IMPACT ANALYSIS OF SMALLHOLDER IRRIGATION SCHEMES ON HOUSEHOLD POVERTY REDUCTION IN SWAZILAND: THE CASE OF NTFONJENI AND NGWEMPISI RURAL DEVELOPMENT AREAS

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DECLARATION AND APPROVAL

1. Declaration

This thesis is my original work and has not been submitted for an award of any degree in any other University.

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DEDICATION

To my dear mom Mrs. T.E. Sithole for her hard work, prayer, the role of a model and an inspiring Mother. My beloved Father, my brothers and sisters.

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ABSTRACT

The most distinguishing feature between developed and developing countries is the relative poverty rates. Poverty scourge undermines lives of many in developing countries including Swaziland (63%). The general belief is that irrigated agriculture limits crops failure, external shocks hence Swaziland has seen development of new and rehabilitation of existing Smallholder irrigation schemes (SHIS). The Poverty Reduction Strategic and Action Programme (PRSAP) advocates for the development of smallholder irrigation schemes towards achieving Millennium Development Goals (MDG 1). This study examined whether smallholder irrigation schemes had a significant impact on poverty reduction in Swaziland using Ntfonjeni and Ngwempisi Rural Development Areas (RDA) as a case study and two irrigation schemes were selected in each RDA. The study used the "with and without approach" and was based on empirical evidence from a representation of 190 households which were randomly selected from four enumeration areas located in the four irrigation schemes. Data were collected using questionnaires. Analysis involved poverty measures for members' versus non members, socioeconomic demographics, factors influencing household decision to participate in irrigation schemes was determined using a logit model while average treatment effects using propensity score matching was used to assess the impact of smallholder irrigation schemes on poverty reduction. The study revealed that the members in Ngwempisi had significantly low poverty incidence as compared to non members of 58% versus 79%, whilst the poverty gap was 6% for members versus 17% for non members. In Ntfonjeni 53% members were poor and 83% of non members were poor. The poverty gap was 8% for members versus 34% for non members. The empirical results revealed access to credit positively influenced participation in irrigation scheme by 26% and other significant variables were age, farm size, occupation, distance to the irrigation scheme and other group membership. Finally access to the irrigation scheme had a positive impact to the households consumption and expenditure level. The Average Treatment effect of Treated (ATT) indicated that, consumption expenditure of irrigation members was 21% more than non members of irrigation showing a positive impact in poverty reduction of households. Hence the government can invest more on smallholder irrigation schemes as one of the poverty reduction tools, which should be complemented with an agrarian reform involving all the stakeholders to ensure efficiency in that value chain.

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LIST OF ACRONYMS AND ABBREVIATIONS

EA	Enumeration Areas
FAO	Food and Agricultural Organizations (United Nations)
GOS	Government of Swaziland
HVI	Human Vulnerability Index
IFAD	International Fund for Agricultural Development
KDDP	Komati Downstream Development Project
LUSIP	Lower Usuthu Irrigation Project
MOA	Ministry of Agriculture
MDG's	Millennium Development Goals
NGO's	Non Governmental Organizations
PRSAP	Poverty Reduction Strategic and Action Programme
RDA	Rural Development Area
SADP	Swaziland Agricultural Development Project
SHIS	Small Holder Irrigation Schemes
SNL	Swazi Nation Land
SHIES	Swaziland Income and Household Expenditure Survey
SWADE	Swaziland Agricultural Development
SSA	Sub Saharan Africa
UN	United Nations
WFP	World Food Program

CHAPTER ONE

INTRODUCTION

1.1 Background information

The most distinguishing feature between developed and developing countries is the relative poverty rates (Mwabumba, 2013). Poverty rates in developing countries are relatively higher than those in the developed countries. Millions of Africans are born, live and die poor, hungry and malnourished. Most of these unfortunate people live in rural areas and directly or indirectly depend for a large part of their livelihoods on agriculture (Kirsten *et al*., 2009). The role of agriculture has not been ignored by policy makers across Africa but has consistently recognized its importance to the poor of the continent and has stressed the significance of agriculture to African economies and people (*ibid*). Despite all these efforts, poverty prevalence in the Sub-Saharan Africa (SSA) still remains deep, pervasive and intractable.

In most African economies, the contribution of agriculture to GDP is significant and directly provides about 70% of employment along with related services. Many countries in the continent have embarked on different structural changes to fight against poverty through investing in agriculture. Some key investments have been geared to the agricultural sector to increase productivity as well as diversify production as part of achieving Millennium development goal one. African agriculture is predominantly rainfed and the changing weather conditions would further exacerbate the poverty situation (Todaro, 2012). It has been argued that one strategy which would be used to mitigate water scarcity is irrigation. Indeed Pinstrup (2011) and (Hussain, 2004), revealed that investing in smallholder irrigation schemes is one of the best strategies to reduce poverty levels given that majority of the population is found in rural areas and derive about 70% of their livelihood from agriculture.

Since irrigation has limitations in terms of cost, the use of collective action by farmers in smallholder irrigation schemes is one of the key strategies that can be used to enhance utilization especially in developing countries. Delgado (1998) argued that smallholder irrigation schemes in southern Africa cannot be ignored or treated as a small sector of the market economy because they are important for resource and human employment. It has also been observed that, higher incidences of poverty are associated with the places where there is low agricultural productivity (Pinstrup, 2011). In the Republic of South Africa, for instance, smallholder irrigation schemes

have induced a positive impact in increasing crop production, higher yields and lower crop failure (Anne, 1997). An increase in production makes food available and affordable for the poor. Irrigation investment acts as production and supply shifters and has a positive impact on economic growth, benefiting the poor in the long run. Hussain and Hanjra (2004) extensive review suggested that there were strong linkages between irrigation and poverty. These linkages are both direct and indirect. Hence it is in the agricultural sector that the battle for long term economic development will be won or lost (Gunnar, 2009). The main burden of development and employment creation will have to be borne by the part of the economy in which agriculture is the predominant activity, which is the rural sector (Francis, 1993).

In the kingdom of Swaziland, agriculture is mainly rain fed and forms the backbone of economic activity as well as playing a crucial role in economic development by providing food, raw materials and employment to a large proportion of the population. With its present contribution to GDP at 9%, the sector employs 29% of the total labor force (FAO, 2010). However its growth over the past eight years has stagnated with an increase in food insecurity and perpetuating poverty levels in rural areas. As a result the country is a net food importer for maize and vegetables from South Africa (FAO, 2012).

This situation has made the government to invest in the agricultural sector, specifically by improving technologies farmers use in production through irrigation. Irrigation schemes are becoming dominant throughout the country and efforts are made with the help of foreign donors and NGO's to rehabilitate existing and construct new irrigation schemes and dams. Current total irrigated land in the country is 54 933 ha, with sugar cane, which is the main cash crop sector occupying 50 000 ha, while smallholder irrigation schemes cover an area of more than 5000 ha (MOA, 2013). These sugar cane schemes are located in the low-veld region and mostly owned by estate companies. In the other parts of the country, the smallholder schemes grow mainly vegetables which add to the consumption basket of the farmers and income through surplus output sold locally. One of the major enterprises in these schemes which earns income is baby vegetables (vegetables harvested when still tender) which are exported to South Africa and European countries through the National Agricultural Marketing Board (NAMBoard).

The current household poverty level in Swaziland is estimated at 63%. Poverty can be measured at country level, household level and individual level; however most studies focus at household level World Bank (yearly reports), Hussian (2004) and Munir (2004). In Swaziland,

the term poverty is used to define the people without adequate income to buy the minimum amount of food necessary to sustain active life (set as 2100 kilocalories per person per day), and to acquire the non-food requirements for a decent living. This is referred to as income poverty (Swaziland Household Income Expenditure Survey, SHIES, 2011).

Poverty has many dimensions; it is characterized by low income and expenditure, but also by malnutrition, ill health, illiteracy, and insecurity. There could be also a sense of powerlessness and exclusion (SHIES, 2011). These different aspects often interact and combine to keep households, and at times whole communities, in persistent poverty.

The Poverty Reduction Strategy and Action Program for Swaziland (PRSAP, 2006), has reflected that rain fed agriculture limits the extent to which production can increase and highly recommended the Government to continue in investment of more irrigation schemes in the kingdom. Whilst the Draft National Irrigation Policy (DNIP, 2005), has put a main emphasis that water can play an important role towards poverty reduction in Swaziland, it further declares water as a national resource that has to be developed and used for national benefit especially in poverty reduction projects and programs. With the experience of Asia, many SSA countries realized that investment in irrigation infrastructure could be an important poverty reduction policy, which can boost agricultural productivity and also reduce risks associated with rainfall variability, which forms the basis for this study using Swaziland as a case study.

1.2 Statement of the problem

The current focus on smallholder irrigation schemes in Swaziland has seen the establishment and rehabilitation of major vegetable growing irrigation schemes including Mphatheni, Mtsambama, Ekuvinjelweni, Mswati, Maplotini Emavulandlela, Ntamakuphila, Mkhovu, Mancubeni and Nkwene. The schemes benefitted in large part from persistent donor funding over a period of more than five years. Though large numbers of households have been enrolled and allocated land in these schemes it has not been established, however, whether the influx has achieved the intended aim of reducing poverty. It has not been established whether enrolled households have experienced improved incomes. Further, there is no evidence to prove whether the socioeconomic status of the enrolled households have improved when compared to the non-members.

This study focused on irrigation schemes that have been working for more than five consecutive years to determine if indeed smallholder irrigation schemes have a role to play towards poverty reduction in Swaziland. In particular it examines the role of irrigation in addressing consumption, expenditure, and income of smallholder rural farming households.

1.3 Objectives of the study

1.3.1 General objective

To contribute towards improved poverty reduction policies for rural smallholder farmers in Swaziland.

1.3.2 Specific Objectives

Specifically the study aimed:

i. To determine the current household poverty levels between the members and non-members of small holder irrigation schemes.
ii. To compare the socioeconomic dimensions of members and non-members of the smallholder irrigation schemes.
iii. To determine the factors that influence a farmer to participate in the irrigation scheme
iv. To assess the impact of smallholder irrigation scheme on poverty reduction.

1.4 Research hypotheses

i. The poverty levels of members of irrigation scheme are not statistically different from that of non- members of the smallholder irrigation schemes.
ii. There seems to be no significant difference in the socioeconomic dimensions of the members when compared to the non-members.
iii. There is no significant difference in factors that influence farmers' participation in irrigation schemes.
iv. Participation in irrigation scheme has got no significant impact in poverty reduction.

1.5 Justification of the study

Investing in smallholder irrigation schemes is one of the main strategies that the country is using to reduce the poverty levels. As a result the long term development in agriculture in Swaziland is based on realizing the potential of smallholder agriculture by raising productivity

and incomes. This is the most direct route towards achieving agricultural growth, improving food security and poverty reduction. Considering the effort that the government is putting in improving and expanding irrigation schemes, there is a need for a study to evaluate the effect of smallholder irrigation schemes on poverty reduction. The study is expected to provide empirical evidence towards the contribution of access to irrigation water and ultimately towards the standard of living of smallholder farmers. Related studies that are specific to Swaziland are relatively scarce and those that have been done focus mainly on food security and as a consequence, conclusions are often drawn on the basis of quite limited evidence.

Findings from this study will contribute towards the development of short and long-term, policy interventions aimed at fostering poverty reduction and reduction in the country. It will also add literature on the analysis of irrigation and poverty linkages specifically for small holder farmers.

1.6 Scope and limitation of the study

The study focused on schemes involved in vegetable production because these are enterprises which are considered to be of high value and would have a greater impact on incomes for smallholder farmers. Cross sectional data was mainly used because primary data using recall was not appropriate given the long period. However, it is also important to mention that poverty is quite diverse and broad; this study only focused on consumption, expenditure, assets and sanitation thus not all the aspects of poverty were explored given the limited time and resources which were scheduled for this study.

1.7 Operational definitions of terms

Smallholder farmer: they are sometimes called peasant or resource challenged farmers who own less than 2 ha of land with and without access to irrigation water and with limited capital investments. Farmers rely mainly on family labour for production which is both for subsistence and commercial purposes.

Poverty: The poor in Swaziland are those people without adequate income to buy the minimum amount of food (set as 2100 kilocalories/person/day), necessary to sustain a normal and active life and to acquire basic non-food requirements for a decent living (PRSAP,2006).

Irrigation: Watering crops using water from a dam or river as means of improving crop productivity and reducing drought shocks.

CHAPTER TWO

LITERATURE REVIEW

2.0 The concept of poverty measurement

Poverty is an old phenomenon which is multidimensional pronounced deprivation in well-being. There is no straight specific definition of poverty but the conventional view links wellbeing primarily to command over commodities. Therefore, the poor can be defined as those people who do not have enough income or consumption to put them above some adequate minimum threshold, which enables them to live and sustain a normal and active life, which in most cases is measured in monetary terms (Africa Development Bank, 2006).

Due to the many dimensions, poverty may also be measured using the socioeconomic dimensions of households or individuals such as, people could be house poor or food poor or health poor. These dimensions of poverty often can be measured directly, for instance, by measuring malnutrition or literacy. The broadest approach to well-being (and poverty) focuses on the capability of the individual to function in society. Poor people often lack key capabilities; they may have inadequate income or education, or be in poor health, or feel powerless, or lack political freedoms. There are four reasons to measure poverty (Haughton and Khandker, 2009): to keep poor people on the agenda; to be able to identify poor people and so to be able to target appropriate interventions; to monitor and evaluate projects and policy interventions geared to poor people; and to evaluate the effectiveness of institutions whose goal is to help poor people.

However, there is no exact best way to measure poverty. To measure poverty, the first important step is to define the indicator of welfare (threshold/ poverty line). Indicator for welfare differs from country to country; one can use incomes and expenditure or consumption per capita. Information on welfare is derived from survey data such as basket of good for a country (Haughton and Khandker, 2009), which is usually known as Living Standards Measurement Surveys (LSMS). After choosing the welfare indicator, the poor are those whose expenditure (or income) falls below a poverty line. Poverty lines based on three methods: the cost of basic needs, food energy intake, and subjective poverty lines approach. The construction of a poverty line is the most important step in measuring poverty and the appropriate choice of poverty line is a matter of judgment, and will therefore vary from country to country.

There are a number of ways to estimate poverty such as: to calculate the head count index, poverty gap and poverty severity for each household or individual (Ravallion 1991). The *headcount index* measures the incidence level or the proportion of the population falling below some predetermined poverty line. However the headcount index is not enough to explain the living standard of the population as it does not indicate how poor the poor are, or how far they are from the poverty line.

The *poverty gap index* measures the extent to which individuals fall below the poverty line (the poverty gaps). This is more important for policy makers as it gives the minimum cost of eliminating poverty, if transfers were perfectly targeted. However, the measure does not reflect changes in inequality among the poor. The squared poverty gap index (also known as the *poverty severity index*,) averages the squares of the poverty gaps relative to the poverty line. It is one of the Foster-Greer-Thorbecke (FGT) class of poverty measures that allow one to vary the amount of weight that one puts on the income (or expenditure) level of the poorest members in society. The FGT poverty measures are additively decomposable.

The *Sen-Shorrocks-Thon index* combines measures of the proportion of poor people, the depth of their poverty, and the distribution of welfare among the poor. This measure allows one to decompose poverty into three components and to ask: Are the poor poorer? Is there higher inequality among the poor? Other measures of poverty are available. The *time taken to exit* measures the average time it would take for a poor person to get out of poverty, given an assumption about the economic growth rate; it may be obtained as the *Watts Index* divided by the growth rate of income (or expenditure) of the poor (Haughton and Khandker, 2009) This study shall focus only headcount and gap index as measures of poverty

2.1 Irrigation schemes in Swaziland

Irrigation schemes in Swaziland started in 1968 by the Ministry of Agriculture as means of ensuring food security and poverty reduction for the rural poor (SADP/IFAD, 1998). The mandate of the ministry of agriculture is to develop irrigation schemes countrywide in suitable productive areas. In the 2008-2013 strategic plan, the government intended to create 18 irrigation schemes country wide with a budget of Swaziland Rand (SZL) 54.6 Million. (E/SZL1=ZAR 1= 0.1 US$). Ministry of Agriculture 2013 performance report reflected major irrigation schemes in Swaziland to be the following:

The Komati Downstream Development Project (KDDP) is under Swaziland Agricultural Development (SWADE) extends over 27,000 hectares (ha) with a population of about 22,000 people. The aim is to develop 6,000 ha of new irrigation schemes along the Komati basin in collaboration with smallholder farmers using water from the recently completed Maguga dam. It was being implemented by the Swaziland Komati Project Enterprise (SKPE), and funded by the Swaziland Government. The budget allocation for this project for 2013 was SZL26 Million of which SZL16 Million comes from the government of Swaziland and the rest from the donors.

The Lower Usuthu Smallholder Irrigation Project (LUSIP) also under SWADE involves the construction of three dams to form an off-river storage reservoir to impound water that will be diverted from wet season flood flows on the lower Usuthu River. The project is in two phases, and aims to develop a net of 11,500 ha for irrigation. It is being financed through agreed loans from several organizations including the African Development Bank, the Development Bank of Southern Africa, the Arabic Bank for Economic Development in Africa, the International Fund for Agricultural Development, and the European Investment Bank. The budget allocation for 2013 was SZL140 Million of which SZL85 Million come from the government of Swaziland and the rest from the donors.

The Smallholder Agricultural Development Project for irrigation development (SADP) was designed to assist the most disadvantaged agricultural producers in the Swazi Nation Land. In 1993 a loan was approved from the International Fund for Agricultural Development (IFAD). Its subcomponents consist of development of 185 ha of new small-scale irrigation and consolidation of another 257 ha of existing schemes to promote farmers' management of irrigation schemes. There are a total of 20 irrigation schemes created to benefit households (MOA, 2013). Irrigation schemes under this project include Nkwene, Emavulandlela, Mancubeni, Mahhulumba, Mswati, Mphatheni, Mkhondvo, Ekuvinjelweni, Mgubundla, Mbekelweni, Ntamakuphila, Mgofelweni, Nkwungwini, Mahhulimbe,Mashobeni and KaLanga irrigation schemes . Most of these schemes specialise in vegetable production.

Lavumisa Irrigation Project (Maplotini) has developed 300 ha of land, and uses water from Jozini Dam in South Africa pumped by the South African Government as a compensation for flooded land in Swaziland, adjacent to the dam. A total of 75 smallholder farmers are participating in the scheme.

2.2 Rural Development Areas (RDA) Programme in Swaziland

There are 18 RDAs in the kingdom of Swaziland which are located in the Swazi Nation Land (SNL), which were established from 1970, through the help of many donors (RDAP, 2009). The first phase of RDAs in Swaziland was established in 1970 and was financially assisted by the UK government which financed four RDA. The second phase was in 1977-1983 where the UK government funded four more RDAs and ten RDAs were jointly funded by the World Bank (IBRD), the African Development Bank (ADB), European Development Fund (EDF), and United states Agency for International Development (USAID) and the Government of Swaziland (GOS) provided counterpart funds.

The main objective for RDAP is to improve the income and general standard of living of Swazi farmers, especially the peasant farmers and at the same time to protect land resources. This was to be achieved through improving crop and livestock production by strengthening the extension services, highly subsidized tractor hire for farmers, ensuring that soil conservation practices are followed by farmers, building dams for irrigation and other infrastructure such as roads that will assist farmers to improve their production, and ensuring farmers that they get access to both credit and output markets.

RDA centres in Swaziland are located in all the four climatic regions. In the Highveld there is Mahlangatsha/Mponono, Ngwempisi and Motshane. In the Midleveld there is Ntfonjeni, Southern, Central, Mayiwane, Ebulandzeni, Mahlalini, Zombodze, Hluthi, Mliba, Sandleni and Madlangempisi. In Lowveld region there is Siphofaneni, Masala and Sithobela RDA and in Lubombo Platue there is Mpolonjeni RDA.

For the past years there has been a decline in the services offered by these RDAP. The cooperatives that were created to assist farmers with financing issues are no longer operating and the tractor hire service, most of the tractors are not serviced which leads to a shortfall of tractors during farming season. There has also been a significant decrease in the number of extension officers who also have a challenge on how to reach the farmers for trainings. All this has led to the decline of agricultural productivity in the country. Recently in the action plan for 2009, the Government has decided to rehabilitate the performance of the RDAs, in order to improve food production in the country.

2.3 Land Tenure and Land Ownership in Swaziland

The total land area for Swaziland is 1 736 456 ha where 60% is Swazi Nation Land and 40% consist of Individual Tenure Farms (IFT) also known as tittle deed land. SNL is held in trust for the nation by the monarchy and is divided among the 18 RDAs. Within the SNL, arable areas are used by individual homesteads which are customary right allocated by the chief and the chief is acting on behalf of the King. The chief has the right to accept new homesteads and to banish homesteads which are causing trouble for other residents with serious offences to ensure peace. However women are deprived the right of owning land if they are unmarried unless she has a male child whom she will use as a household head despite their contribution to agricultural production, meaning the proxy of land ownership is male or through inheritance. The average farm size is 1.3 ha. The area is both used for crop production and livestock production. Most households found in SNL are peasant farmers who cannot afford to lease or purchase land.

The other land which is the ITF which acquires 37% of the country has got property rights to exclude, use and stop people from using by the title in the paper. The owners of such land can use it as collateral. Most of this land is for private farms which use it for commercial agricultural production of sugar cane, citrus fruits, pineapple and timber mainly for export.

2.4 Project approach to small holder agriculture in rural development

Small holder agriculture can be a "potential solution" for poverty reduction and economic growth (FAO 1997, IFAD and World Bank 2001). There is a potential to expand agriculture and hence promote projects that have been regarded as the most appropriate tools for rural development in developing countries. This is because more population is found in rural areas and tends to use labour-intensive methods as compared to capital intensive methods. Small holder irrigation schemes promote food sufficiency and contribute to rural development when production is linked with markets. In addition there is potential for SHIS to create employment if famers would improve the productivity so as not only produce for home consumption but also for market. This can moderate the rural exodus (migration) which results in shanty towns, create growth linkages, and enlarge market for industrial goods.

Agriculture sector will continue to play an essential role in efforts to accelerate economic growth and alleviate poverty and food security in developing countries, particularly the low income ones (Pinstrup and Watson 2011). Bhembe, (2009) recommended that in order for

Swaziland to reduce the poverty levels of rural households, creating small holder irrigation schemes can be one of the strategies that may help the country.

Although irrigation water is just one significant factor in poverty reduction, it plays a disproportionately powerful role (Hussain, 2003). This is because there is no agricultural activity that can take place without water as an input. Within agriculture water, is a vital resource as a production input. Irrigation water is an important socio-economic input/good with a positive role towards poverty reduction. Access to reliable irrigation enables farmers to adopt technologies and intensify cultivation thus leading to increase in productivity, high production and greater returns from farming. Overall irrigation water improves the income generating function in agriculture especially in the rural setting. In Pakistan, according to Hussain, (2004), irrigation has proved potential in agricultural development of the country by alleviating suffering, preventing famine and advances the material of prosperity of the country.

2.5 Factors influencing farmers participation in small scale irrigation schemes

The major determinants of farmers choice to participate in small holder irrigation schemes is mainly due to socioeconomic dimensions of households, the institutional and technical factors,(Bunclark, 2010). The socioeconomic dimensions of households include household head age, literacy, marital status, household size, farm size, livestock ownership, distance to scheme, farming experience, income levels, off farm income and other group membership. The institutional and technical factors include legal environment, access to credit and market, contracts, market coordination, support, transaction cost, market infrastructure, physical infrastructure such as roads, communication networks and technical support

A probit model was used to determine the factors influencing individual's participation in Rice Development Projects in Ghana (Martey *et al.,* 2013). The dependent variable was binary, involving two mutually exclusive alternatives, the individual either participates or does not. Participation in rice development projects in Northern Ghana is influenced by age of the household head, marital status, access to off-farm income, market price of rice, knowledge of rice varieties and access to credit.

Nxumalo and Oladele (2013) employed a probit analysis to find out factors affecting farmers' participation in agricultural programme in Zululand District, Kwazulu Natal Province, South Africa. They found out that the major constraints which prevented farmers from

participating were land accessibility, lack of funding, high input cost and lack of technical knowledge. Other factors which influenced participation decision of households were the attitude of farmers, other crop and livestock enterprises and sources of information available to the farmers.

According to Asayehegn *et al* (2011), despite the efforts that the Ethiopian government is trying, smallholder farmers are found to be reluctant to participate in small-scale irrigation schemes. The study also explored the effect of participation in small-scale irrigation on the income of rural farm household where a Heckman's two-stage estimation were used to estimate determinants of small-scale irrigation participation and household income. The analysis revealed that income, gender, access to market information and health condition of households are important determinants for participating in small scale irrigation schemes. The analysis further revealed that irrigation participation, family labor force, livestock ownership and access to market information and credit are positively and significantly associated with household income

Collective action has also been shown to influence decisions to participate in a channel due to increased bargaining power and reduced transaction and marketing costs (Makhura *et al.*, 2001), through improved the organization of the marketing channels which result in economies of scale. Collective action enables farmers to have better access of production resources, transport and better access to extension services and other development programs.

2.6 Impact of smallholder irrigation schemes on poverty reduction

There is extensive literature documenting evidence on the productivity and poverty related impacts of irrigation. While the studies vary widely in terms of scope, methodology and geographic coverage (from South Asian countries, India, Ethiopia and Tanzania). Most of them conclude that in agricultural irrigation infrastructure contributes significantly towards improving livelihoods and reducing poverty.

Mohammed and Jema (2013) used the "with and without" approach to evaluate the impact of irrigation schemes in Telela, Ethoipia. The poverty line was the cost of basic needs by Ravallion 1994, and food requirement of 2200 kilocalories per person per day. Poverty line was given by the equation 1 below:

$$Povertyline = \frac{Average\ \min imum \times \cos ts\ average\ bundle}{Calories\ in\ average\ for\ a\ bundle\ of\ a\ poor\ household} \quad \text{…….. (1)}$$

Headcount, poverty gap and severity index (FGT) was used to measure the poverty levels. To evaluate the impact of schemes in poverty reduction, a propensity measurement score (PMS) was used with the logit model. The output variable was consumption expenditure per equivalent adult. Independent variables were education, gender and age, occupation of household head, cultivated area and income. Access to irrigation water was found to be significant in poverty reduction by increasing consumption of members by 21%. The same method was used by Babatunde (2009) to assess the impact of irrigation scheme on poverty reduction in Nigeria.

Hussain *et al.,* (2006) evaluated the impact of small scale irrigation schemes on poverty reduction in marginal areas of Punjab in Pakistan. The study employed the 'with and without' approach by comparing beneficiaries and non-beneficiaries in the same area. Poverty line was from the government statistics and updated using the consumer price index CPI of the year 2003. Household income was defined as the total income received both in cash and kind in a given season/year. Total income used was net cash of all expenses but excluding value of all resources owned by the household (family labour and draft animals). To determine the impact of irrigation scheme, a logit model was used with poverty as the dependable variable, value one if household is poor otherwise zero. Access to irrigation water family size, cultivated area and education were the most significant factors contributing towards poverty reduction.

Amaza and Kwaghe (2008) in the Borno state, Nigeria defined poverty as the inability of households to satisfy their basic needs such as food, shelter and clothing. The poor are those unable to meet social and economic obligations lack employment and are deprived of access to basic facilities such as education. In determining the poverty status of households a poverty line was constructed using two thirds mean per capital household expenditure and households below the line were defined as poor. Probability of being poor, poverty depth was obtained from Tobit regression estimate. Tobit model was further disaggregated to determine the effect of change in the variables on the changes in the probability of household being in poverty and expected depth of poverty.

Mahmood (2004) used a three stage sampling technique to select a sampling frame in Chashma Right Bank Canal (CRBC) of Pakistan. A comparison was based on area under cultivation, cropped area, cropping pattern, yield, crop intensity of irrigated and non-irrigated are of the beneficiaries and the non-beneficiaries. Cobb Douglas analysis was employed to analyze

the data and quantify the incremental benefits of major factors of inputs to outputs. The *t*-test was used to compare yield, consumption, savings and intensity.

Chazouachi (2012) used descriptive statistics with socio demographic characteristics such as asset ownership, employment and livestock. The weakness of this study is that it does not quantify the impact of the schemes on poverty reduction, which becomes very difficult for policy makers to utilize such information.

Summary of findings:

The major findings from these studies suggest that:

(1) Irrigation has strong poverty reducing potential through its direct and indirect growth promoting linkages and positive impacts at the local, regional and national levels.

(2) Other than access to irrigation water, household size and literacy rate have a major influence in the poverty levels.

(3) Poverty is much more and deeper in non-irrigated areas compared to that in irrigated areas.

(4) The impacts of irrigation on poverty vary across settings and the magnitude of the anti-poverty impacts of irrigation depend on a number of factors which include: a) institutional factors on land ownership and tenure b) condition of the irrigation infrastructure c) irrigation water allocation and distribution procedures, d) irrigation and production technologies/methods, cropping patterns and crop diversification, e) support measures such as information, input and output marketing.

2.7 Conceptual framework.

In this study it is hypothesized that access to irrigation positively influences poverty reduction. However factors influencing farmer's decision to participate may be due to socio-economic, institutional and technical factors (Bunclark, 2010). The conceptual framework in figure 1 shows the linkages between access to irrigation water and poverty reduction. Variables have been obtained from past literature.

According to Nxumalo and Oladele (2013) major technical and institutional constraints which prevented farmers from participating were land accessibility, lack of funding, high input cost, lack of technical knowledge towards participations, access to information and high transaction cost. Asayehegn *et al.,* (2011), found income, gender, and health condition of

households and distance to irrigation scheme as important socioeconomic determinants for participating in small scale irrigation schemes.

Conceptual framework in figure 1 shows that government policies towards investment in irrigation, increase output by increasing irrigable area, reducing rainfall risk, improves productivity through multi-cropping and use of high variety crops. However, the household decision to participate in influenced by the socioeconomic, institutional and technical factors. It is also hypothesized that access to irrigation water improves food security and income for households which leads to poverty reduction and improved livelihoods.

Conceptual framework for this study is adopted from a study by Nedumaran (2009), in Ghana.

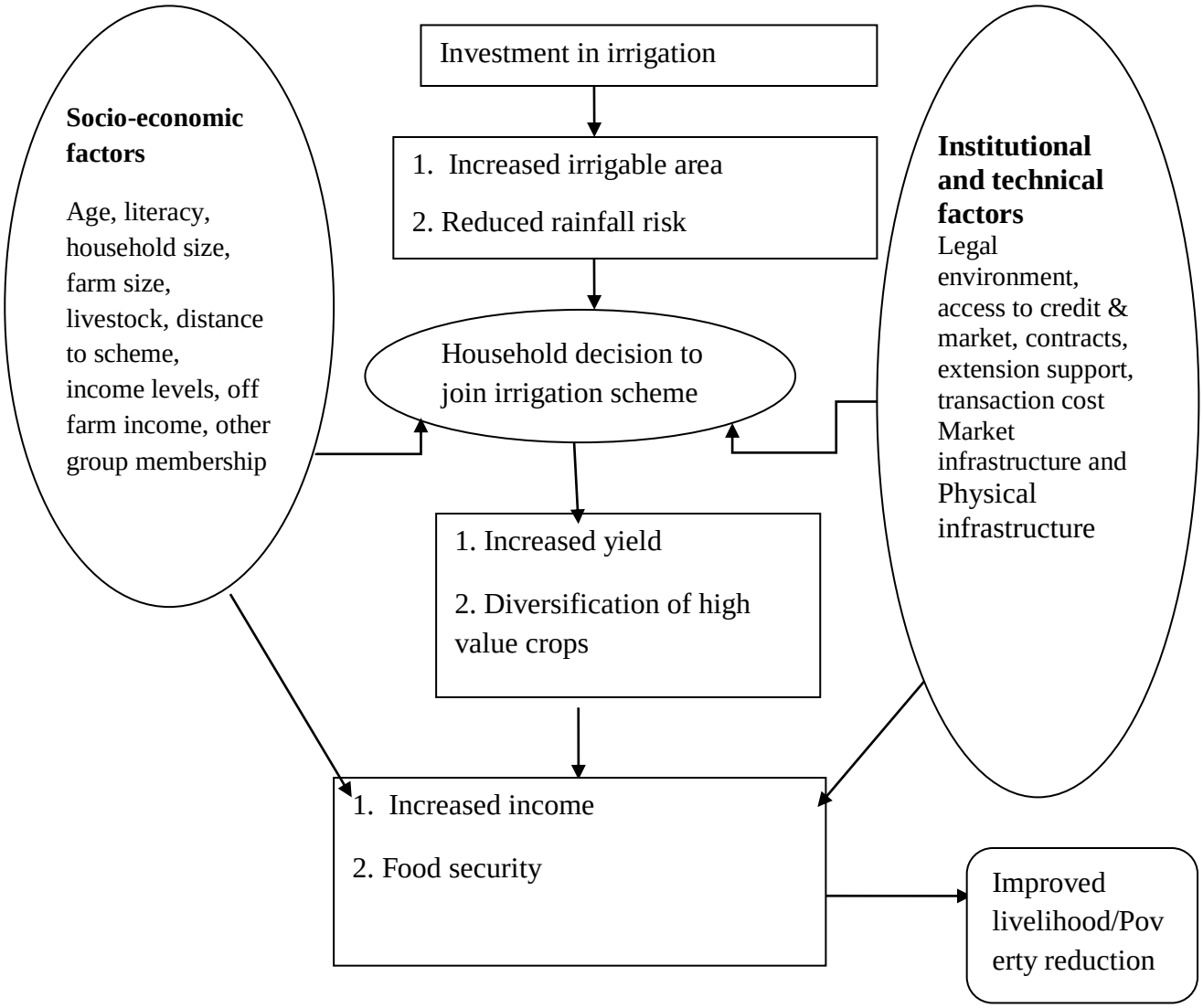

Figure 1: Conceptual Framework

CHAPTER THREE

METHODOLOGY

Due to time constrain and absence of previous data for farmers, the study used cross-sectional data to evaluate the impact of irrigation schemes on poverty reduction. Specifically it used two types of households. The members of the irrigation scheme (treatment group) and non-members of the scheme (control group). The analytical framework was adopted from past studies that have successfully analyzed the impact of irrigation on poverty reduction and the Swaziland Household Income and Expenditure Survey (SHIES). In particular, this study followed Hussain (2006) and Mohammed and Jema (2013), where they studied the impact of small holder irrigation schemes on poverty reduction.

3.1 Sampling method and study area

To have more reliable data, the study selected vegetable irrigation schemes, which had been operating for the last five consecutive years. Hence purposive sampling was used to select two Rural Development Areas (RDA's) which are Ntfonjeni in Hhohho region and Ngwempisi in the Manzini region. Two irrigation schemes were selected in each RDA with their respective Enumeration Areas (EA's) already coded. In Ntfonjeni: Emavulandlela EA (12126) and Mkhovu EA (12165) irrigation schemes were selected. In Ngwempisi: Ngwempisi farm (EA 21122) and Ntamakuphila (EA 21130) irrigation schemes. Household population lists for the selected areas were obtained from the Central Statistics offices.

Total household size for the four Enumeration areas was 349 households and sample size was 184 households, obtained proportionately to size using Yamane, (1967) at 95% confidence interval. Random sampling was then applied until the desired sample size was obtained. The general formula for sample size was:

$$n=\frac{N}{1+N(e)^2} \quad \text{......} \quad (2)$$

Where n is the desired sample size, N is the population size and e is the acceptable error (0.05).Therefore**:**

$$n = \frac{349}{1+349(0.05)^2} = 184 \text{ households}$$

Table 1: Household population and sample size

EA Code	RDA	EA Local Name	Irrigation scheme	Household numbers	Sample size
12126	Ntfonjeni	Kandwandwe	Emavulandlela	68	36
12165	Ntfonjeni	Mvembili	Mkhovu	96	51
21122	Ngwempisi	Lushikishini	Ngwempisi farm	83	44
21130	Ngwempisi	Velezizweni	Ntamakuphila	102	53
	Total			**349**	**184**

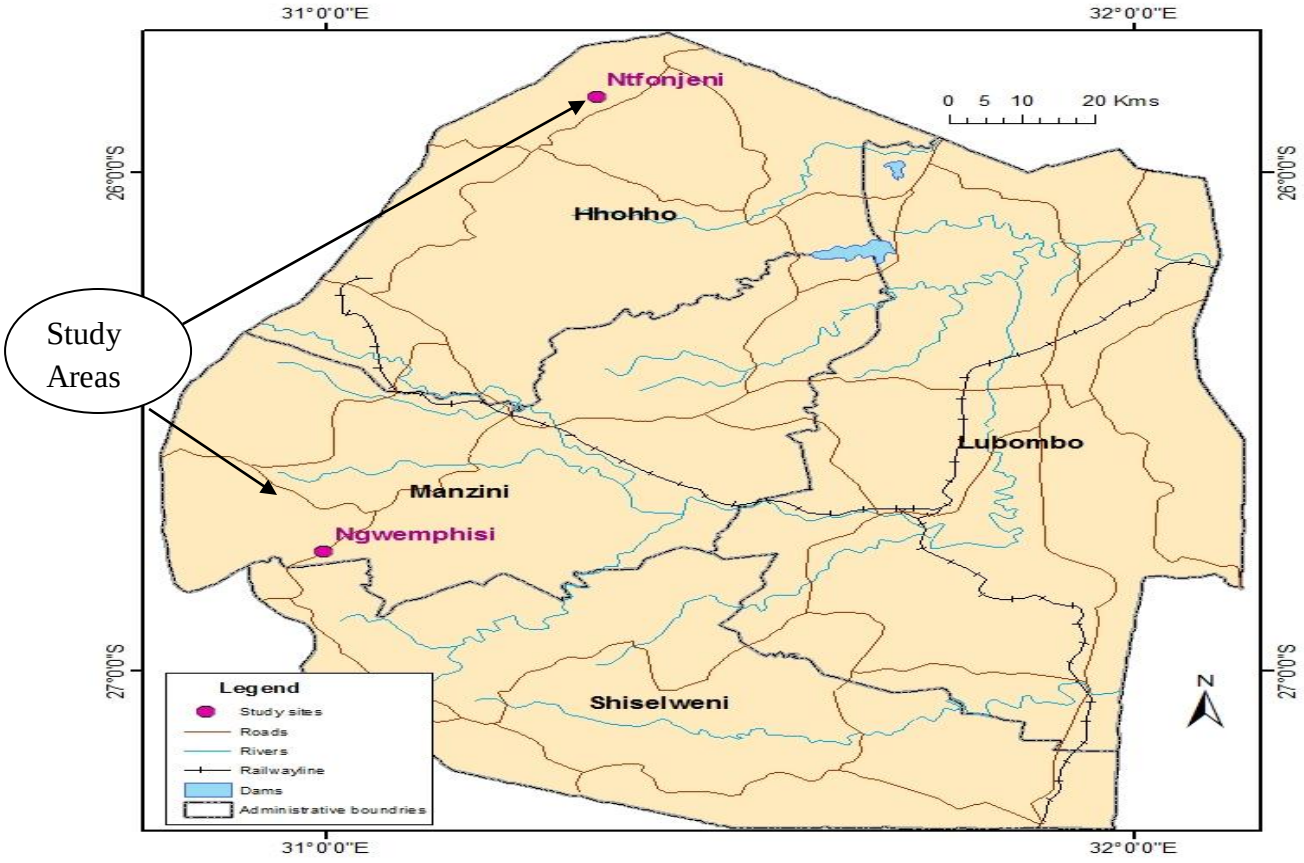

Figure 2: Map of study area (Source: www.wri.org)

3.2.0 Description of study areas

3.2.1 Ntfonjeni Area

Nfonjeni area is located in the Moist Middleveld (MMV) livelihood zone of Swaziland, latitude 25.82^{o} S and longitude 31.42^{o}E, (Figure 2). Average annual rainfall is 1099.4mm/year and maximum temperatures of 34^{o}c. The area is located in the top north of Swaziland next to RSA border to Mpumalanga province. Crops that are grown here include maize (*Zea mays*), sweet potatoes (*Impomoea batatas*) and vegetables and rice which are irrigated. The area has 336 homesteads with 420 households, located in five enumeration areas. Total population is 2439 people where 1096 are males and 1343 are females. The area was resettled to accommodate schools both primary and high school, clinic, grave yard, grazing area and the irrigation schemes for vegetable and rice. There are five irrigation schemes which are producing. Mswati irrigation scheme specializes on rice and sweet potatoes production and Embonsweni, Bambanani, Mkhovu and Emavulandlela are mainly for vegetable production. Mkhovu and Emavulandlela produce for the National Agricultural Marketing Board (NAMBoard). MMV zone is characterized by moderate in cereal production (SAVAA, 2009) and hence maize is produced in those regions to supply even the dry areas of the country through selling the maize at National Maize Cooperation.

3.2.2 Ngwempisi area:

Ngwempisi area is located in the Highveld Cattle and Maize (HCM) livelihood zone of Swaziland, latitude 26. 44^{o} S and longitude 31^{o}E, (see Figure 2). Average annual rainfall is 1100mm/year and maximum temperatures of 30^{o}c. The area is located in the west part of Swaziland next to RSA border to Mpumalanga province. Crops that are grown here include maize (*Zea mays*), sweet potatoes (*Impomoea batatas*) and vegetables and which are irrigated. The area has 333 homesteads with 409 households, located in four enumeration areas. Total population is 2431 people where 1104 are males and 1327 are females. The area was resettled to accommodate schools both primary and high school, clinic, grazing area and the irrigation schemes for vegetable. There are two major vegetable irrigation schemes which are producing: Ngwempisi farm and Ntamakuphila irrigation scheme which sell their produce to the National Agricultural Marketing Board (NAMBoard). HCM zone is characterized by surplus in cereal production (SAVAA, 2009), and livestock production and hence more maize is produced in

those regions to supply even the dry areas of the country through selling the maize at National Maize Cooperation.

3.3 Data collection

A questionnaire was used to collect data for the study. Primary data was based on the, consumption, expenditure of households and socio economic variables of households. Also the questionnaire collected other information on factors influencing poverty at household level including access to irrigation water. All selected members and non members were interviewed on a one to one interview; the researcher, four (4) enumerators, two (2) supervisors carried the exercise. Focus group discussion was used to determine the effects of collective action in members. Relevant secondary data was obtained from central statistics office, ministry of agriculture, extension officers, and the meteorology station**.**

3.4 Data analysis

Data were analyzed using SPSS 20 and STATA 12. Analysis was both quantitative and qualitative. Qualitative analysis was employed to compare the socio-economic dimension of the two groups. Quantitative analysis focused on poverty measurements of members and nonmembers, a logit model to identify factors which contribute to household decision to participate in the local irrigation scheme. Average treatment effects using propensity score matching was used to evaluate the impact of irrigation on poverty reduction.

3.5.0 Analytical Framework

3.5. 1 Objective 1: Measurement of poverty level

In order to measure poverty level the first important step is to estimate poverty using the poverty line. A poverty line is defined as the per-capita monetary requirements an individual needs to afford the purchase of a basic bundle of goods and services, and can be measured using the calories intake, income and expenditure needed for the required food intake or the cost of basic needs.

After computing the poverty line, a Head count index (HCI) was computed, which measures the incidence of poverty .The HCI shows the percentage of the population whose expenditure or income is below poverty line. These are the people that cannot afford to buy the basic basket of goods and services. However, the headcount index ignores the depth and severity of poverty,

therefore this equation is supplemented with the poverty gap (PG), depth and poverty severity. The poverty gap index highlights the poor below the poverty line by measuring how poor they are whilst the squared poverty gap (SPG) measures the severity of poverty giving more weight the poor. All these measures are under Foster-Greer-Thorbecke (FGT).

If population size is n and q is the number of poor people then

Head Count Index: $HCI = \frac{q}{n}$ …….…….. (3)

If z is poverty line, and Y_k is expenditure of individual k then poverty gap is:

$$PG = \frac{1}{n}\sum_{k=1}^{n}\frac{z - Y_k}{z} \quad \text{……..…… (4)}$$

A zero gap is expected for the non poor

Poverty gap may also be calculated as the product of expenditure gap and the head count index ratio as given below:

$$PG = I * HC \quad \text{…….……...…… (5)}$$

Where I is expenditure gap and is:

$$I = \frac{z - Y_q}{z} \quad \text{……..……..…... (6)}$$

Where: $Y_q = \frac{1}{q\sum Y_k}$ is the average expenditure of the poor household, and K=1

Squared poverty gap (SPG) measures the severity of poverty giving more weight to the poor and the direction is calculated as follows:

$$SPG = \frac{1}{n}\sum_{k=1}^{n}(\frac{z - Y_k}{z})^2 \quad \text{…….. (7)}$$

The general formula for all these three measures which will depend on parameter α and is given below as:

$$FGT(\alpha) = \frac{1}{n}\sum_{k=1}^{k} [\frac{z - Y_k}{z}]^{\alpha} \ldots\ldots (8)$$

Where α takes a value of zero for the head count index, one for the poverty gap index and two for the squared poverty gap index.

A *t*-test was be used to test if the poverty levels between the members and the non-members are statistically different from each other. This method has the advantage of comparing polices which are aiming to reach the poorest such as the PRSAP and National Irrigation Policy.

***A priori* expectations**

Due to the many dimensions of poverty and results from past studies the study hypothesized a neutral expectation of the two groups in terms of poverty levels.

Table 2: *a priori* expectations for poverty levels

Group	*a priori*
Members	+/-
Non members	+/-

3.5.2 Objective 2: Compare the socioeconomic dimensions of poverty among beneficiaries and non-beneficiaries

Descriptive statistics was applied where charts and graphs were used, employing the "with and without" approach. The main aim of this objective was to determine the role of irrigation if it has an effect on improving the households livelihoods. After separating the poor and the non-poor, the study compared variables that the poor and the non-poor have access. Variables included sanitation, farm size and access to irrigation water, employment, age, marital status and gender of family head and possession of durable goods (variables obtained from the Swaziland Household Income and Expenditure Surveys, 2010).

3.5.3 Objective 3: To determine the factors that influence farmers to participate in the irrigation scheme

The enrollment of farmers in the scheme was on voluntary basis. There was no criteria used to select them neither did they select themselves. Participation in irrigation schemes is an important platform for joint learning and technology transfer (Martey *et. al.*, 2013). The dependent variable participation which is binary was assumed to be influenced by following the independent variables. Each variable is defined with their hypothesis based on empirical results of past studies and economic theory. The logit model is specified as:

Probability of participating: $$Y(0,1) = Log\,[\,\frac{P}{1-P}\,] = \beta_0 + \beta_i X_i + \varepsilon_i \quad \text{..... (9)}$$

Dependant variable: participation (participant 1, otherwise 0), β_0 is the constant term or intercept and βi represent the parameters to be estimated and ε is the error term.

P= probability of being participating

1-P= probability of not participating

Table 3: Independent variables (X_i) and *a priori* expectations for participation

Independent variable	Unit of measure	*a priori*
Sex	Dummy(1=male, 0=female)	+
Age	Years	+/-
Distance to scheme	Kilometers	-
Education	Numbers of years in school	+/-
Household size	Number of household members	+
Farm size	Hectare	+
Off- farm income	SZL	-
Livestock	Number of cows	-
Extension	Dummy (1= access, 0=no access)	+/-
Access to market	Dummy (1= access, 0=no access)	+/-
Credit	Dummy (1= access, 0=no access)	+
Occupation	Dummy (1=peasant, 0= otherwise)	+
Other group membership	Dummy (1= yes, 0=no)	-

Sex of household head: is a dummy variable 1 if male and 0 if female and is expected to determine the difference in decision to participate in small holder irrigation schemes between male

and female household heads. Males are expected to have a high probability of participating as compared to females because they make the final decisions in the households. On the other hand women are sometimes discriminated to access to land and are often occupied with other household's activities hence the probability of them to participate is very low.

Age: is a continuous variable. Previous empirical studies found a two way relationship between age and participation in irrigation scheme as well as other agricultural technologies. Younger household heads are more dynamic with regards to adoption of innovations than older household head; however they are usually more occupied with other job opportunities as compared to farming. Also older household members are assumed to have more experience in farming and hence an increase in the probability of participation. Therefore, this study did not hypothesize the sign of relationship between age of the household head and participation in irrigation scheme

Marital status: is a dummy variable 1 if married 0 otherwise. Due to joint decision making, married households are expected to have a higher probability of participating as compared to single headed households, hence divorced and widow were treated as not married in this study

Education: is a continuous variable indicating formal years in schooling**.** There is also a two way relationship with education and the probability of household willingness to participate. Most previous studies indicated that the possibility to adopt and apply new methods of farming increased along with education level is posited to have a positive effect on participation since it enables an individual to make independent choices and to act on the basis of the decision, as well as increase the tendency to co-operate with other people and participate in group activities (Etwire. et al., 2013). However, it is also possible that education could increase the chances of the household head earning non-farm income and opting for white collar jobs as compared to farming. This could reduce the household dependency on agriculture and thus participation.

Household size: is a continuous variable indicating the number of people who live and eat together. This variable is expected to positively influence farmers' participation. Household size serves as a form of family labour and complements the effort of the household heads on the farm (Martey. et., al 2013). The availability of family labour provides the household head the opportunity to share responsibility and save time for other development activities. Also, larger households spend more on food and other household needs and hence the need for external support.

Farm size includes total land size that the household has which is irrigated and non-irrigated. This variable is continuous and hypothesized to have a positive influence on household decision to participate. Household head with more land will require improve seed varieties that are

more yielding. However farm size alone is not sufficient to influence the probability of participation as peasant farmers will also need access to HYV of seeds and also the issue of labour of which most of them depend on family labour.

Off-farm income is expected to have a negative relationship with probability of participation. Household head that earns off-farm income may have little time to participate in farming activities in small holder irrigation schemes.

Livestock is a continuous variable which is expected to have a neutral relationship. Households that are more into livestock farming may not see the need of also doing a lot of vegetable production since both activities are time consuming

Other groups' membership: is a dummy variable with 1 if there is other group excluding the scheme joined and 0 otherwise. It is expected that household head membership of group will negatively affect participation. However, savings, and other agricultural groups are expected to increase the probability of participation.

Credit availability is essential input in peasant farmers to purchase inputs. Access to credit serves as an incentive for farmers to increase their production and overcome the financial constraints in participating in development projects which also has a direct impact on their livelihoods. This variable is dummy with 1 if a farmer has access to credit and 0 otherwise, hence a positive relationship is hypothesized.

Distance to the irrigation scheme: is a continuous variable which is hypothesized to have a negative relationship. Households near to the irrigation scheme are expected to participate more as compared to far households.

Occupation: is a dummy variable taking the value of 1 if the household primarily depend on farming to support the family and zero otherwise. A positive relationship is hypothesized for this variable. Household heads which have got no other sources of income are expected to participate in the irrigation development.

Market and extension: are dummy variables taking the value of 1 if the household has access to market or extension and zero otherwise. A neutral relationship is hypothesized for these variables, due to different results from past studies.

3.5.4 Objective 4: To access the impact of smallholder irrigation schemes on poverty reduction

To evaluate the impact, the outcome variable that was used for comparison in this study, is households' consumption expenditure per day per adult equivalent. The average change in the

outcome variable was estimated using Propensity Score Matching (PSM), to solve the problem of self-selection bias. Participant households (treatment group) were matched with non-participants (control group), that are assumed to have same probability to participate in the small-scale irrigation scheme. The probability of participation in the small-scale irrigation scheme (propensity score), was estimated as a function of observable household characteristics using a logit model (Mohammed and Jema, 2013, Abadie, 2003). The PSM approach tries to capture the effects of different observed covariates *X* on participation in a single propensity score or index. Then, outcomes of participating and nonparticipating households with similar propensity scores were compared to obtain the program effect using the nearest neighbor matching approach. Households for which no match is found were dropped because no basis exists for comparison, Rosenbaum and Rubin (1983)

The Average Treatment Effect of the i^{th} household (ATE^i), the difference in households' consumption expenditure per day per adult equivalent, which can be expressed by: $Y_1^i - Y_0^i$. Where, Y_1^i is the consumption expenditure of the i^{th} participant household and Y_0^i is the consumption expenditure per day per adult equivalent of the i^{th} non-participant household (Mohammed and Jema, 2013). Assuming *D* as household participation status in the irrigation scheme (*D* = 1 for participant and *D* = 0 for non-participant), the (ATE^i) in casual effect notion can be expressed by:

$$(ATE)^i = E(Y_1^i \mid D=1) - E(Y_0^i \mid D=0) \quad \text{(10)}$$

Where $E(Y_1^i \mid D=1)$ is the average consumption expenditure per day per adult equivalent for household with access to irrigation scheme and $E(Y_0^i \mid D=0)$ is the average consumption expenditure per day per adult equivalent for household with no access to irrigation scheme. For the sample households in the study area, the Average Effect of Treatment on the Treated (ATT) can be expressed by:

$$ATT = E(Y_1^i - Y_0^i \mid D=1) = E(Y_1^i \mid D=1) - E(Y_0^i \mid D=0) \quad \text{(11)}$$

Assumptions:

The common support assumption states that, the test of the balancing property is performed only for observations with propensity score between the common support region of the participants

and the nonparticipant's propensity score that is between 0 and 1. While, the conditional independence assumption states that, the irrigation scheme assignment condition is independent of the post-irrigation scheme outcome.

Covariates:

Table 4: Covariates for propensity matching and *a priori* expectations

Independent variable	Unit of measure	*a priori*
Sex	Dummy(1=male, 0=female)	+
Age	Years	+/-
Distance to scheme	Kilometers	-
Education	Numbers of years in school	+/-
Household size	Number of household members	+
Farm size	Hectare	+
Non farm income	SZL	-
Livestock	Number of cows	-
Other group membership	Dummy (1= yes, 0=no)	-
Occupation	Dummy (1=peasant, 0= otherwise)	+

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Poverty levels of members and non-members

In order to address the first objective, consumption and expenditure was used as a proxy to measure the poverty levels of household. Household consumption covered food and non-food items. Sources of food for consumption included own crop production, purchases and food received. Nonfood expenditure items were education, health, rent and other household's monthly expenditure such as toiletry, transport, electricity and entertainment. Household expenditure was calculated for a single month period and all yearly expenditures such as education, cash purchase of furniture were divided by 12 to obtain monthly expenditure. Expenditure on durable goods was excluded as it may give misleading information. Similarly data on household's incomes was excluded in poverty calculation because the variable income is often rather difficult to obtain, and households are not overly keen to divulge details about their earnings. Furthermore, income estimation is generally more difficult when numerous households are self-employed and there is not proper recording of accounts (SHIES, 2010), as compared to consumption and expenditure.

The poverty line was estimated using the expenditure of households, and based on the consumer price index. The poverty line for 2010 from national census was corrected for variations in prices over time to prevent spatial price variations. There are two types of poverty lines: the absolute poverty line and the extreme poverty line which is often referred to as food poverty line. The absolute poverty line was SZL(Swaziland Rand) 572 per month per equivalent adult and the food poverty line was set to be SZL 268 per month per equivalent adult. The minimum calories per equivalent adult per day were fixed at 2100 kilocalories per person per day which were used in the Swaziland Household Income and Expenditure survey. These calories are necessary to sustain an individual for a normal and active life (SHIES, 2010).

4.1.1 Poverty indices for members and non-members in Ngwempisi RDA

Results for poverty indices for the Ngwempisi scheme are presented in Table 5. The poverty headcount index (FGT α=0), indicates the percentage of households who are below the poverty line (poor households). Using the poverty headcount index, there was a significant

difference in absolute poverty levels between members and non members with 58.4% and 79% respectively. Thus members of schemes were lower in poverty by about 21%. On the other hand, food poverty was 33.3% for members and about 58 % for non members which was higher by about 25%. These results indicate that members of irrigation schemes had significantly lower poverty levels as compared to non members.

Similar findings have emerged, for instance, Beshir (2010) found the headcount index of members of irrigation scheme in Ethiopia was 11% lower than that on non members. In Nigeria, members of irrigation scheme had their poverty levels reduced by 10.5 %, whilst non members in the same area experienced only a reduction of 2% in poverty levels (Babatune, 2009), Yogyakarta (2002), in Indonesia observed that there was a 22% difference between the head count index for members and non members, whilst in Asia the difference of poverty levels between members and non members vary from 20% to 30% (Hussain and Wijerathina, 2004).

There is a significant difference between the poverty gap of members when compared to non members. The poverty gap measures the extent to which the poor households fall below the poverty line, and it is often given more weight in policy making. The poverty gap was 0.060 for members and 0.035 for non members. In other words, the aggregate poverty deficit (FGT α=1) of the poor relative to the poverty line was 6% for members and 35 % for non members. The push – up level that is needed by non members to escape the poverty trap is wide as compared to the members. While the poverty severity index (FGT α=2), taking into account the consumption distribution of households falling below the poverty line, was found to be only 0.3 % for members and 3% for non members.

Therefore, from all the three indices there is indication of a significant difference in terms of the poverty levels for members and non members in Ngwempisi RDA suggesting strongly that irrigation schemes can indeed reduce poverty levels in rural areas.

Table 5: Poverty indices for members and non-members in Ngwempisi RDA

Indices (Mean)		Members		Non members	
		Absolute poverty	Food poverty	Absolute poverty	Food poverty
Headcount	α=0	0.583	0.333	0.791	0.581
Poverty gap	α=1	0.060	0.036	0.335	0.175
Poverty severity	α =2	0.014	0.003	0.112	0.030

4.1.2 Poverty indices for members and non-members in Ntfonjeni RDA

There was a significant difference in poverty levels between members and non members in Ntfonjeni RDA of 53.1% and 82% respectively in the poverty headcount index, indicating a 29% difference between members and non members as indicated in Table 6. About 21.2% of member households were unable to meet the daily food requirement whilst 55% of the households for non members were unable to meet the daily food requirement.

The poverty gap was 0.081 for members and 0.469 for non members. This means that members needed and 8% additional income to reach the poverty line, whilst non members needed about 46% additional income to escape the poverty trap. The poverty severity index (FGT α=2), taking into account the consumption distribution of households falling below the poverty line, was found to be only 1.2% for members and 12 % for non members. All three indices suggest that member households in the scheme enjoy a better welfare than non members.

Table 6: Poverty indices for members and non-members in Ntfonjeni RDA

Indices (Mean)		Members		Non members	
		Absolute poverty	Food poverty	Absolute poverty	Food poverty
Headcount	α=0	0.531	0.212	0.829	0.553
Poverty gap	α=1	0.081	0.053	0.469	0.342
Poverty severity	α =2	0.023	0.012	0.220	0.117

4.1.3 Aggregate poverty indices

The combined results for both the RDA's (table 7), shows that the overall absolute poverty level for the study areas was 68.4%. This means that about 68.4% of the households were poor and could not afford to meet the monthly requirement for a decent living given the national poverty line. However, this figure is slightly lower as compared to the last census for the country (SHIES, 2010), where it recorded a 63% overall national absolute poverty but the rural poverty was 73.7%. The results indicate that most rural households are poor and have not seen much improvement in their livelihoods as compared to urban households. This is because most

of these households primarily depend on agriculture which apparently is not generating adequate food and income. It is, however, important to note that the drop in absolute poverty in the RDAs by 5.3% from national rural average could rightly be attributed to the impact of irrigation schemes.

The overall extreme poverty or food poverty was 42.1%, meaning that a large number of households were unable to meet the daily food requirement. They neither afford to purchase nor grow enough food for the family consumption. Unfortunately, the number had increased by 9% from the last national survey (SHIES, 2010), however the figure was combined for both rural and urban areas. This could be attributed to the inflation where the food cost has dramatically increased, drought and unreliable rainfall that the country has been facing over the last three years.

The overall poverty gap was 0.236, which indicates the households below the poverty line. In other words, the aggregate poverty deficit (FGT α=1) of the poor relative to the poverty line was 23%. It is however important to note that there was an improvement by 14 % in the poverty gap when compared to the last poverty survey (2010) While the poverty severity index (FGT α=2), was 9% which when compared to 2010, had dropped by 13% .

Table 7: Aggregate poverty indices

Indices (Mean)		Absolute poverty		Food poverty	
		Index	Std. error	Index	Std. error
Headcount	α=0	0.684	0.033	0.421	0.035
Poverty gap	α=1	0.236	0.054	0.151	0.067
Poverty severity	α =2	0.092	0.014	0.041	0.020

4.2. Socioeconomic dimensions of members and non-members of the smallholder irrigation schemes

4.2.1 Demographic characteristics of sampled households in Ngwempisi RDA

The combined results of members and non members in Ngwempisi (Table 8) shows the average age for household heads was 53 years with no significant difference between members and non members. The mean age for members and non members was 54 and 52 years

respectively. About 64% of the households were male headed and 36% female headed with no significant difference between the two. However, when the two groups were separated, 70% of member households were headed by males and 59 % for non members.

The mean household size was 6 members with no significant difference between members and non members, and the dependency ratio was also not statistically different for both groups. The average landholding for the study area was 2.35 ha. There was a significant difference at 1% level in the size of land for members and non members. Like most developing countries the study observed that 74% of the household derive their livelihoods from agriculture where members rely more on farming (86%) as a primary source of income as compared to non members.

Table 8: Demographic characteristics of sampled households in Ngwempisi RDA.

Variables	Members		Non members		Total		*t* test	p-value
	Mean	SD	Mean	SD	Mean	SD		
Age	53.14	12.08	52.06	15.52	53.14	13.88	0.76	0.447
Sex	0.70	0.45	0.58	0.53	0.64	0.53	1.22	0.224
Hshld size	6.08	2.22	6.27	3.34	6.17	2.82	0.32	0.747
Farm size	3.01	1.21	1.69	1.29	2.35	1.34	5.49***	0.000
Education	7.75	4.1	6.58	4.82	7.16	4.49	1.27	0.102
Occupation	0.86	0.35	0.61	0.32	0.74	0.51	9.74***	0.002
Dep Ratio	1.31	0.17	1.27	0.19	1.29	0.18	0.74	0.621
Livestock	8.17	8.29	8.54	16.85	8.36	13.42	0.12	0.458

*,**,***: refers to significance at 10%, 5%and 1% level, respectively

4.2.2 Demographic characteristics of sampled households in Ntfonjeni RDA

The average age for household heads was 52 years with no significant difference between members and non members. The mean age for members and non members was 54 and 50 years respectively. About 65% of the households were male headed with no significant difference between the members. The average landholding for the study area was 1.79 ha. There was a significant difference at 1% level in the size of land for members and non members. Like Ngwempisi RDA 74% of the household derive their livelihoods from agriculture and 88% of the members rely on farming as a primary source of income. There was also a significant difference at 1% level at the number of cows owned by members as compared to non members, which indicate that members were practicing both horticulture and animal farming.

Table 9: Demographic characteristics of sampled households in Ntfonjeni RDA.

Variables	Members		Non members		Total		*t* test	p-value
	Mean	SD	Mean	SD	Mean	SD		
Age	54.3	14.49	50.17	14.61	52.25	14.63	1.38	0.168
Sex	0.68	0.51	0.63	0.48	0.65	0.49	0.41	0.681
Hshld size	6.57	2.62	5.68	2.64	6.12	2.66	1.64	0.103
Farm size	2.64	1.06	0.94	0.76	1.79	1.25	8.91***	0.000
Education	6.76	4.38	6.17	4.52	6.46	4.44	0.64	0.518
Occupation	0.88	0.30	0.59	0.32	0.74	0.54	12.6***	0.002
Dep Ratio	1.29	0.18	1.30	0.18	1.29	0.18	0.47	0.638
Livestock	5.00	7.84	1.08	3.12	3.04	6.25	3.17***	0.002

*,**,***: refers to significance at 10%, 5% and 1% level, respectively

Pooled or aggregate results for both Ngwempisi and Ntfonjeni RDA, show that the two areas have almost the similar demographic characteristics of households especially the age and sex of household head, household size, education level and occupation of the households head.

Table 10: Pooled demographic characteristics of sample households.

Variables	Members		Non members		Total		*t* test	p-value
	Mean	Std	Mean	Std	Mean	Std		
Age	54.28	13.26	51.02	15.03	52.70	14.22	1.53	0.126
Sex	0.69	0.48	0.61	0.51	0.65	0.49	1.16	0.246
Hshld size	6.15	2.42	5.99	3.01	6.15	2.73	0.08	0.383
Farm size	2.83	1.15	1.32	1.03	2.07	1.32	9.47***	0.000
Education	7.26	4.2	6.37	4.65	6.88	4.47	11.36	0.286
Occupation	0.87	0.36	0.60	0.30	0.74	0.51	15.68**	0.002
Dep Ratio	1.32	0.17	1.27	0.19	1.29	0.18	0.74	0.458
Livestock	6.61	8.15	4.85	12.68	5.73	10.80	1.126	0.263

*,**,***: refers to significance at 10%, 5% and 1% level, respectively

4.2.3 Poverty by access to energy for cooking and lighting

Most Swazi households use wood for cooking in the rural areas. There is no significant difference of energy for cooking in both members and non- members in the two RDAs. About 97% of households used wood as main source for cooking and only 3% used either electricity or gas. There has been no improvement in these results when compared to the last national survey (SHIES,2010), this is because wood is cheaper as compared to electricity and gas in the country

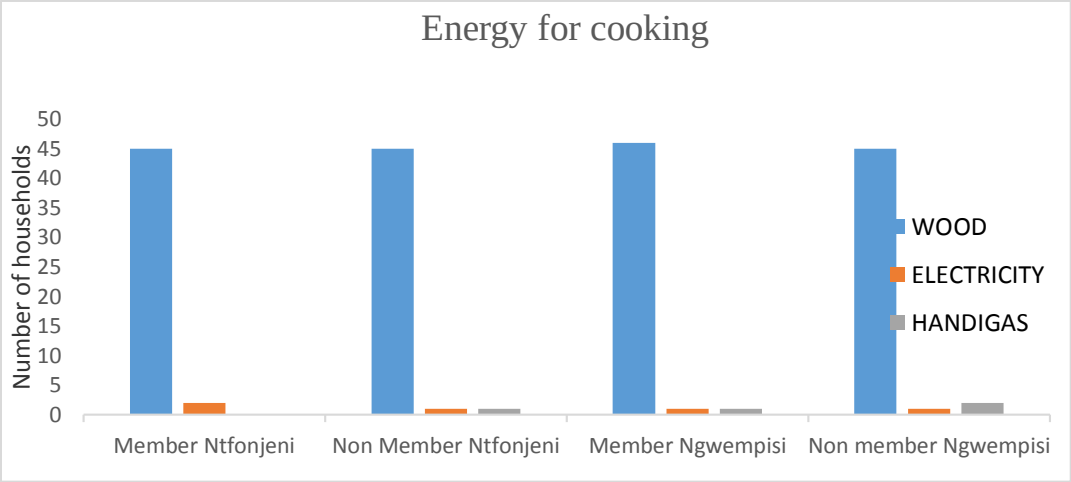

Figure 3: Energy for cooking

Sources for energy for lighting were candles, electricity, paraffin and solar for households. There was a significant difference in members as compared to non-members in terms energy usage for lighting. About 63% of members had access to electricity for lighting as compared to 35% of non-members. This suggests the government has invested more on connecting electricity to the schemes. The overall results indicate an improvement of rural households which have access to electricity by 17.55% when compared to SHIES 2010 report.

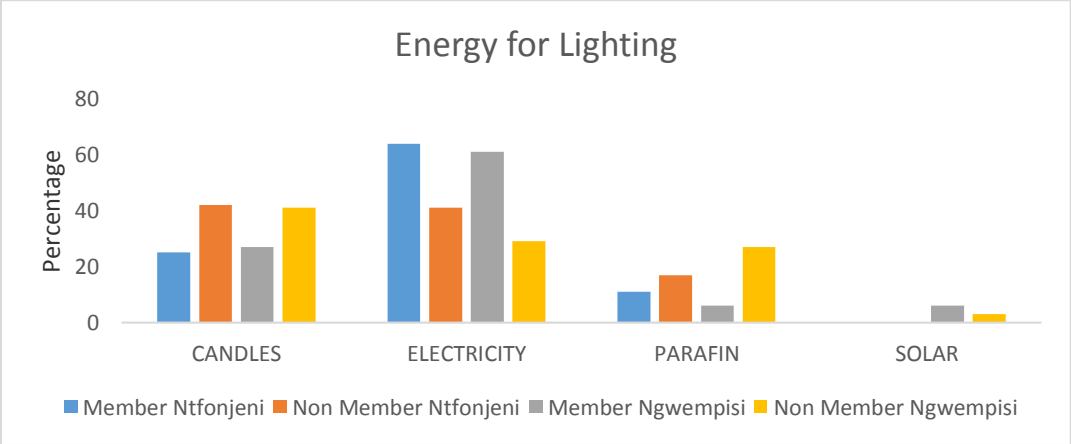

Figure 4: Energy for lighting

4.2.4 Poverty by Sanitation

Using the sanitation indices, results in figure 5 indicate that 79% of member households in Ntfonjeni had complete pit latrines compared to 68 % on non members. In Ngwempisi, the results were 81% and 79% for members and non members respectively. About 3.25% of the households had no toilets at all. As far is this index is concerned, the differences were not significant since the use of toilets is mandatory for all human beings. However, these results indicate a huge improvement in sanitation by 15% when compared to 2010 SHIES report. The ministry of health has improved the sanitation in country, and working towards achieving the MDGs.

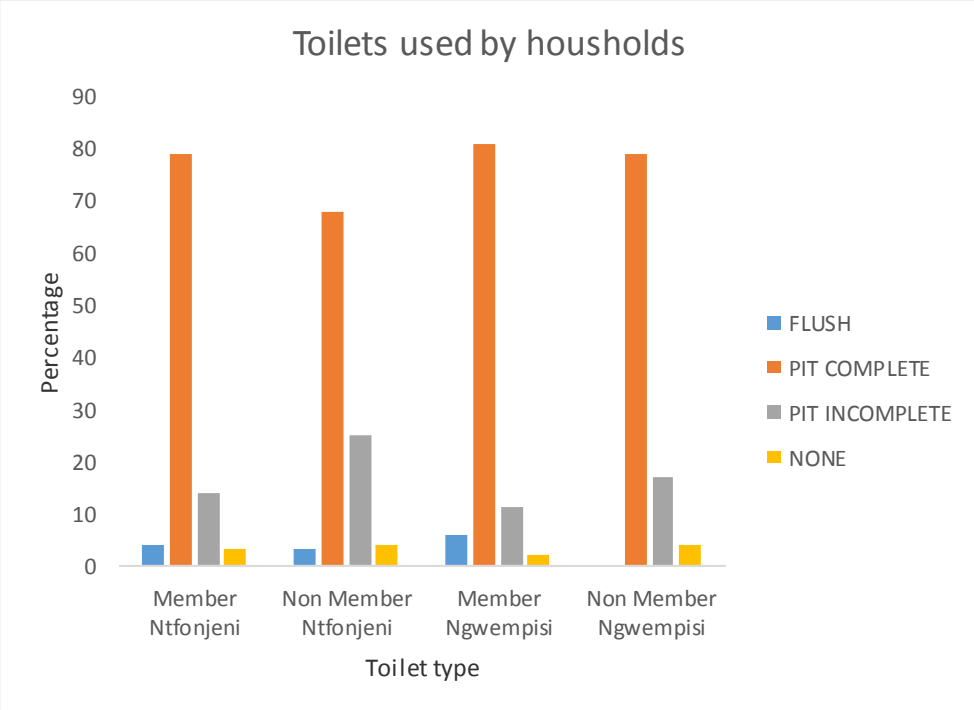

Figure 5: Toilets used by households

4.2.5 Poverty by access to safe drinking water

Safe water refers to water piped to homesteads, protected springs and wells (SHIES, 2010). Safe water allows individuals to avoid water-borne diseases and access to safe water is an indicator of improved quality of life (SHIES, 2001). Unsafe water is water from dams, unprotected spring and well which can be also be used by animals such as cows, goats and dogs. Unsafe water is also not protected from human water pollution which results in contamination.

Results in Figure 6 reveal that 76% of members in Ntfonjeni had piped water compared to 57% on non members. The Ngwempisi area registered lower numbers of 31% and 15% for both types of households respectively indicating that they accessed unsafe water from streams and rivers. The overall difference between the two groups in both areas was significant suggesting that member households were better off than non members. When comparing results with SHIES 2010, there has been an improvement in households accessing piped water by about 5%.

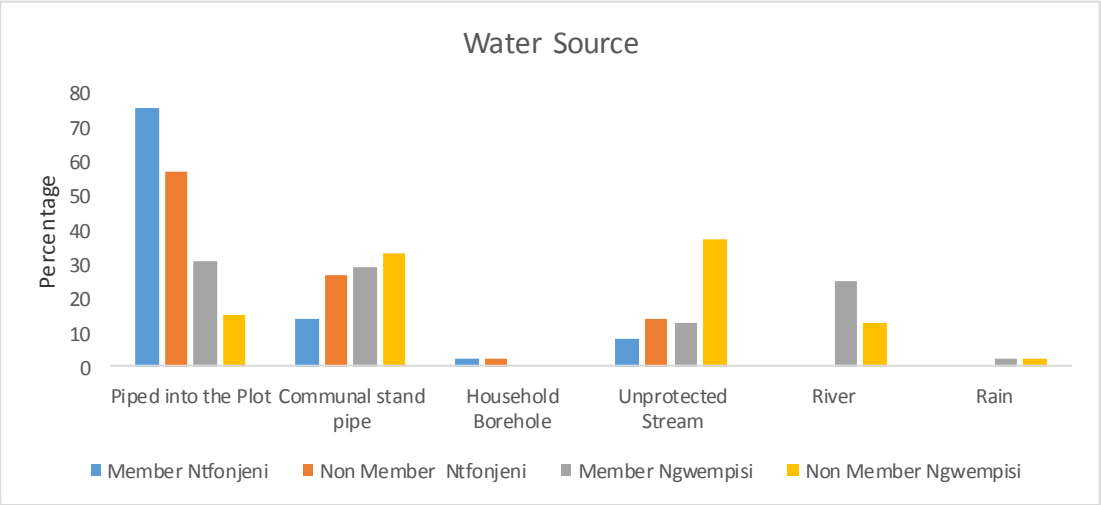

Figure 6: Water sources

4.2.6 Poverty by house type

Results presented in Figure 7 indicate that 95% and 85% of members and non members had cement brick houses in Ntfonjeni. However, in Ngwempisi, it was 86% and 72% respectively. The difference between the two groups in both areas was significant suggesting that member households were better off compared to non- members. The last SHIES report and the Annual Vulnerabity Assessment report (Swazi VAC) had no report on the type of housing used by rural households, hence it is difficult to state whether there has been an improvement or not in housing in the country.

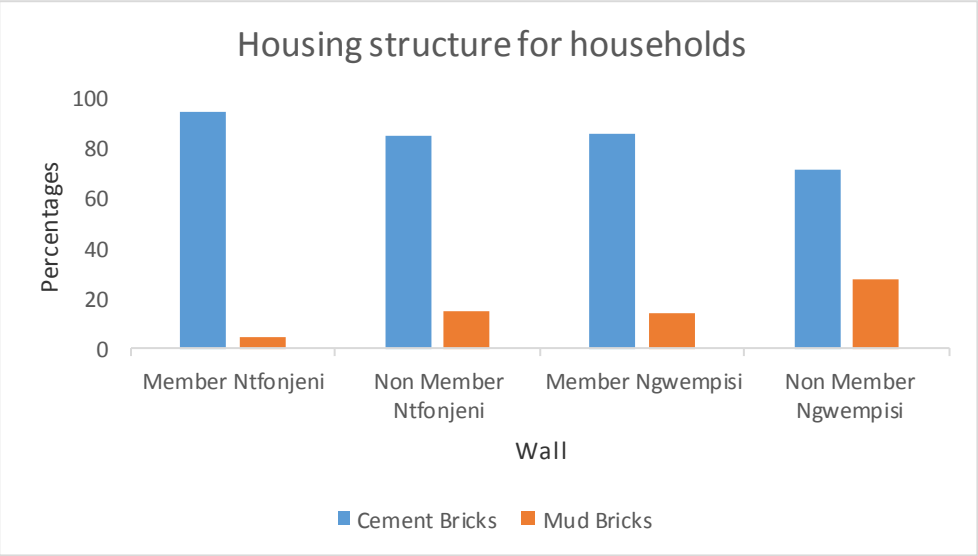

Figure 7: household structures

4.2.7 Poverty by household assets

Another measure of poverty is through possession of household assets. Asset possession is an indicator for welfare in the sense that the households which own such assets are assumed to better in terms of poverty level as compared to those who cannot afford to purchase such items (SHIES, 2001). Results in Figure 8 reflect ownership of a wide range of durable goods. Assets for production were tractor and ox plough. It should be noted that a hand hoe was omitted since 97% of all the households had at least two hand hoes for farming. Compared to non members, it was noted that members had significantly higher numbers of productive assets such as tractor and ox plough. However when compared 2010, there has been a 4% increase in the number of households owning tractors. Members also had significantly higher numbers of vans, with a 3% increase in ownership.

The number of households owning fridge and TV had increased by about 15% however it was still noted that members were better off in possession of TV and Fridge as compared to non members. There was no significant difference in possession of cellphone by members and non members as most households seemed to possess it, however when compared to 2010 there had been an increase of cellphone possession by 9%. However it was noted that assets such as grinder, computer and household boreholes were scanty for both members and non members.

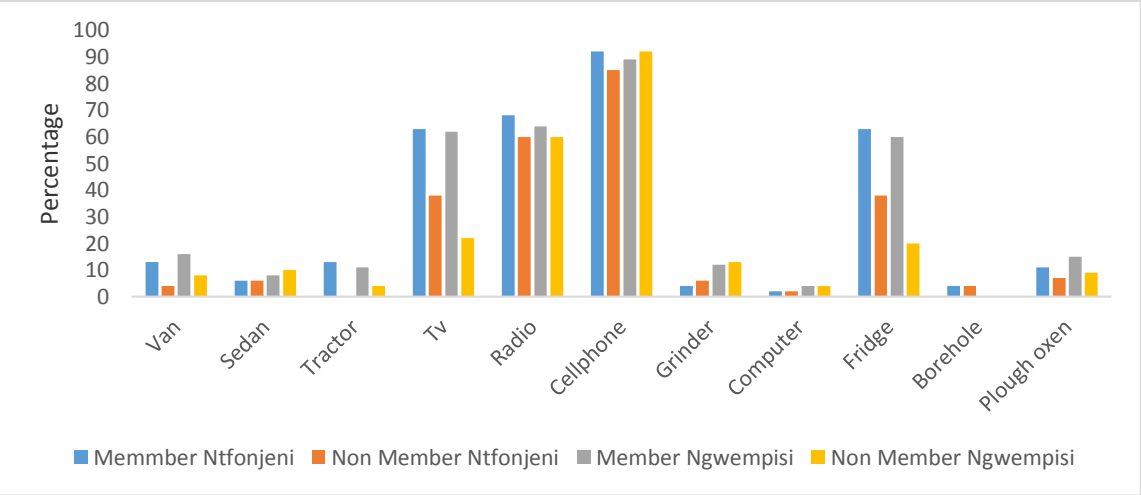

Figure 8: Asset ownerships of households

4.3 Factors influencing participation in irrigation schemes

Participation in irrigation schemes is an important platform for joint learning and technology transfer (Martey *et al*., 2013). The dependent variable was membership or participation in the irrigation scheme which assumed binary value taking 1 if household is participating and 0 otherwise. The Logit model results of factors influencing participation in irrigation schemes are presented in Table 11.

Table 11: Logit model results for factors influencing participation

Membership	Coefficient	Std. Err.	Z	P>|Z|	Marginal effects
Distance	-1.483	0.569	-2.60	0.009***	-0.046
Household size	-0.322	0.226	-1.42	0.155	-0.009
Sex	-1.590	1.258	-1.26	0.206	-0.049
Age	0.063	0.053	1.18	0.080*	-0.001
Marital	0.304	1.443	0.21	0.833	0.009
Education	0.108	0.162	0.67	0.504	0.003
Occupation	5.925	1.991	3.50	0.003***	0.183
Nonfarm Income	0.001	0.002	0.05	0.962	0.397

Table 11 Continued

Membership	Coefficient	Std. Err.	Z	P>|Z|	Marginal effects
Livestock	-0.004	0.043	-0.10	0.920	-0.001
Extension	-3.187	2.047	-1.56	0.120	-0.098
Market	1.904	1.662	1.15	0.252	0.059
Credit	8.671	3.075	2.82	0.005***	0.268
Farm size	1.24	0.484	2.57	0.010**	0.038
Other group	-2.710	1.451	-1.87	0.062*	-0.084
Constant	-6.849	4.466	-1.53	0.125	

Number of obs = 190 LR chi2(12) = 224.46
Prob > chi2 = 0.0000 Pseudo R2 = 0.8522

*,**,***: refers to significance at 10, 5 and 1% level, respectively

Membership participation in small holder irrigation schemes is significantly influenced by households distance to the scheme, age, occupation of household head, farm size and access to credit and memberships in other groups. The results indicate that marital status, sex, education level, household size, extension, market access and non-farm income and livestock ownership had no influence with the household head decision to participate in membership of irrigation development.

The relationship between age and choice to participate in smallholder irrigation schemes (SHIS) was negative. A unit increase in age of household head significantly decreased the likelihood of the households head participation in irrigation scheme by 0.1%. Similar results were obtained by Martey *et al.,* (2013) that younger household heads were more innovative in terms of technology adoption and are more likely to take risk than older household heads. However, on the contrary, studies by Etwire *et al.*, (2013); Khalherili (2008) and Oladele (2013) established that age was not significant in the household head decision to participate in agricultural projects.

Distance to the scheme significantly influenced of households head decision to participate in SHIS. However, the relationship is negative, which means that households that are

near to the scheme are more likely to participate as compared to households that are located far. A one kilometer increase in distance significantly decreased the likelihood of the households head's participation in irrigation schemes by 4.6%. However, Asayehegn (2011), found that distance had no impact on participation in Ethiopia.

Farm size significantly influenced the probability of participation. A unit increase in farm size significantly increases the likelihood of the households head participation by 3.8%. This means that households who have access to more land are more likely to participate in the scheme as compared to households who have less land. Martey *et.,al* (2013); Mohammed and Jema, (2013) and Nxumalo and Oladele (2013), also observed that farm size influenced the household heads decision to participate in agricultural projects.

Access to credit is associated with a positive effect on participation in SHIS. The probability of participation in SHIS by a household head with access to credit was higher than those without access to credit. A unit increase in credit significantly increases the likelihood of the households head participation by 26.8%. The result is consistent with the findings by Martey et al., 201; Asante *et al*., (2011); Nxumalo and Oladele (2013) and Etwire *et al*., (2013). Access to credit enables farmers to overcome their financial constraints associated with production and adoption of innovations. It also encourages group formation and learning. Occupation was associated with a positive effect on participation in SHIS. The effect on participation in SHIS by a household head with no other job except farming (peasant farmers) was 18.3% higher than those other sources of income. The result is consistent with the findings by Mohammed and Jema (2013). This is plausible because the main activity in rural areas is agriculture hence farmers are more likely to participate in agricultural projects which can change their wellbeing. Finally, membership in other groups had a negative effect on participation. The likelihood of participation by households with other community groups was less by 8%. This means that engaging in irrigation schemes is time consuming and leaves little time for participating in other self-help groups.

4.4 Impact of irrigation on household poverty reduction

4.4.1 Propensity Score Matching (PSM)

Table 12 represent the logit model which was used to create the counterfactuals for matching and the outcome variable was consumption per equivalent adult. Matching of members

to non members was based on distance to the scheme, occupation, education and farm size. These are the variables which both groups had similar characteristics suitable for matching. The average treatment effect of the program was then calculated as the mean difference in outcomes across these two groups.

Table 12: psmatch2 logit results

Variables	Coefficient	Z	Std. Err.	P>|Z|
Distance to scheme	-0.287	-2.03	0.141	0.042**
Family size	-0.076	-1.08	0.071	0.282
Age	0.017	1.06	0.016	0.289
Sex	-0.156	-0.34	0.457	0.733
Occupation	4.443	2.75	0.458	0.003***
Education	0.110	0.94	0.055	0.063*
Farm size	1.314	6.14	0.214	0.000***
Livestock	-0.011	-0.55	0.020	0.581
Other group	0.306	0.76	0.401	0.445
Nonfarm Income	-0.005	-0.75	0.007	0.455
Constant	-2.504	-1.95	1.286	0.052*

Number of obs = 190
LR chi2(10) = 83.11
Prob > chi2 = 0.0000
Pseudo R2 = 0.3155
Log likelihd =- 90.1432

*,**,***: refers to significance at 10, 5 and 1% level, respectively

4.4.2 Average Treatment Effects on consumption expenditure and income

To identify the impact of access to irrigation scheme, the average a monthly consumption expenditure was compared for members and non members. The result obtained indicate that, the average monthly consumption expenditure of irrigation scheme members was SZL572.02 which is equivalent to 572.02 South African rands or US$57, was higher than non members, SZL 448.48. This implied that, the irrigation access increased the per capita consumption expenditure of scheme members by SZL 123.52 or by 21%. Households who are members of irrigation

scheme have better annual income as compared to non members, and this extra income enables those households to meet the daily to daily expenses, (Mohammed and Jema, 2013)

The result obtained indicate that the average monthly income of members, SZL 1900, was higher than non-members which was SZL 1507. This implied that, the irrigation access increased the monthly income of scheme members by SZL 392 or by 31%. Results are consistent with findings for Hussain (2006), Asayehegn (2011), Gataneh (2011) and Amaza (2008). According to Gataneh (2011), members of irrigation scheme in Ethiopia had their income increases by 27% as compared to the non members. Access to irrigation has a direct impact on the household income which also provide employment opportunities for farmers (Lipton, 2003; Hussain and Wijerathina 2004; Hussain 2006; and Mahmood and Khan 2012). The additional income enables farmers to purchase high yielding varieties of seeds and other necessary inputs to improve production

Table 13: Average treatment Effects on consumption expenditure and income

Variable	Sample	Treated	Controls	Difference	S.E.	*t*-stat
Consumption Expenditure	Unmatched	572.02	342.173	229.84	60.35	3.81
	ATT	572.02	448.48	123.53	82.67	1.49
Income	Unmatched	2389.43	1580.7	808.68	355	1.18
	ATT	1900	1507.80	392.19	592	0.66

Region of common support

This condition ensures that treatment observations have comparison observations nearby in the propensity score distribution (Heckman, LaLonde, and Smith 1999). Results in table 13 indicate that there were no cases that were outside the region of common support. This means that the treatment group was therefore similar to non treatment group in terms of observed characteristics unaffected by participation hence no units were dropped. Heckman, Ichimura, and Todd (1997) encourage dropping treatment observations with weak common support. Only in the area of common support can inferences be made about causality.

Table 14: Region of common support

Treatment assignment	Off support	On Support	Total
Untreated	0	95	95
Treated	0	95	95
Total	0	190	190

Covariate imbalance test

After matching the results, the covariate imbalance were checked and a ps-test command was used. The ps-test shows the percentage reduction in bias which is the standardized biased. A good bias reduction is supposed to be below 5%, however 10% is also reasonable (Rosenbaum and Rubin, 1983). The variables after matching are not supposed to be significant. Results in Table 14 indicate that after matching there was less bias in the covariates which was below 10% and all variables were insignificant after matching. U represents unmatched, and M represents matched.

Table 15: ps-test for covariates

Variable	Matching	Matched	Treated Control	%bias	% reduction |bias|	T	p>t
Distance to scheme	U	1.9061	2.7941	-42.2	73.9	-2.91	0.004
	M	1.9061	1.6742	11.0		1.40	0.164
Family size	U	6.3263	5.9789	12.7	78.7	0.87	0.383
	M	6.3263	6.2526	2.7		0.18	0.858
Age	U	54.284	51.126	22.3	39.0	1.54	0.126
	M	54.284	52.358	13.6		1.00	0.317
Sex	U	.69474	.61053	16.9	100	1.16	0.246
	M	.69474	.69474	0.0		-0.00	1.000
Occupation	U	.67368	.61053	13.1	33.3	0.91	0.367
	M	.67368	.63158	8.8		0.61	0.545
Education	U	7.2632	6.3789	19.8	65.5	1.37	0.174
	M	7.2636	6.9579	6.8		0.46	0.645
Farm size	U	2.8316	1.3247	137.8	93.6	9.50	0.000
	M	2.8316	2.7353	8.8		0.60	0.550

Table 15 Continued

Variable	Matching	Matched	Treated Control	%bias	% reduction |bias|	T	p>t
Livestock	U	6.6105	4.8526	16.3	31.7	1.12	0.263
	M	6.6105	5.4105	11.1		1.03	0.303
Other group	U	.41053	.32632	17.4	50.0	1.20	0.231
	M	.41053	.45263	-8.7		-0.58	0.560
Nonfarm Income	U	1880.3	1626.8	9.8	93.3	-0.04	.9670
	M	1.880.3	1895.9	-0.6		0.74	0.462

Sample	**Pseudo R2**	**LR chi2**	**p>chi2**	**Mean Bias**	**Med Bias**
Raw	0.31	83.11	0.000	29.9	17.2
Matched	0.027	7.02	0.072	8.1	8.8

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

In this chapter conclusions, the implications and recommendations are presented. The main purpose of the study was to assess the impact of smallholder irrigation schemes on poverty reduction and reduction in Swaziland. The results have revealed that smallholder irrigation schemes have a potential to reduce poverty especially for rural farmers. The poverty incidence levels and poverty gap for members of smallholder irrigation schemes were significantly lower than non members. The schemes also contribute towards improving household food security, which was reflected by the significantly lower food poverty incidence among members.

It was further demonstrated that not only was the poverty incidence better for members, but also the socio-economic status of the members was better off as compared to the non-members. Likewise, members are better off in terms of income, access to electricity, possession of durable goods, housing, water and sanitation as compared to the non members. Therefore, it can be concluded that smallholder irrigation schemes contribute towards household expenditure, income, and improves the standard of living of the rural poor and make them to be self-sustaining. This is due to the indirect benefits that members obtain from participating in these schemes such as employment opportunities and ease access to credit.

Factors which influenced household decision to participate were distance to the irrigation scheme, occupation, farm size, other group membership access to credit and age of household head. The impact of the irrigation scheme in terms of consumption expenditure of households was higher for members, indicating a positive impact of the irrigation schemes towards poverty

reduction. Hence it can be concluded that small holder irrigation schemes play a crucial role in improving the standard of living of the Swazis.

5.2 Recommendations

There is a need for government to continue in rehabilitating and expanding smallholder irrigation scheme in the Swaziland due to the significant contribution of these schemes in poverty reduction, especially the consumption expenditure of the households which are members. This is mainly because, irrigation is one alternative way to improve and sustain food production and hence consumption expenditure of rural households. However, though there was poverty reduction in irrigation schemes, there is dire need for a comprehensive structure to engage all stakeholders to improve production. This could involve inputs suppliers, extension, credit, markets and farmers. There is an urgent need to develop a complete value chain for produce from irrigation schemes. This policy will ensure a wholistic approach of rural development in the agricultural sector.

Lastly, it is evident that access to credit positively influenced the households decision to participation, hence it is very important to provide credit access among rural households by establishing more microfinance and credit services. This will improve production as peasant farmer cannot afford to buy the necessary quality inputs to improve production.

5.3 Areas for future research

It is recommended that a study should be conducted on other factors that may reduce the poverty levels in Swaziland in order to achieve MDG 1. There is also a need for a study which will focus on the sustainability of all the irrigation schemes in Swaziland and evaluation of all the RDAs to find out if they are efficient.

Finally, small holder irrigation schemes were introduced without carrying out the SWOT analysis, therefore it is recommended for future research to consider the SWOT analysis of the irrigation schemes

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Questionnaire No._____

APPENDEX 1 :QUESTIONNAIRE

IMPACT OF SMALL HOLDER IRRIGATION SCHEMES ON POVERTY REDUCTION IN SWAZILAND. A CASE OF NTFONJENI AND NGWEMPISI RDA

Please read the following consent form

My name is ..... We are collecting information here in your community for the above topic. I would like to ask you to participate in a one –to one interview, to help us in assessing the impact of irrigation poverty reduction. The discussion will take two hours and your neighbours are also expected to participate. I request you to answer all questions truthfully and there is no benefit, money or compensation which you will get from participating in the study. You may refuse to participate and that will not affect your family. However we hope that this research will benefit Swaziland by improving policies implemented by the government towards the agriculture sector which forms the backbone of the economy.

NB: Information collected here is confidential, only the researcher can access it. We request that you permit us to record your name on questionnaire.

If you have any questions for me about this study, you may ask any time.

Interviewer's signature: _____Date:_____

Enumerators signature: _____Date:_____

Supervisors signature: _____Date:_____

Remarks

1. Completed
2. No household member at home at time of visit
3. Entire household absent for extended period of time
4. Postponed
5. Refused

SECTION 1: Identification

1. Enumeration Area: 1= Velezizweni 2= Lushikishini 3= Kandwandwe 4= Mvembili
2. Homestead No.:_____
3. Household number (Distance to scheme):_____
4. Total number of household members :

SECTION 2: Demographic characteristics

Current Household Member (start with household head)	Name of household member	Sex 1= male 2= female	Age	Marital status of household member 1= Married 2= Divorced 3= Widower (M) 4= Widow (F) 5= Single 6= Not applicable (below marital age)	Education level 1= illiterate 2=Pree-school 3= Sebenta 4= Primary 5= Secondary 6= High 7= Tertiary 8= Not attending ***(applicable to child within school attending age)***	Occupation 1= Wage employed 2= Farmer 3= Self employed 4= Labourer 5= Pensioner 6= Unemployed 7= Scholar 8 = Infant (below 6 years)	Health status of member of the household For the last 12 months did member had illness which prevent him/her to fully perform duties in current job 1= Yes 2= No	Medical treatment 1= Regular go to doctor 2=go to doctor but does not take regular medicine 3= no doctor no medicine	Estimated monthly income
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									

SECTION 3: EDUCATION EXPENSES

List all household members that have been in school in the last 12 months										
Household members currently attending school	**Education level** 1=Pree-school 2= Sebenta 3= Primary 4= Secondary 5= High 7= Tertiary	**Who is responsible for fees** 1=Parent 2= Self 3=Relative 4=GOVT 5=NGO 4=Other	**EXPENDITURE** How much was spent in each of the following						TOTAL	Any Gifts And Value In Kind Goods
			School fees or top-up	**Books and Stationery**	**Boarding/ Rental**	**Exam**	**Transport and pocket money**	**Uniforms**		
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										

SECTION 4: INCOME AND EXPENDITURE SUMMARY

What are the main sources of Expenditure for the household?

	EXPENDITURE	**Monthly**		**EXPENDITURE**	**Monthly**		**Monthly**
FOOD ITEMS How much does the household spend on food ……	Staple food *(maize)*		**Education**	School fees		Women clothing	
	Other cereals *Rice and samp*		**Other Monthly expenses** ……	Electricity		Children clothing	
	Chicken			Firewood		Men clothing	
	Beef			Water		Milk baby	
	Pork			Cell phone credit		Disposable...baby	
	Fish (Fresh)			Life insurance		Cigarettes	
	Fish (Tin)			Car insurance		Alcohol	
	Beans and other legumes			Car premium		Entertainment	
	Fruits			Life Premium		Others [state]	
	Vegetables			Medical aid			
	Soup and spices			Rotary clubs			
	Oil			Transport			
	Milk			Furniture (cash)			
	Milk (Powder)			Repayment of furniture loan			
	Sugar			Jet			
	Bread			Ds-tv			
	Eggs			Truworths			
	Jam , margarine			SNAT			
	Roots and tubers						
Medical Expenses ……	Hospital bills Medical Aid			Toiletry			
	Traditional healing			Rent			
	Burial and marriage expenses			Cleaning items			
Farming ……	Seeds			Bedding			
	Fertiliser			Make-up			
	Tractor hire			Appliances			
	Labour			Utensils			
	Other						

What are the main sources of income for the household?

INCOME	**Monthly** *If weekly convert to month*	**INCOME**	**Monthly** *If weekly convert to month*
Wages earned by people living in homestead		Crop sales [state]	
Money sent by people living away from homestead		Retail shop	
Saloon		Handcraft	
Livestock sales [state]		Social Grant	
Tractor hire		Pension	
Oxen hire		Inheritance	
Transport operator [circle] bus, kombi, taxi, for hire		Hawker	
Traditional healing		Repairs [state]	
Brewing or Bottle store/ Bar		Others [state]	

SECTION 5: FOOD CONSUMPTION Key Data on Food Consumption (recall - past 7 days)

	v1	v2	v3			v4	v5		v6		v7	
Over the past one week (7 days), did the household acquire, purchase or consume any [ITEM]?	Yes = 1 No = 2 *If No => next item*	ITEM CODE	How much was purchased? QUANTITY	UNIT CODE	VALUE (E)	How much of the purchased quantity was consumed? QUANTITY	How much was consumed from own production? QUANTITY	UNIT CODE	How much was consumed from own stocks? QUANTITY	UNIT CODE	How much was consumed from gifts and other sources? QUANTITY	UNIT CODE
Bread and Cereals												
White Bread		001		Loaf/grams/ Kilograms								
Brown Bread		002		Loaf/grams/ kilograms								
Breakfast Cereals		003		Grams								
Biscuits		004		Grams								
Cake		005		Grams/kg								
Wheat Flour		006		Grams//kg								
Maize Flour (imphuphu)		007		Kg								
Broken Maize		008		Kg								
Samp (sitambu)		009		Kg								
Spaghetti/Macaroni		010		Grams								
Sorghum Meal		011		Kg								
Rice		012		Kg								
Other (please specify)		013										
Meat												
Beef		014		Kg								
Chicken		015		Kg								
Turkey		016		Kg								
Goat Meat		017		Kg								
Mutton		018		Kg								
Pork		019		Kg								
Game (inyamatane)		020		Kg								
Sausages		021		Grams								
Tinned Meat		022		Grams								
Castings (ematfunbu)		023		Kg								
Rough Tripe		024		Kg								
Other Offal		025		Kg								
Other (please specify)		026										
Fish												

Canned Fish		027		Grams								
Fresh / Frozen Seafood		028		Kg								
Dried and Smoked Fish		029		Grams								
Other (please specify)		030		Grams/kg								

	V1	**v2**	**v3**			**v4**	**v5**		**v6**		**v7**	
Over the past one week (7 days), did the household acquire, purchase or consume any [ITEM]?	Yes = 1 No = 2 *If No => next item*	ITEM CODE	How much was purchased? QUANTITY	UNIT CODE	VALUE (E)	How much of the purchased quantity was consumed? QUANTITY	How much was consumed from own production? QUANTITY	UNIT CODE	How much was consumed from own stocks? QUANTITY	UNIT CODE	How much was consumed from gifts and other sources? QUANTITY	UNIT CODE
Milk, Cheese and Eggs												
Fresh Milk		031		litres								
Sour Milk		032		litres								
Skimmed Milk		033		litres								
Powdered Milk		034		grams								
Powered Baby Milk		035		grams								
Cheese		036		grams								
Cream		037		grams								
Yoghurt / Yogi Sip		038		grams								
Eggs		039		dozen								
Other (please specify)		040										
Oils and Fat												
Butter		041		grams								
Peanut Butter		042		grams								
Cooking Oil		043		litres								
Lard/Dripping		044		grams								
Margarine		045		grams								
Other Vegetable Oil		046		litres								
Other (please specify)		047										
Fresh Fruits												
Apples		048		Kg								
Apricots		049		Kg								
Avocados		050		Kg								
Bananas		051		Kg								
Grapes		052		Kg								
Lemon/Lime		053		Kg								

Mangoes		054		Kg								
Mulberries		055		Kg								
Oranges		056		Kg								
Pawpaws		057		Kg								
Peaches		058		Kg								
Pears		059		Kg								
Pine Apples		060		Kg								
Plums		061		Kg								
Strawberries		062		Kg								
Other fresh fruit (please specify)		063		Kg								
Tinned Fruits												
(please specify)		064		Grams/kg								
	V1	**v2**	**v3**			**v4**	**v5**		**v6**		**v7**	
Over the past one week (7 days), did the household acquire, purchase or consume any [ITEM]?	Yes = 1 No = 2 *If No => next item*	ITEM CODE	How much was purchased? QUANTITY	UNIT CODE	VALUE (E)	How much of the purchased quantity was consumed? QUANTITY	How much was consumed from own production? QUANTITY	UNIT CODE	How much was consumed from own stocks? QUANTITY	UNIT CODE	How much was consumed from gifts and other sources? QUANTITY	UNIT CODE
Dried Fruits												
(please specify)		065										
Fresh Vegetables												
Beetroot		066		Kg								
Cabbage		067		Kg								
Carrots		068		Kg								
Cauliflower		069		Kg								
Cucumber		070		Kg								
Garlic		071		grams								
Green mealies		072		Kg								
Green pepper		073		Kg								
Lettuce		074		Grams/kg								
Mushrooms		075		grams								
Okra		076		grams								
Onions		077		Kg								
Peas		078		grams								
Pumpkin and Squashes (emahwala)		079		Kg								
Pumpkin Leaves (umbhidvo wetintsanga)		080		Kg								
Pepper/Chili		081		grams								

Radish		082		Kg								
Spinach		083		Kg								
Tomatoes		084		Kg								
Ginger		085		Grams/kg								
Turnips		086		Grams/kg								
Other Fresh Vegetables (please specify)		087		Grams/kg								
Tinned Vegetables												
(please specify)		088										
Dried Vegetables												
Beans		089		Kg								
Peas		090		Kg								
Other Dried Vegetables (please specify)		091										
BFrozen Vegetables												
(please specify)		092		Kg								
Nuts												
Peanuts/Groundnuts		093		Grams/kg								
Roundnuts (tindlubu)		094		Grams/kg								
Other (please specify)		095										

	V1	**V2**	**v3**			**v4**	**v5**		**v6**		**v7**	
Over the past one week (7 days), did the household acquire, purchase or consume any [ITEM]?	Yes = 1 No = 2 *If No => next item*	ITEM CODE	How much was purchased? QUANTITY	UNIT CODE	VALUE (E)	How much of the purchased quantity was consumed? QUANTITY	How much was consumed from own production? QUANTITY	UNIT CODE	How much was consumed from own stocks? QUANTITY	UNIT CODE	How much was consumed from gifts and other sources? QUANTITY	UNIT CODE
Potatoes and Tubers												
Cassava		096		Kg								
Potatoes		097		Kg								
Sweet Potatoes		098		Kg								
Other starchy tubers (please specify)		099		Kg								
Sugar and Sweets												
Sugar		100		Kg								
Sweets		101		grams								
Glucose (specify)		102										
Other Foods												
Baking Powder		103		grams								
Chips and Crisps		104		grams								
Chocolate (excl. drinks)		105		grams								
Jam		106		grams								

Jelly and Pudding		107		grams								
Honey		108		grams								
Ice Cream		109		ml/litres								
Salt		110		Kg								
Sauces		111		Grams								
Spices/Seasoning/Soups		112		Grams								
Syrup		113		Grams								
Vinegar		114		ml/litres								
Other (please specify)		115										
Meals Out/Take Away												
Chicken and Chips		116		Grams/kg								
Chicken and Rice		117		Grams/kg								
Hamburger/Sandwich		118		Grams								
Meat Pie/Samosa		119		Grams								
Pap and roasted meat		120		Grams/kg								
Other (please specify)		121										
Coffee and Tea												
Ground Coffee		122		Grams/kg								
Instant Coffee		123		Grams/kg								
Tea Leaves		124		Grams								
Tea Bags		125		Grams								
Chocolate Drink		126		Ml								
Other (please specify)		127										

	V1	**V2**	**v3**			**v4**	**v5**		**v6**		**v7**	
Over the past one week (7 days), did the household acquire, purchase or consume any [ITEM]?	Yes = 1 No = 2 *If No => next item*	ITEM CODE	How much was purchased? QUANTITY	UNIT CODE	VALUE (E)	How much of the purchased quantity was consumed? QUANTITY	How much was consumed from own production? QUANTITY	UNIT CODE	How much was consumed from own stocks? QUANTITY	UNIT CODE	How much was consumed from gifts and other sources? QUANTITY	UNIT CODE
Beverages												
Fruit Juices		128		ml/litres								
Mineral Water		129		ml/litres								
Sodas/Lemonades/Cola		130		ml/litres								
Other Non-Alcoholic Drinks (please specify)		131		ml/litres								
Alcohol and Tobacco												
Beer		132		Ml								

Brandy		133		Ml								
Gin		134		Ml								
Vodka		135		Ml								
Whiskey		136		Ml								
Wine		137		Ml								
Other Alcoholic Drinks (please specify)		138		Ml								
Cigarettes		139		grams								
Cigars		140		grams								
Pipe Tobacco		141		grams								
Chewing Tobacco		142		grams								
Snuff		143		grams								
Other Tobacco (please specify)		144		grams								

SECTION 6: Water and sanitation

What is the main source of water supply of your homestead? [Tick appropriate answer] multiple answers are possible		
Source	**Option**	**Time taken to and from the source (minutes)**
Piped into dwelling	1	
Piped to yard/plot	2	
Communal stand pipe	3	
Community Borehole	4	
Household Borehole	5	
Protected well/spring	6	
Unprotected well/spring	7	
Rain water	8	
Tanker	9	
River/canal	10	
Stream	11	
Dam	12	
Irrigation channel	13	

SECTION 7 : ASSET OWNERSHIP HHD XSTICS

Asset	**Quantity**	**State** 1= usable 2= not usable
Car – van		
Car – sedan		
Tractor		
Planter – tractor drawn		
Planter – ox drawn		
Plough		
Disc harrow		
Cultivator		
Hand hoe		
Scotch cart		
Trailor		
Truck		
Motor cycle		
Bicycle		
Wheel barrow		
Television		
Radio		
Telephone – landline		
Cellphone		
Maize mill		
Borehole		
Computer		
Fridge		

What sources of energy are used by the household? [can have multiple answers]	
Cooking 1 = Wood 2 = Paraffin 3 = Electricity 4 = Handigas 5 = Solar 6 = Generator	**Lighting** 1 = Candles 2 = Electricity 3 = Handigas 4 = Solar 5 = Parafinn 6 = Generator
Toilets used by household	**Housing Structure**
1= Flush	Rooms
2=Pit complete	Wall
3= Pit incomplete	Roofing
4= none	Floor
5= Other	

SECTION 8: AGRCULTURAL ACTIVITIES

How much total arable land does the household have _____(ha)?

Please provide information for the last season (2013/2014)

Type of Crop	**Area planted (ha)**	**Season planted** 1 = summer 2 = winter 3 = both	**Irrigated** 1 = Yes 2 = No	**Source of draught power** 1 = Own tractor 2 = Hired tractor 3 = Own oxen 4 = Hired oxen 5 = Manpower	**Planting cost** **Seeds and manure**	**Fertiliser and pesticides costs**	**Hired labour**	**Quantity harvested**	**Quantity sold** **If none, write *Not applicable***	**Income generated**
Dry maize								*(50kg bags)*	*(/50kg bags)*	
Green mealies								*# of cobs*	*# of cobs*	
Beans								*(ligogogo)*	*(ligogogo)*	
Sweet Potatoes								*(ligogogo)*	*(ligogogo)*	
Sorghum								*(70 kg bags)*	*(/70 kg bags)*	
Cotton								*(bales)*	*(bales)*	
Groundnuts								*(ligogogo)*	*(ligogogo)*	
Jugo Beans								*(ligogogo)*	*(ligogogo)*	
Vegetables [specify]										
Vegetables [specify]										
Vegetables [specify]										
Vegetables [specify]										
Orchard										

Livestock & livestock products	Cattle	Oxen	Goats	Sheep	Indigenous pigs	Commercial pigs	Indigenous chickens	Broilers	Layers
Number currently owned									
Number sold in 2013									
Feed cost									
Medication cost									
Labour cost									
Total income from animal sales ***[Refer to bottom of table]***									

Farm tools purchased and cost ....

Farm repair e.g fencing ....

How would you compare last year's production of cereal crops, cash crops and tubers to previous years?
1 = increased; 2 = decreased; 3 = no change

Agricultural enterprises	Area under cultivation	Yields
Cereal crops		
Cash crops		
Vegetables		

If reduced (1) what were the reasons?

1 = not enough land; 2 = no cash for inputs; 3 = have no interest in crop; 4= lack of training; 5 = no tractor/oxen for ploughing; 6 = not enough time; 7 = market price too low for crop; 8 = takes too long to mature; 9 = low yields; 10 = household head has died; 11 = household head is sick 12= homestead is still new; 13= Shortage of water ; 14drought damage ; 15damage of pest and diseases; 16=labor shortage; 17=damage by wild animals 18=difficulty in renting machinery; 19 = other (specify)…… ……..
[Can have multiple answers]

SECTION 9: LIVELIHOODS

What are the main sources of food for the household?

[Tick in relevant box for each, however, note where you are required to state in writing]

Source of food	**Most important**	**2nd most important**	**3rd most important**
Purchased food			
Own crop production			
Own livestock production			
Food aid [source]			
School feeding			
Labour exchange			
Others [state]			

SECTION 10 A SHOCKS AND FOOD SECURITY

Did you experience any unusual food shortages during 2013? 1 = Yes 2 = No. If yes, identify 5 major problems that led to the food shortage and rank them in the order of importance

Codes	**Cause of food shortage**	**Rank**
1	Drought/irregular rains, prolonged dry spells	
2	Death of bread winner	
3	Serious illness of bread winner	
4	Loss of employment of breadwinner	
5	Reduced income of a bread winner	
6	Unusually high prices of food	
7	Unusually high level of human disease [state]	
8	Theft of productive resources [state]	
9	Relocation of family	
10	Cut off remittances for relatives not staying in homestead	
11	Floods	
12	Other [specify]	

SECTION 10 B: COPING STRATEGIES

Which of the following coping strategies did the household use when there was food shortage?

[Use the following codes in the last column] 1 = Never; 2 = Sometimes; 3 = Often	
Consumption strategies	
Borrowed money to buy food	
Bought food on credit	
Relied on less preferred foods as a substitute for maize	
Members reduced the number of meals eaten per day	
Members reduced the quantity eaten (portions) per day	
Members skipped entire days without eating due to lack of food	
Eaten unusual types of wild food that are not normally eaten	
Restricted consumption of adults so that children can eat normally	
Slaughtered more livestock than normal for food	
Send members to beg for food	
Eating of cereal seed (otherwise meant for planting)	
Eaten all maize green and nothing left for harvest	
Avoided spending on healthcare in favour of buying food	
Reduced expenditure on education to buy food	
Reduced expenditure on crop and livestock inputs	
Took children out of school	

SECTION 11: MARKETING AND FINANCE QUESTIONS

1. Are you a member of the local irrigation scheme
.....Yes=1 .....No=2
.If no why
?.....
.....

2. Are you a member of any other group: (please state).....
.....

3. What do you use to water your crops
.....Rainfall=1 .....Irrigation=2 .....Irrigation plus rainfall=3

4.How much area is irrigated.....
5.How much area is rain fed.....

6. Years involved in farming.....
7. Skills acquired if any.....
8. What is the main source of information .....
.....

9. When do you sell your crops/veg
. .....Rainy season=1 .....dry season=2 .....both =3

9What are the outlets of your produce
.....NAMBoard=1 .....local=2 .....Town markets=3

10,a) If NAMBoard is part of your market ,what other services have u benefited from NAMBoard
....
....
10, b) If NAMBoard is not part of your market what are the reasons behind
....
.....

11. What have you benefited from the Ministry of Agriculture?
....
.....

12. How many times do you see an extension officer per month and from which organization?
....
....

13.What are the sources of credits available to you
.....Commercial banks (State) .....Fincorp
.....Informal Loans .....Never tried

14. What are the obstacles in accessing loans?

.....Collateral .....Legal Requirements .....Imperfect information .....Never tried .....Other

15 What are the most challenges that you face as a small holder Farmer
....
....

16. What are the advantages of working as a scheme (collective farming) as compared to working individual?
....
....
17. What are other development projects that you have benefited after the scheme was developed.
....
.....

Irrigation schemes have the potential to reduce poverty.
Justify**.....**
.....
.....
.....

THANK YOU !!

1.**FACTORS INFLUENCING FARMERS PARTICIPATION IN SMALLHOLDER IRRIGATION SCHEMES IN SWAZILAND: THE CASE OF NTFONJENI RURAL DEVELOPMENT AREA h**as been ACCEPTED to be published with **Journal of Economics and Sustainable Development,** ISSN (Paper)2222-1700 ISSN (Online)2222-2855.

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