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Towards sustainable smallholder irrigation development projects: A case study of the Maplotini irrigation scheme, Swaziland

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Sustainability principles demand that agriculture projects must be capable of maintaining their productivity and usefulness to the society over the long run and must be environmentally friendly. Swaziland has made huge investments in irrigation projects over the last half century for improved livelihoods and economic growth. The study aimed to determine whether investments made in Maplotini irrigation scheme has delivered according to some of the key indicators of sustainable agriculture. The study methodology included household interviews, focus group discussions and key informants interviews at Maplotini irrigation scheme. Secondary data was obtained from review and analysis of stakeholder documents and records. The findings indicated the scheme is faced with major sustainability challenges ranging from inadequate access to irrigation water, inadequate knowledge and skills on sustainable agriculture production practices leading to poor crop yield performance and environmental degradation; poor irrigation designs, high debts, poor market environment and inadequate skills on business management. Social constraints included conflicts arising from poor management, lack of cooperation by members, land tenure issues and poor productivity. Improvement and maintenance of crop productivity and economic viability; and addressing the social and environmental constraints are some of the main recommendations of the study to improve sustainability of the irrigation scheme.

Key words: Sustainable agriculture, smallholder irrigation scheme, Swaziland.

INTRODUCTION

Agriculture is the backbone of the Swaziland economy and it is understood to be critical for the achievement of the overall development objectives of the country (GOS, 2010). Water through irrigated agriculture is central to the economy of Swaziland as it contributes significantly (7.8%) to the Gross Domestic Product (GDP) via agriculture export and basic livelihood of the people. The Government of Swaziland continues to prioritise investment in agriculture through development of irrigation schemes in order to improve the country’s agricultural productivity which has been on decline over the past two decades (GOS, 2009, 2010) and to bring other social services to the rural populations. A majority of the irrigation schemes has been established in Swazi Nation Land (SNL) where a total of more than 20% of the population lives on food aid and agriculture is the principal livelihood (GOS, 2002, 2006).

Irrigated agriculture is vital for the improved productivity
of the Swaziland agriculture sector and for the improvement of the livelihoods of the society. Over the past years the irrigated agriculture sector has been dominated by large commercial farmers owing to the financial capacity to access financial support and the ability to refund the irrigation infrastructure. To complement that, the government over the past decade has embarked on agricultural development projects using water as a catalyst and as a major step towards alleviating and improving the rural standards of living in the country. Now there is a noticeable participation of smallholder farmers under SNL in irrigated farming and most of this is dedicated to cash crops and horticultural farming. Most of the development of smallholder irrigation projects has formal links with the sugar companies. The irrigation investments in the country include several smallholder irrigation development schemes, small earth dam projects, the Maguga dam and recently the Lower Usuthu Smallholder Irrigation Project (LUSIP). These initiatives coupled with improved crop production technologies such as use of fertilizers, hybrid varieties, etc, has enabled many countries to move towards achieving self-sufficiency in food production (Gorantiwar and Smout, 2005).

However, despite all the good development initiatives by the role players in irrigated farming, a general observation have shown that the success rate of small scale irrigation development projects is low compared to the large scale irrigation in commercial farming. Several studies that have been conducted on irrigation schemes both nationally and internationally suggests that the prevailing situation within irrigation schemes lacks sustainability. Sustainability requires that agriculture projects must be “capable of maintaining its productivity and usefulness to the society over the long run, it must be environmentally sound, resource-conserving, economically viable and socially supportive, and commercially competitive” (Dantsis et al., 2009; Lichtfouse et al., 2009). Studies done by Manyatsi (2005), Fanadzo et al. (2010), Malaza and Myeni (2009) and Tapela (2008) in Southern Africa on small holders irrigation development indicated that many irrigation schemes do not perform up to the expectation or in yielding the intended objectives hence the continued decline in agricultural productivity especially in small scale commercial farmers.

This case study was focused on investigating the situation at Maplotini irrigation scheme based on the practical application of the principles of sustainable agriculture (productivity, security, protection, profitability, and social justice) in order to determine its long term sustainability. The study area was found to be more appropriate for the investigation since it is located in the most dry and highly impoverished area of Swaziland. The findings of the study are important to inform policy and strategies of government since the expansion and development of new irrigation schemes is focused on the most dry areas of which are mainly are highly impoverished.

METHODOLOGY
Study design
Description of study area
Maplotini irrigation scheme is located at the far south eastern part of Swaziland (27.3167°S, 31.9000°E), which is only less than 10 km away from Lavumisa border gate between Swaziland and South Africa. The scheme is located in the Lowveld, and is in the Shiselweni region of Swaziland. It receives not more than 600 mm of rain per year (Sweet and Khumalo, 1994) which is very erratic as a result it is very difficult for farmers to farm effectively under dry land conditions. Rains for crop production start in October and continue till March. The spread of rainfall has been very poor in the past decade leading to inadequate moisture during the cropping season to sustain the maize crop (staple food) hence decline in maize yields (Oseni and Masarirambi, 2011). The scheme was established by the Government of Swaziland through the Ministry of Agriculture (MOA) in 1999. It has got 72 members and they are trading as a cooperative called Maplotini Farmers’ Cooperative Association who own and manage the irrigation scheme. The irrigation scheme was allocated by government a continuous delivery of 141.6 l/s capable of delivering a volume of 4,465,000m³ per annum from the Pongolapoort dam. The installed irrigation infrastructure covers a total of 405ha while the full utilization of the allocated water could support 530ha of irrigated agricultural development hence the scheme still has an opportunity to expand its farming operations. Currently the scheme only utilises 264 ha (184 ha planted with sugarcane and 80 ha with vegetables and maize) of their whole area.

Sampling technique and size
Both probability and non-probability sampling methods were employed in the study. A purposeful sampling method was employed in selecting the study area; the study area is located in the most dry and highly impoverished side of Swaziland which makes a typical case to assess the sustainability of irrigation schemes. The study also purposefully targeted only households for members of the irrigation scheme for conducting household’s interviews. To sample respondents from the targeted households a systematic sampling as described by Nachamias and Nachamias (1996:187) was applied. The targeted sample size was at least 30 percent of the households of the members of the irrigation scheme. This was based on the available budget for the study while still maintaining a reasonable sample for the credibility of the results. To identify the first household for interview a bottle spinning technique was used, where a bottle was spun and the household where it has pointed was the first to be interviewed.

In Focus Group Discussions (FGDs), the stratified method of sampling was used where the types of crops grown (the irrigation scheme were defined as strata that is, sugar cane farmers’ strata, and maize or vegetables strata), within each strata, a FGD was formed ensuring representation of the whole area. In addition for the Key Informant Interviews (KII), a snowball approach to sampling was also used. The number of people to be interviewed were determined by the need as the interviews were conducted (information needs identified through previous respondents).

Data collection
A combination of quantitative and qualitative research methods were used in data collection since the two compliments each other (Strobeel, 2004:18). Primary data was collected through household survey, FGDs and KII. A semi-structured questionnaire was
administered to 19 out of 72 households who are members of the Maplotini irrigation scheme. Two FGDs were conducted for issues concerning sugarcane production, and on alternative crops (maize and vegetables) production. KIIs were conducted with officers of organisations (government and development agencies agriculture officers, sugar companies extension officers, financiers extension officers, community leadership and national marketing board extension officers) working with the irrigation scheme.

Secondary data was obtained from the review and analysis of the following documents and records (project design documents, evaluation reports, national polices, management plans, marketing strategies or sector strategies). Over and above, that secondary data was also obtained on records of physical capital, technological capital, natural capital and financial capital (country landscape documents).

Data analysis

Data was recorded, transcribed, coded, analyzed and interpreted according to the various dimensions mentioned in the study design. Data was analyzed using the Statistical Package for Social Sciences version 16.0. A chi-squared test was used at 95% confidence level. The data analysis methodology was modified from Dlamini (2010:35-41).

RESULTS

Characteristics of the respondents

The composition of the respondents was fairly balanced in terms of gender, 43.6% male and 56.4% female. A higher proportion of the respondents were married (61%) and 87% were heads of the households or wife/husband of the households head which bears positive influence on the accuracy of the responses. Only 2.6% of the respondents had not enrolled in formal education which means a majority of the respondents were able to read, write and understand the questions as well as the subject of concern. The highest household size range was between 6 to 10 people as it recorded 41%, it was followed by a range of between 3 to 5 people which recorded 25.6%.

Characterization of household resources

A comparative analysis of ownership of basic common household assets before and after the scheme indicated that there was a decrease in the ownership of grazing animals such as cattle, goats and chickens (Figure 1). This was due to the re-allocation of land for grazing to the cultivation of crops especially sugar cane. The resettlement of the households to a new clustered site led to the huge decline in the population of chickens as households are no longer able to rear a large number of chickens under free range since they are now very close to each other.

Similarly, Figure 2 indicates that after the implementation of the scheme the area that is cultivated for other cash crops declined and a large part of the land was allocated for sugarcane production because of its well organised marketing structure in Swaziland (SADC, 2009). The area cultivated with vegetables also increased because of the availability of water and the support to commercial vegetable production by the government. With the arrival of collective sugar cane irrigation blocks, people had to leave their scattered dwellings and move to other residential dwellings at the fringes in order to free up good soil for the sugarcane cultivation and to enable regular burning of sugarcane during harvesting. It can also be observed from the results that there was a drastic decline on the area cultivated with cotton and an increase on the area cultivated with vegetables and sweet potato as a result of the introduction of irrigation water.
Source of irrigation water and irrigation systems

Irrigation water to the scheme is drawn with two submersible pumps in Pongolapoort Dam at reduced level (RL) 118 m which pump to a booster pump station at RL140.9 m with three booster pumps. The water is then continuously delivered to the fields by gravity. Sugarcane production is given first priority in the utilization of the irrigation water since it is the primary commercial crop. The respondents indicated that sometimes vegetable crops suffer from water shortage as irrigation scheduling is not properly planned and in some cases such as during the dry season the water is not enough even for the sugarcane crop. Concerning the irrigation system itself, the farmers complained of high electricity costs due to poor maintenance or deteriorating status of the irrigation infrastructure and due to regular mechanical faults of the pumping system.

A total of 51.7% of the interviewed households reported that they use both furrow and sprinkler irrigation while a larger proportion (79%) used drip irrigation method for irrigating the crops. Among the rest of the households it was found that the usage of watering cane, hosepipes and buckets for watering vegetables was common. Though the farmers are using modern technology in irrigation but they stated that their production levels and yields were low mainly due to depletion of soils nutrients as a result of the poor drainage system of their irrigation system.

Access to irrigation water

There was no significant difference (p < 0.05) between the famers who responded that access to irrigation water limits the area under cultivation in any season of the year, a high proportion (41%) of the farmers responded in agreement to the question. In addition there was also no significant difference (p < 0.05) in the weights of the magnitude of the problems, as an equal proportion (38.5%) reported that the magnitude of the problem was neither high nor low, while 23.1% reported the issue to be low.

Soil health and crop production practices

Concerning the knowledge and skills of the farmers on basic means to agricultural natural resources conservation, it was found that a majority (68%) of the farmers in the irrigation scheme are using crop rotation at least once in every crop cycle. On the other hand half of the farmers reported to be using commercial fertilizers, whereas the other half responded in disagreement to the question. Among those using commercial fertilizers, there was a significant difference (p > 0.05) in the responses pertaining the rationale used for fertilizer application in the fields. A portion of 58% stated that fertilizer application is based on historical practice since specific applications are not known; 40% stated that application is based on specialists’ recommendation on crop-specific nutrient needs and realistic yield goals; 37% reported that application is based on soil tests; and only 28% stated that only animal manure was used as fertilizer in the fields. Among the farmers who highlighted that only animals’ manure was used for fertilization, the reason was lack of money and the high prices of fertilizers. However there was no significant difference (p < 0.05) on judging the changes fertility level of their land after the implementation of the irrigation scheme. An equal proportion of 33 to 35% of the farmers regards the fertility status to have increased while 23.1% of the farmers stated that the fertility status has declined after using the irrigation water.
Regarding the time and techniques used for fertiliser application, there was a significant difference ($p > 0.05$) on methods used by farmers. A high proportion (75%) of the farmers were not applying the appropriate practices or had no clue on how to practice appropriate skills to maximize fertilizer utilization and to avoid pollution by fertilizer in the soil (only 24.1% of the farmers were making some effort to avoid fertilizer application near water sources).

The low levels of fertilizer application occur even though the farmers were been trained by several stakeholders in the industry. The farmers stated that the higher prices of farm inputs and lack or delays in financial support were the key challenge surrounding fertilizer application.

With regard to tillage practices, about 36% of the farmers stated that tillage practices are undertaken without consideration of impact on the soil. According to the interviewed farmers the implementation of the irrigation scheme had no environmental effect and statistical analysis of the responses indicated that there was no significant difference ($p < 0.05$) with regard to loss of vegetation, medicinal plant species, grazing areas, increased soil erosion and water pollution.

** Farmers' participation in project management**

Concerning the political administration of the irrigation scheme, the communities believe it is appropriate for the irrigation scheme to be under the chief since it promotes and retains the Swazi culture and it provides structures for conflict resolution hence increased donor confidence for further investment in the communities.

It was found that the traditional leaders are entry points for mobilization of community development projects like the irrigation schemes. The study discovered that the farmers participated in some of the stages of the whole project cycle (irrigation scheme); the only limitation was that the farmers lacked the technical knowledge especially on engineering.

The farmers were involved in the project assessment phase (resource assessment), which came up with the community development plan. On project planning, the farmers formed themselves into entities (co-operatives) with bankable projects, of which in this case, it was more biased on sugarcane production.

It was found that sugarcane is preferred because of its strong organizational structure and improved irrigation facilities hence reduced risks.

As a result of the organized structure lenders are able to collect their loans repayments via the sugar mills which are the primary receipt point for sugar sells proceeds. Therefore it is for this reason that a large portion of the land owned by the irrigation scheme is under sugarcane production and small portions are used to produce vegetables, maize and other cash crops for household consumption and surplus for sale.

**Socio-economic issues to beneficiaries**

A majority of the farmers (82%) have been involved in the irrigation schemes for a period more than 5 years, with 59% more than 11 years. Some of the interviewed farmers inherited the shares from their parents, especially those who reported that they have been in the scheme for a period less than 5 years. In contrary to the general assumption that long service equals increased income, a proportion of 59% of the farmers responded negative to the question regarding improved household food security.

On the positive side, 31% stated that their involvement in irrigated crop production has increased household food self sufficiency and only 10% reported a surplus for market. The above mentioned findings are supported by the response obtained with regard to the level of satisfaction on the returns obtained in irrigated farming. A high proportion of the farmers (67%) stated that the returns were unsatisfactory and only 10% felt the returns were good. The farmers are also open towards adoption of new farming practices and technology, as 80% of the respondents responded positive to the question soliciting their flexibility towards new farming practices.

Among the causes of the poor socio-economic improvements is the lack of tractors services especially for the cultivation of the other cash crops except sugar cane since the inefficient government tractor pool services are used for all land operations. The second issues is the lack of adequate market for the vegetables as the farmers are not happy with the low and inconsistent prices offered by current formal monopolised vegetable market in the country, so only informal marketing systems are used for selling the vegetables. Then, the last and main issue is that the co-operative was highly indebted hence there have been no benefits from the sugarcane production. The problem of finances ends up resulting to lower yields hence increasing the intensity of the problem. Besides the benefits from the irrigated crops the irrigation scheme has helped to provide drinking water for people and livestock in the communities especially because all this areas fall under very dry areas in Swaziland.

**Scheme business performance**

In Maplotini, the total construction costs of irrigation infrastructure for the 400 ha amounted to USD 1 million. The pumps and main irrigation lines were government grants, but farmers had to take a loan of USD 0.4 million (for the first 184 ha) from a reputable financier for on-farm development. However, returns from the irrigation investments had been very disappointing hence creating a heavy debt burden for the Cooperative. In 2006, it was reported that the loan had risen to USD 0.7 million, but even then, seasonal loans which are estimated at USD 0.1 million are still required for seeds, fertilizers, and herbicides. The farmers get nothing as the loan obligations
for the financier are immediately subtracted from income before the sugar mill pays the Cooperative. Several factors were identified to be the major contributing factors to the poor business performance of the scheme. First, it was the quality and installation of the irrigation system of which the farmers believe it had not been optimal. Secondly, poor technical and weak farm management skills as the yields of sugarcane had been low at 80 T/ha (with 100T/ha as a standard) ever since the early 2000s. Lastly, the internal management of the cooperative was fraught with non-accounting practices. A number of previous committees had been forced out of office without proper financial reports. There has been allegations and deep mistrust on financial issues especially to the management committee. Members do not understand how much is owed and why the Cooperative is failing to repay.

**Structural organization of the irrigation scheme**

The irrigation scheme is managed by a management committee which is elected during an annual general meeting as per the Swaziland Cooperatives Act, 28/1964. The main role of the management committee is to manage and administer all operations taking place in the scheme. Sugarcane farming being the core business remains the management committee’s responsibility. In addition to the sugarcane business the management committee also administers all minor land issues on behalf of government. Then below the management committee are sub-committees like the vegetable or and other cash crops production committees which are formed to speed up some of the projects which the management committee may not have enough time to address. Then, there is a supervisory committee which represents interests of all members of the co-operative by ensuring that the management committee adheres to all standards either provided by the cooperative act, the by-laws or agreed by the general meeting. This is a requirement of the Cooperative Act. The cooperatives of the irrigation scheme indicated that new members were not allowed to join but for cases where members leave the association as a result of death, replacements are done with someone from the same household.

Farm operations are headed by a farm Manager, who supervises the labour force on best practices of producing sugarcane for optimum yields. The farm Manager and the supervisory committees are responsible for keeping record of the business revenue and expenditure. The farm Manager works with a number of stakeholders in running the operations of the farm. The irrigation scheme works with several stakeholders who include agri-business financiers, sugarcane milling companies, and government agencies for rural development and technical support.

Regarding the institutional management, 51.7% of the farmers stated that it was poorly organized; 41.4% stated that it was fairly organized and only 6.9% stated that it was well organized. Although the interviewed farmers indicated that the institutional arrangement was not perfectly organized but all of them agreed that it was democratic. The farmers reported that a variety of conflicts were experienced in the irrigation scheme. The conflicts were caused by a number of factors including alleged misappropriation of funds, material theft, and poor participation by members in scheme activities, land conflicts especially non cooperatives members allowing animals to destroy fields and stealing of water, and lack of accountability by committee members. Efforts to resolve conflicts were done through the management committee in collaboration with the local community leadership and active stakeholders in the scheme.

**DISCUSSION**

According to Jama and Pizarro (2008), the promotion of improved agriculture performance through smallholder development should drive poverty by the direct effects of increased agricultural productivity and income to the beneficiaries. However, the results from this paper indicate that the poor performance of Maplotini irrigation scheme had made it difficult for meaningful poverty reduction among the farmers. The findings of this study are almost similar to studies conducted by Yves Le-gal et al. (2003), Manyatsi (2005), Fanadzo et al. (2010), Malaza and Myeni (2009) and Tapela (2008). The studies stated that, public small scale irrigation schemes in developing countries are faced with sustainability challenges ranging from technical level (maintaining and replacing the hydraulic infrastructure, poor agronomic practices leading to low yields); economic level (covering the long term water costs, high debt, low farm income, market constraints and high inputs); to social level (conflicts, exclusions and continued poverty); and ecological level (preserving water and soils under irrigation).

**Technical and production issues for sustainability of the irrigation scheme**

Smith (2004) indicated that the contribution of irrigation especially in smallholder schemes can either be positive or negative depending on the management practices applied. This was also observed in this study that through the irrigation farmers have been able to diversify into high value crops and enterprises (commercial maize (dry and green sales), vegetable and sugarcane production) instead of specialisation to only dry-land crops and low value subsistence diversification. However the findings of this research study showed that the irrigation scheme is faced with low and continued decline in crop productivity.
The reasons behind the decrease in yields and low levels of production included limited knowledge and applications of appropriate agronomic practices for the different crops. These findings are in agreement with Fanadzo et al. (2010), Malaza and Myeni (2009) and Manyatsi (2005) which also attributed poor performance of smallholder irrigation schemes to the same factors. This appears to be disappointing especially due to the fact that a huge investment has been made on infrastructure and capacity building trainings to increase crop productivity and given the technical support by extension officers that have been assigned to continue supporting the farmers. Lack of proper irrigation scheduling was another contributor to reduced crop productivity such that calculations for water supply or requirement for cropping patterns as suggested by (Chancellor and Hide, 1997) were not discussed and agreed among the farmers. As a result there were no provisions for flexibility to allow changes in cropping patterns especially during the dry season were irrigation water demand is normally very high.

Environmental and ecological constraints in the irrigation scheme

The farmers have a mixed agricultural system in place and crop rotation is practiced, this is positive for sustainable agriculture production and resilience to food security. To promote sustainable soil management, the farmers use conservation tillage to maintain crop residue on the soil. Crop residues play an important role in setting a new organic matter equilibrium in the soil therefore the removal of crop residues decreases the carbon input in the soil and thus inherently lowers organic matter level. However, with regard to tillage practices, about 36% of the farmers stated that tillage practices are undertaken without consideration of impact on the soil. An implication of this is soil compaction which then leads to decline in crop productivity especially considering the fact that a number of land operations in the sugarcane crop are done with heavy machinery. According to the interviewed farmers the implementation of the irrigation scheme had no environmental effect (p < 0.05) and statistical analysis of the responses indicated that there was no significant difference with regard to loss of vegetation, medicinal plant species, grazing areas, increased soil erosion and water pollution. This is in contrary to the allegation by many authors that land use patterns as a result of agriculture development accelerated deforestation, environmental degradation, decreasing biodiversity, overgrazing, and pollution by fertilizer, pesticides and by herbicides (Chel and Kaushik, 2011; Jordan and Constance, 2008; Lichtfouse et al., 2009; Dantsis et al., 2009; Reber and Grega, 2008). Perhaps a more detailed analysis can be important to ascertain if the findings reflect the status in the study areas and also the education level of the farmers can have an influence in the responses given.

According to Chel and Kaushik (2011) the choice of irrigation is very vital in sustainable agriculture as it has different implication on soil health. Such effects include the loss of soil through soil erosion, loss of organic matter and loss of biotic capacity of soil to nature plant growth, structural deterioration, compaction and hard setting, nutrient imbalance and leaching, salinity, and diminution of root zone moisture characteristics. As suggested by Smith (2004), the irrigation scheme has brought some negative effects which have led significant land degradation in the area. Due to poor drainage (caused by poor scheme designs, deteriorating infrastructure, poor technical and management skills) a large portion of the arable land has become unusable as its normally waterlogged so tractors cannot access it, also the fields had developed swamps and water weeds such as Bullrush (Typha capensis) and Nutsedge grass (Cyperus esculentus). The problem of water-logging and salinization has rendered almost 20% of the area covered by the irrigation infrastructure to be lost to production and reduction in yields of the crops including the maize (green and dry maize harvests) and vegetables. The poor drainage is also alleged to causing the presently sinking of the main road passing on the downside of the fields. This is now in total contrary to the principles of sustainable agriculture which states “sustainable agriculture projects must be capable of maintaining its productivity and usefulness to the society over the long run and must be environmentally friendly” (Dantsis et al., 2009).

Social constraints in the sustainability of the irrigation scheme

The findings of the study indicated that social constraints were among the major contributors to the poor performance of the irrigation schemes. The scheme is characterized by land ownership issues, low contribution to households’ income, inactive and poorly supported management, conflicts, and poor cooperation between members and the management of the scheme.

Based on the Swaziland land tenure system, the land used by Maplotini irrigation scheme is categorised as crown land. Crown land is distinguished as land owned by the government or a section of government. As a result of the type of land tenure at scheme, the chief has no power over the allocation of land although the people may pay allegiance to him. This makes it difficult for the community leaders to intervene on land associated issues in the irrigation scheme. The issues of land tenure proved to be a major problem since the other members of the community are not having access to the land and drinking water is accessed at a fee from the cooperative. In addition surrounding members of the scheme had to pay rental fee to the cooperative to acquire a plot for farming in the scheme and financiers could not fund them because they do not hold the permit to the land.

In addition, due to the changes of the household
settlements after the introduction of the scheme, farmers had to give away most of their livestock which made the household to be vulnerable to food insecurity, income generation and maintaining social networks especially because the specialization to sugarcane has not yielded to any profits. For small and marginal farmers, livestock are often the only capital reserve of farming households to be sold during times of hardship. In addition, animal draught power and nutrient recycling through manure compensate for unavailable access to tractors and fertilizers.

On participatory planning it was also found that the farmers participated in some of the stages of the whole project cycle; the only limitation was that the farmers lacked the technical knowledge especially on engineering. But despite the biasness on sugarcane production, the processes that were used during the project cycle had some elements of empowerment, access to rights and it promoted the capability for collective action and participation in community activities.

Economic constraints affecting the sustainability of the scheme

As highlighted in other regional studies (Tafesse, 2003) this study also discovered that the availability of financial resources for the effective operation and rehabilitation of the irrigation scheme is a major constraint. Though the farmers were able to source start-up capital from local financiers but due to the below average yields, high operation costs and high interests charged by the financiers, it is difficult for the farmers to pay back the loans. This has been exacerbated by the continuous increase of farming inputs prices and electricity charges in Swaziland leading to the scheme to be highly indebted and members dissatisfied with irrigation project. As a result the scheme has not been able to alleviate poverty amongst the farmers through increased productivity and income as advocated by Jama and Pizarro (2008).

Challenges in marketing were also among the major causes of poor returns to the farmers in the irrigation scheme. Most of the farmers produce vegetables like tomatoes, onions, spinach, beetroot and cabbages, so due to the perishable nature of the crop and the poor crop scheduling farmers are sometimes forced to sell at lower prices (forces of supply and demand). Further due to the poor regulation of the vegetable market in the country, the middlemen takes advantage of the situation and farmers get marginal returns. The vegetable farmers are totally not pleased with the low and inconsistent prices offered by current formal monopolised vegetable market in the country, so only informal marketing systems are used for selling the vegetables. In addition, planning of production was found to be another contributing factor to the low prices and low returns to the farmers because in some cases, the farmers will produce large quantities of a particular crop hence flooding the market and then the forces of supply and demand will automatically lower the price.

Conclusions

The following conclusion can be drawn from the study:

1. Despite the huge investments in the irrigation infrastructure, the irrigation scheme have not yet contributed to improving the quality of live on smallholder farmers as well as increasing agricultural productivity for economic growth in the country. In addition, the scheme causes land degradation as a result of poor operations and maintenance activities which is a critical environmental problem.
2. The socio-economic status of the smallholder farmers have not improved as a result of the irrigation projects. Factors contributing to that include incompatible technology especially on the irrigation system; farmers are highly indebted in sugarcane, lack of markets for vegetable crops and lack of training on business and financial management.
3. The institutional arrangement of the irrigation scheme is well accepted by the smallholder farmers but it is faced with a number of conflicts arising from lack of training on management, lack of cooperation by members, land tenure issues and poor productivity of the scheme.

To ensure the sustainability of the irrigation scheme the study recommends that the irrigation infrastructure should be rehabilitated and the whole production processes be started all over again for effective economic and social gains to the farmers.

REFERENCES