvantages

The system requires good community management skills to reduce physical damage to the laterals as well as reduce interpersonal conflicts. The system requires a high capital installment to establish and a power source to operate.

Cultural acceptability

The system is very welcome among the communities and is viewed as "real irrigation" when compared to drip kits and treadle pumps.

Potential for up scaling

Given Swaziland's abundant surface water resources, particularly in the middle and high velds, this system may be ideal for the communities to engage in commercial production of vegetables and maize.

3.4. Direct applicator hose-pipe.

This is a uniquely Swazi design which solves one of the main disadvantages of surface irrigation, namely how to uniformly distribute the water in the irrigation area.

Technical description

In this system a hose-pipe is fitted into a risomatic stand on gravity pressured pipes. When a hose pipe is inserted into the risomatic stand it pushes a ball valve system down thus opening the pipe and allow water to flow into the hosepipe. When the hosepipe is removed the valve shuts and flow is stopped. This design allows water use to be regulated as well as be distributed uniformly throughout the irrigation area since water is only available when one wants to use it. It is also possible, though it is not yet being practiced in the country, to measure the flow of water by attaching a meter to the risometric stand.

Figure 3.1 The direct applicator system.

Extent of use

The system is being used only at the Nkwene irrigation scheme in Swaziland.

Operation and maintenance

At the Kwene irrigation scheme each individual farmer operates four plots of 30 m by 5 m each. Farmer groups are organized around a hydrant from which they draw water. Seeds are grown communally by the group but each member is responsible for their crop after transplanting.

The government provides maintenance of the system and is also responsible for system design and capital outlay.

Level of community involvement

Only women and children work on the plots. Men generally do not approve of the scheme and often prevent their wives from working in the scheme during the rain season preferring that they work on the family dry land farms. As a result the scheme mostly lies idle in the rain season.

Costs

The costs scheme set up, operation and maintenance were not available. Generally, no records of scheme operations are kept.

Effectiveness of technology/practice

It is clear that the system saves and uniformly distributes water compared to a surface irrigation system. Beyond this the scheme performance still needs to be evaluated.

Suitability

The system is ideal for gravity fed systems where water distribution is not uniform along furrows. The system also offers an opportunity for measuring the amount of water used by each irrigator and will therefore go a long way in promoting water charging and consequently water use efficiency.

Environmental benefits

There is greater water flow control.

Advantages

Uniform water distribution is achieved within the scheme. Water is saved. the users need not give each other turns to irrigate as all can access water at the same time. The exact amount of water used by each irrigator can be measured (if such a need arises). The system requires no energy input.

Disadvantages

Only feasible were a substantial head can be developed to allow for effective risometric stand operation. The system will not work on very flat ground. The technology can be adopted for the household level. He system relies entirely on the run of river.

Cultural acceptability
The use of hose pipes is generally accepted and even liked by children so the system is good for family based schemes.

Potential for up scaling
The system is perfect replacement for the furrow system and should be adopted fro previously furrow based schemes.

3.5. Riverbed suction abstraction system

This abstraction system is designed to solve turbidity problems associated with surface water when used for drip irrigation. The design is uniquely Swazi and is still to be tested at a larger scale.

Technical description
Water is abstracted from below the riverbed level. A filter consisting of a gravel pack of two to three layers of different grain sizes underlain by stainless steel strainers is constructed on the riverbed. Water filters through the filter pack by gravity, collects at the bottom and is pumped to another system of filters closer to the point of use. One or more filters can be placed after the pump.

Extent of use
The use of this system is still very experimental and is limited to the Dvokoliwako irrigation scheme in the Kwasa area of Swaziland.

Operation and maintenance
When it clogs the filter pack can be cleaned by either forcing back wash water of by simply dismantling the pack and refilling it with fresh or washed sand. No expertise is required and the farmers do it themselves.

Level of community involvement
Day to day community involvement is not relevant nor desirable since the system is only for water abstraction. The community may assist in constructing the filter pack by ferrying the required sand and gravel or by contributing financially towards purchasing the stainless steel screens.

Costs
Costs could not be ascertained for this technology. It has to be noted however that this technology is only used in combination with another technology, in this case drip lines.

Effectiveness of technology/practice
Not yet verifiable.

Suitability
The system is suitable in those areas where clean groundwater for drip systems is not readily available. This is generally the case with the middle and high velds of Swaziland.

Environmental benefits
None that could be verified.

Advantages
The system eliminates the need for commercially designed primary filters for drip systems that use surface water. The system operates with minimum intervention and is easy to maintain and repair.

Cultural acceptability
Cannot be verified since only one site uses this system.

Potential for up scaling
The system may be ideal for those areas in which surface waters have a high turbidity.

3.6. The trench garden

This system received massive support from the government of Swaziland as it was seen as a way of alleviating the impacts of HIV/AIDS. The system was promoted on the national media and through field extension staff.

Technical description
The trench garden is a simple 5m by 1 m strip of land in a household's backyard where "5 cabbages" can be grown and irrigated using "grey water" from household chores such as dish washing, laundry and bathing.

Extent of use
The system was nationally promoted but take up was poor.

Operation and maintenance
None is required.

Level of community involvement
This was a top-down promotion and the community never really took a liking to it.

Costs
Costs are nominal since they are "just for the cabbage seeds"!!

Effectiveness of technology/practice
People rejected the practice.

Suitability
The practice sounds good on paper.

Environmental benefits

The practices reduces the amount of nutrients going to the main sewers in the case of reticulated sewer system and reduces groundwater pollution in the case of local disposal of household wastewater.

Advantages

Uses water that was going to be wasted anyway.

Disadvantages

Grey water not quite attractive to the user particularly for the growth of food crops.

Cultural acceptability

People do not like the idea of "eating their waste".

Potential for up scaling

Minimal unless cultural perceptions change.

4. REVIEW OF AGRICULTURAL WATER PROGRAMS

4.1. Introduction

Swaziland is gradually moving away from farming for livelihoods towards commercial production in a number of areas. In all the places visited and the interviews conducted indicated a move towards commercial crop production. In one of the project (Nkwene) areas visited where the majority farmers are women the technology introduced there was the direct applicator mainly because there were problems around the ability of the system to meet crop water requirements. Prior to the introduction of this technology it was confirmed that cycling around for all members was not easy but since the introduction of the system all members were able to irrigate when they needed to. There were problems highlighted in this project, which included marketing of produce, the drought, and the shifting priorities in summer when maize is to be grown in members homes for grain. It was also observed here that there are maintenance related problems and that planning for preventative maintenance was not given high priority as there was no mention of money set aside for maintenance.

4.2. Donor/NGO supported programs

General

The other scheme visited down the Mkhondvo river, which had been established through an NGO called World Vision, was also a farmers association whose composition was mostly family units headed by men. At this scheme the system used was dragline sprinkler with a pump feeding directly to the system. (See Figure 4.1) This project looked very good and the chairman was of the opinion that it is sustainable and marketing was not that much of a problem because of their proximity to one of the major cities (Manzini) in Swaziland. The energy for irrigation is provided through a power line sourced from the Swaziland Electricity Board.

Figure 4.1. An NGO financed community managed irrigation scheme in Swaziland.

4.3. Private sector initiatives

When sugar prices were very good the government of Swaziland encouraged communities to engage in sugarcane farming in a number of areas. Funding was made available through a number of financial institutions in Swaziland which include but not limited to:

- The Swazi Bank,
- Swaziland Water and Agricultural Development Enterprise (SWADE)
- The Enterprise Trust Fund (ETF) which later became Swaziland Development Finance Corporation (FINCORP)
- Swaziland Industrial Development Company (SIDC)

Communities were encouraged to resettle and allow for the most irrigable areas to be used for such projects. This indeed took place and hence the birth of farmers associations such as Bambanani Balimi Farmers association which was visited at Hlane in the lowveld in Swaziland. This farmers association obtained its water from Royal Swaziland Sugar Corporation's share after the company had installed drip irrigation on large hectares of its land but was intending to expand the mill in order to be competitive. In its quest to expand the mill it then approached communities nearby and asked them to venture into sugarcane farming given the financing facilities that were being made available and its commitment was to give up some of its water allocation to these farmers. These farmers have used systems including subsurface drip irrigation. The subsurface drip irrigation system has been very profitable in that it saved the farmers both water and energy costs. However, there are problems around the system some of which include this being a new system to new farmers whose exposure and experience in irrigation is rather limited. The main area which has been neglected and will become a problem and affect the sustainability of such schemes is the lack of preventative maintenance. This will not only affect the projects established through RSSC but also those established through SWADE according to the Outgrower Development Manager at RSSC.

All the projects visited here are projects who in my opinion have a potential for upscaling provided marketing improves and business skills are imparted to the farmers. In the projects visited there were obvious benefits to the local communities in that electric power and water was brought nearby and this has enabled those communities to benefit in terms of bring power and water to their houses.

4.4. Government supported initiatives

The Lower Usuthu Smallholder Irrigation Project

The scheme is targeted at smallholder sugar cane growers in Central Swaziland. The project is to be run by a government controlled enterprise, the Swaziland Komati Projects Enterprise (SKPE) and will be financed to the tune of USD24 million. The main objective is to "increase household income, enhance food security, and improve access to social and health infrastructure for the rural people…"

5. SUMMARY OF KEY ACTORS IN MICRO IRRIGATION AND RWH

There are basically four types of actors in micro irrigation in Swaziland, the government (usually with assistance from bi and multi lateral donors), the NGOs, the private business and communities. The last are generally the targeted beneficiaries of the micro irrigation initiatives.

5.1. The national government

The ministry of Agriculture and Co-operatives is responsible for the development, management and monitoring of most smallholder schemes in the country. Among their main tasks are:

i) technical design survey and supervision,
ii) provide irrigation equipment,
iii) organization and formulation of community associations
iv) farmer training
v) financial support in the form of grants and loans to farmers,
vi) development of local legal frameworks, constitutions, etc
vii) organizing market support and (export facilitation)

Though these terms of reference for the ministry do look impressive, the reality on the ground tells a different story. The ministry is understaffed in relation to the needs of the micro irrigation sector in the country. In fact, from the field visits, it does appear as if most beneficiaries of communal irrigation schemes recognize the name of a single individual in the ministry! Most staff involved in micro irrigation has an engineering background. As such their appreciation of socio-economic issues is limited. The result is that no capacity building interventions are put in place in most of the schemes. Training in marketing, community organization and budgeting is virtually non-existent.

The other government ministries involved in micro irrigation include the ministries of Health, Home Affairs and Natural Resources. The role of these ministries in micro irrigation is very minimal. In fact, there are no terms of reference for their participation in the promotion of micro irrigation technologies in particular.

5.2. External support agencies and NGOs

Several ESAs and associated NGOs operate in the micro irrigation sector in Swaziland. The major NGOs include World Vision, ACAT and Farmer's Foundation. World Vision is very active and visible on the ground in Swaziland. The driving force for intervention by NGOs is clearly stated as poverty alleviation (the motive of cause may be something else). The main activities of NGOs include:

i) Provision of equipment such as treadle pumps, drip kits, etc.
ii) Provision of start-up finance for communally owned schemes
iii) Provision of training services for established community schemes

The NGOs often identify communities, or households within communities, that are in need of livelihood support. Based on the NGOs assessment it then recommends the type of technological intervention that may help in poverty alleviation. Though visited, the communities are seldom involved in the choice of technology. This approach may have contributed to the low uptake or poor maintenance of some of the micro irrigation technologies such as the trench garden.

World Vision has expanded its brief in micro irrigation to go beyond mere poverty alleviation to focus more on development assistance. The NGO has been promoting the provision of loans to communally managed and owned irrigation schemes. However, World Vision sees itself as an organization for the rights of children and therefore does not consider its efforts in this regard as its core business. The NGO also offers basic capacity building in community based management, financial management and operation of maintenance. However this activity comes low in the packing order such that its impact may be minimal.

The operation of NGOs in Swaziland is similar to that in other SADC countries such as Zimbabwe, Zambia and Malawi. The local NGOs feed into programs run by External Support agencies such USAID and DFID and provide the link for such ESAs and the local communities. However, what is worrying is that these organization are not very forth coming in revealing this relationship.

The capacity of the NGOs to continue playing a significant role in the promotion of micro irrigation technologies could not investigated fully during the course of this study but it could be deduced that more funds could be availed to the communities if NGOs played only an advocacy role and let the community based organizations deal directly with the ESAs in financial matters and selection of technologies.

Table 2 summarizes the main actors and their roles in micro irrigation in Swaziland.

Table 2: Main actors in micro irrigation in Swaziland.

Name of NGO/Agent	**Physical Address Website and tel numbers**	**Project in irrigation for livelihood support : technologies and support**	**Contact person**	**Technologies /practices promoted**
World Vision	P.O. Box 2870 Mbabane Swaziland +268-422-1665	Community based projects that are aimed at providing jobs and have a commercial element.	Mr. Maduna	Sprinkler (semi-portable), short furrows, direct application from low pressure tanks. Pumping direct from the river using electric driven pumps.
Ministry of Agriculture and Cooperatives through International donors such as FAO, IFAD, USAID	MOAC P.O. Box 21 Mbabane Swaziland +268 –404-2321	Community based projects that are aimed at providing jobs and have a commercial element.	Mr. P. M. Khumalo Mr. M. Ngwenya	Short furrows, direct application (using hosepipe connected to a riser with a coupling and an automatic valve. Drip kit technology. Microjets.
Swaziland Water and Agricultural Development (SWADE)	Dlanubeka House Mbabane +268 – 404-7950	Government company that aims at using water as its vehicle for development. Schemes are mostly commercial with entrepreneurship capacity building to ensure sustainability.	Mr. Doctor Lukhele	Subsurface and surface drip irrigation, center pivot and dragline sprinkler.
Swaziland Development Finance Corporation FINCORP	Gwamile Street Mbabane (Asakhe House) P.O. Box 6099 Mbabane Swaziland	A financing agent mainly dealing with small businesses including agribusiness.	Mr. S. Nxumalo	Subsurface and surface drip irrigation, center pivot and dragline sprinkler.

Name of NGO/Agent	Physical Address Website and tel numbers	Project in irrigation for livelihood support : technologies and support	Contact person	Technologies /practices promoted
	+268 – 404 -9436			
Swaziland Industrial Development Company (SIDC)	5th Floor Dlanubeka House P.O. Box 866 Mbabane Swaziland +268-404-3391 www.sidc.co.sz	A financing agent for large and small businesses mainly looking at previously disadvantaged entities.	Dr. T. Gina	Subsurface and surface drip irrigation, center pivot and dragline sprinkler.
SWAZI BANK	Gwamile and Engungwini Buildings Gwamile Street P.O. Box 336 Mbabane Swaziland +268-404-2551	A financing agent for large and small businesses mainly looking at previously disadvantaged entities.	Mr. S. Matsebula	Subsurface and surface drip irrigation, center pivot and dragline sprinkler.

6. SCALING UP CONSIDERATIONS

A number of issues need to be addressed in Swaziland for micro irrigation to prosper.

6.1. Irrigation policy

The country has recently developed an irrigation policy that promotes the growth of micro irrigation in the country as both a viable alternative and complementary system to large scale irrigation in the country. The problem, however is that overall government policy has not yet put in place the relevant institutional support instruments for the implementation of the irrigation policy. Also donor agencies such as USAID have not yet dovetailed their support to the framework of the irrigation policy.

6.2. The land tenure system

The country has two different land tenure systems. In the Swazi National Land, land is owned communally and there is no free-hold title. This makes it difficult to attract private capital into the communal lands as there is no security of tenure. The lack of individual ownership also means individuals do not fully commit their resources to developing proper irrigation schemes.

On title deed land, there is no possibility for smallholder irrigators to penetrate the system.

6.3. Co-ordination of activities in micro irrigation

There seems to be parallel approaches to the development of small scale irrigation, one based on semi-portable sprinkler systems for food crops in the middle and highlands of the country and one based on out grower drip irrigation schemes for sugarcane production mostly in the lowlands of the country. The parallel approaches have different organizational systems, the former is more livelihoods oriented whilst the later is purely commercial. There is need to co-ordinate and harmonize the activities under these seemingly different approaches.

6.4. Institutional roles

Swaziland is a traditional society and has community based structures that may not be ideal for the new initiatives being undertaken by the government and/or NGOs. There is need therefore to define the roles of such structures in new programmes to both enhance uptake as well as improve sustainability of the schemes. Linked to this is the issue of community involvement in new schemes. The relationship between donors, government, NGOs and the communities vis viz the needs of communities needs a thorough review.

6.5. Traditional technologies

Though traditional irrigation practices have not been discussed in this report it is recommended that they be considered in any irrigation initiatives. Focus should be placed on how to upgrade or adapt such practices and technologies to be compatible with the new technologies being introduced to the communities.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. Conclusions

General conclusions

The main conclusions of this study are that:

i) Micro irrigation in Swaziland is supported by government, the donor community and private business.

ii) There are two distinct approaches to small scale irrigation development, one for food production supported by the government and some NGOs and one for commercial sugarcane production supported by the sugar industry.

iii) Micro irrigation schemes vary in size from 10 ha to 250 ha whilst individual plots range in size from 0.06 ha to 10 ha.

iv) Schemes are run as farmer associations, individual plots as well as group holdings within one scheme.

v) The favored technology is the drip system followed by sprinkler. However localized initiatives are encouraged.

vi) The more innovative technologies and practices include the direct application, river suction and the trench garden.

vii) The Swaziland government, the Swaziland business community and some donor agencies favour a free enterprise approach to micro irrigation instead of poverty alleviation and humanitarian approaches.

viii) The micro irrigation schemes by government, donors and NGOs support horticulture whilst the private sector prefers developments linked to the sugar industry.

ix) The most probable development line in micro irrigation in Swaziland will be through the private enterprise approach. However serious thought needs to be given for the involvement of the sick, orphaned and vulnerable in future micro irrigation initiatives.

x)

About NGOs and ESAs

i) NGOs tend to decide what the communities want and prioritise the technologies to be adopted and the programs to be followed. The communities are not very enthusiastic about this.

ii) Finances for micro irrigation initiatives are channeled through NGOs from ESAs to NGOs not directly to the community based organizations.

iii) NGOs seem reluctant to reveal the source of their financing, preferring instead to highlight their achievements on the ground in terms of drip kits distributed, treadle pumps installed, etc.

iv) Some NGOs, World Vision in particular, are already venturing into developmental assistance through the provision of loan facilities for community based micro irrigation initiatives.

7.2. Recommendations

General recommendations
This study recommends that:

i) Swaziland continues its focus on the private enterprise approach to micro irrigation development. Donor agencies should complement these efforts instead of pushing the 'livelihoods' approach only as is done in the other SADC countries.

ii) Donor agencies channel resources towards the financing of micro irrigation schemes that have the free enterprise focus as well as those that focus on poverty alleviation and OVCs. Swaziland needs both developmental and humanitarian assistance.

iii) Swaziland adopts the relevant technologies, particularly the Drip irrigation kits for nutrition gardens, for the elderly, sick and OVIs in the rural poor and urban poor sections of the society.

iv) Swaziland adopts and maintains the semi-portable systems for commercial food production by communities in the middle and high velds of the country and the conventional drip for sugarcane production by out-grower schemes in the lowveld.

v) Swaziland documents the development of micro irrigation schemes and technologies to date.

For NGOs and ESAs

i) NGOs should focus more on capacity building and advocacy rather than direct involvement in the provision of technologies.

ii) ESAs endeavour to work directly with local community based organizations rather than operate through NGOs as is currently the case.

ANNEXES

List of contacts

Name of NGO/Agent	**Physical Address and tel numbers**	**Website**	**Contact person**
World Vision	P.O. Box 2870 Mbabane Swaziland +268-422-1665		Mr. Maduna
Ministry of Agriculture and Cooperatives through International donors such as FAO, IFAD, USAID	MOAC P.O. Box 21 Mbabane Swaziland +268 –404-2321		Mr. P. M. Khumalo Mr. M. Ngwenya
Swaziland Water and Agricultural Development (SWADE)	Dlanubeka House Mbabane +268 – 404-7950		Mr. Doctor Lukhele
Swaziland Development Finance Corporation FINCORP	Gwamile Street Mbabane (Asakhe House) P.O. Box 6099 Mbabane Swaziland +268 – 404 -9436		Mr. S. Nxumalo
Swaziland Industrial Development Company (SIDC)	5th Floor Dlanubeka House P.O. Box 866 Mbabane Swaziland +268-404-3391	www.sidc.co.sz	Dr. T. Gina
SWAZI BANK	Gwamile and Engungwini Buildings Gwamile Street P.O. Box 336 Mbabane Swaziland +268-404-2551		Mr. S. Matsebula

List of documents

Patrick Mgcini Khumalo	Group and individual training course on irrigation water resource and environmental impact assessment in arid and semi arid areas,
Extension Newsletter	Sugarcane Mosaic outbreak, 2005 – *www.ssa.co.sz*
Afrol News	Irrigation project in Swaziland, 2005 – *www.afrol.com/articles/10631*
FAO	FAO's Information system on water and agriculture, 2005 – *Aquastat ?*
Tambankulu Estates	Tambankulu Estates – *www.huletts.co.za/tambankulu.html*
IFAD	Swaziland: Smallholder agricultural development project – *www.ifad.org/evaluation/public_html/eksyst/doc/prj/region/pf/swaziland/sw323.htm*
ECS	The lower Usutu smallholder irrigation project, 2001 – *www.ecs.co.sz/projects_lowerusutu.htm*
Lankford	Smallholder irrigation issue paper for Swaziland, Lankford, 2001 ?
Zanele Dlamini	Food Crisis – Swaziland, 2003
United Nations	Policies for small scale sugar cane growing in Swaziland, 2000 – *United Nations conference on trade and development*
FAO	FAO/WFP crop and food supply assessment mission to Swaziland, 2003 – *www.fao.org//docrep/005/y9665e/y9665e00.htm*