UNISA university of south africa

COLLEGE OF AGRICULTURE AND ENVIRONMENTAL SCIENCES

DEPARTMENT OF GEOGRAPHY

Socio- economic impact assessment of Lower Gweru Irrigation scheme in Zimbabwe.

By

Kaitano Dube

A thesis submitted in partial fulfilment of the requirements for the degree of Master of Science in Geography

Supervised by

Professor S.E. Mini

The Socio economic impact assessment of Lower Gweru Irrigation Scheme in Gweru Zimbabwe

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Kaitano Dube

Submitted in accordance with the requirements for
the degree of

Master of Science

In the subject

Geography

at the

University of South Africa

Supervisor: Professor S.E. Mini

November 2012

46592385

I declare that the dissertation hereby submitted by me for the qualification Masters of Science in Geography at the University of South Africa is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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Vol/Issue

School Code

MASTER'S DEGREE DATA

5. Full name of university conferring degree, and college or division if appropriate
University of South Africa College of Agriculture and Environmental Science

6. Abbreviation for degree awarded
DFGGR91-12-Y1

7. Year degree awarded

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ACKNOWLEDGEMENTS

I would like to extend my deepest appreciation to Professor S. E. Mini for his invaluable guidance and wisdom throughout the research process. May God bless him and his family. Secondly I would like to thank Mr F.Chidavaenzi (Agricultural Engineering Chinhoi and Mr S. Jeri from Midlands State University for their assistance in the conducting of this research study.

Further appreciation is extended to the Lower Gweru irrigation scheme farmers and the community leadership for affording me your time from your busy work, without your cooperation this research project would not have been possible.

Last but not least I would like to thank GOD for giving me the strength and resources to conduct this thesis.

Abstract

This study aimed at examining the social and economic impact of rural irrigation schemes with a particular focus on the Lower Gweru Irrigation scheme. The general objective of this study was to assess if rural irrigation schemes can act as livelihood security assets in transforming rural livelihoods, reduce poverty and attain food security in light of climate change.

Results are based on findings from self-administered questionnaires directed at farmers and irrigation stakeholders, and face to face interviews involving farmers and stakeholders. Using Statistical Package for the Social Sciences, Microsoft excel and Health 24 web BMI calculator it was concluded that; Lower Gweru schemes, is a source of livelihood security securing food security, reduce poverty and creates rural employment. Regardless of various challenges faced by rural irrigation farmers, irrigations act as poverty and climate change buffers, providing an opportunity for communities to raise their Human Development Index and attain sustainable development.

Key Words

Food security, livelihood security, irrigation farming, sustainable development, Human Development Index, agriculture, climate change, poverty reduction, Zimbabwe, Lower Gweru

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Chapter 1 : Research Context

1.1 Introduction and Background

Despite the remarkable expansion of irrigated agriculture in Africa and Zimbabwe which brought dramatic increases in aggregate food production in the past three decades, there remain vast areas in the established rural irrigation schemes where productivity and incomes of farmers remain generally low and highly variable. This is attributed to a number of factors, including inequitable access to water, poor management, and a range of other physical, socio-cultural and economic constraints (Girmay et.al. 2000). The efforts of developing countries such as Zimbabwe to address poverty reduction in these specific areas have been limited and ineffective due to the lack of proactive policies, actions, knowledge of how alternative economic, institutional, governance, and technical interventions can address poverty related constraints. However , in the face of increasing water scarcity caused by climate change ,climate variability and ever increasing demand for food , many developing countries in the Sub-Saharan region are gearing up for major policy and institutional reforms to optimise the management of their water resources.

Enhancing the productivity of poor farmers in rural areas is a priority to all development agencies. These areas are most vulnerable to the impacts of climate change, climate variability and related water scarcity CRS, (1999). Poverty eradication and irrigated food production is now the shared goal of donors including the African Development Bank, Reserve Bank of Zimbabwe, the Government of Zimbabwe and other research and development institutions. Since the bulk of the poor people in Africa and Zimbabwe still live in rural areas and are largely dependent on agriculture for food, income and livelihoods it is logical to focus on how rural irrigation schemes are performing in the context of rural poverty and livelihood security is concerned (Manzungu and van der Zaag, 1996).

Studies carried out on rural irrigation schemes points to conflicting conclusions with regard to benefits derived from them. Some donor agencies such as FAO in (2006) and academics who include Gulilaat, (2002) and Mate (2006) point out to strong rural irrigation significance whereas others lampoon rural irrigation schemes as sheer waste

of tax payer's money. The impact of rural irrigation schemes is a controversial issue as evidenced in countries such as Ethiopia and Zambia recently. Whilst there is empirical evidence that irrigation development has a substantial impact on livelihood security and poverty reduction, it's becoming increasingly clear that such impact is determined by the type of irrigation agriculture, scheme size, the type of operation and maintenance, the system of water allocation, etc. The above factors can play an important role in determining the eventual impact on the beneficiaries Manzungu et al. (1996).

A review of literature reveals an over emphasis on economic efficiency of established rural schemes at the expense of a human development approach that focuses on human livelihood contribution of rural irrigation schemes. This happens at a time when there is an increased interest in poverty alleviation and governments worldwide especially in developing countries need to take strategic decisions in the wake of increased climate change, hunger and poverty, hence the need to take strategic decisions on future investments in irrigation FAO, (2006).

This study is necessitated by the need to help understand the linkages between Insukamini irrigation development and poverty reduction in Lower Gweru. The study is also aimed at proposing recommendations on how to increase the socio economic impact of rural irrigation schemes on household and rural livelihood security. Through a socio economic assessment of the Insukamini irrigation scheme the study aims to provide a framework for analyzing socio- economic impacts of rural irrigation schemes and to review some evidence of these impacts. It is hoped that through this research the findings and recommendations can help in shaping future investment strategies in rural irrigation schemes.

1.2 Spatial Background

The Insukamini Irrigation Scheme is located in the Lower Gweru communal area in Gweru District of Midlands Province. It is about 46 km North West of the town of Gweru. It falls in Natural Region IV of Zimbabwe's ecological zones. Natural region IV and V are associated with frequent droughts and their soils and topography are poor. These regions are too dry for successful crop production without irrigation but

communal farmers have no other choice but to grow crops in these areas even without access to irrigation. Millet and sorghum are the common crops but maize is also grown. Communal farmers occupy 50% of the area of natural region IV and 46% of the area of natural V , a region in which agriculture is severely limited by inadequate rainfall. This makes irrigation important in this region for any meaningful crop production. The scheme utilizes a semi- portable sprinkler irrigation system. Upon establishment the scheme was divided into three blocks A, B and C having 47, 60 and 57 farmers respectively. Since the opening up of the scheme a total of 15 people have been added to the scheme and plans are underway to add more people to the scheme and land clearance is taking place. Plot sizes are 0.5 ha in blocks A and B and 0.3 ha in block C. About 58% of the irrigators are women.

Following the construction of the Insukamini Dam, The Government of Zimbabwe in 1986 initiated Lower Gweru Irrigation Scheme. The government had several objectives in initiating this scheme: to improve farm incomes, reduce rural to urban migration, ensuring community and household food security and cutting down on food hand-outs to the Insukamini community. The Department of Water Resources (DWR) was the lead government institution in the identification process.

1.3 Area of Study

Lower Gweru was chosen due to its strategic location close to the city of Gweru. Due to the fact that Lower Gweru is close to Gweru and is by and large a dry area but replete with ground water there is need to invest in research on how this water can be utilised to improve the rural livelihood of this impoverished community. It is a typical example of most rural areas in Zimbabwe which have a lot of either surface or underground but, the level of these water bodies utilisation for rural development is either little or non-existent.

1.3.1 Lower Gweru

Lower Gweru, communal lands that are located in rural Gweru in the Midlands province, is in agro-ecological region IV. Lower Gweru lies between 19º14ˈ0ˮ south, 29 º15ˈ0ˮ east. Lower Gweru have pockets of developed and under developed areas lying 40km north west of Midlands provincial capital city Gweru and stretches further 50km to the west. Chiefdoms in Lower Gweru include Sogwala, Sikombingo, Bunina and Mkoba. The settlement type in Lower Gweru is well planned and is mostly linear along roads although it is dispersed in some remote areas. Lower Gweru, has several business centers which includes Maboleni and Insukamini. Insukamini is a former district administration center which is also one of the few state townships in the country. The selected area of wards lies between Nyama and Mdubiwa in the Maboleni area.

Figure 1.1 Location of Insukamini: Google Earth 1:100km

1.3.2 The Physical environment of Lower Gweru

While Lower Gweru district is classified under both agro-ecological regions IV and V the bulk of the district falls under region IV. The average rainfall received is 650mm. Rainfall is received between November and April. The area has an average minimum temperature of 16˚C and an average maximum and minimum temperatures of 24˚C and 10, 7˚C respectively. Severe mid- season dry spells are common as result good farm management is required to retain moisture during the growing season (Drimie and Gandure , 2005).Most of the areas are well watered and marshy .The major river is Vungu which is a tributary of the Shangani River. The soils in Lower Gweru are predominantly sandy loams but soils in Nyama ward vary from clay to sandy soils and the terrain is predominantly flat. Nyama can be considered a favorable locality because of the prevalence of wetlands. In addition it has a higher water table. On the other hand however, Mdubiwa ward is rather dry, with an undulating terrain and sandy soils. The water table is deep and there are no signs of inundation.

1.3.3 Climate Average Weather Data for Lower Gweru

The table below shows the average rainfall received in Lower Gweru indicating the level of aridity in Lower Gweru. Winters are drier with hot wet summers. Temperature is estimated to increase by between 5 and 10 degrees Celsius. Data is presented in both metric and "English" units.

Table 1.1 Lower Gweru Precipitation rank

NOAA Code	Statistic	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
0615	Precipitation Mean Monthly Value	Inches	5.5	5.2	2.5	1.2	0.2	0	0	0	0.2	1.2	3.7	6.3	2.2
0615	Precipitation Mean Monthly Value	mm	134.4	128.0	61.6	28.5	5.4	1.2	1.2	0.9	4.7	28.2	90.3	153.5	53.16

1.3.4 The population profile of Lower Gweru

Lower Gweru has a population of about 93 128 45 609 females, 47 519 males. There are 20 756 households with an average family size of 4.5. (2012 Census Report). Lower Gweru is close to the provincial capital of Midlands, Gweru. Gweru falls between Shona and Ndebele regions and a sizeable percentage of the population can speak both of the major local languages although, Shona is spoken by a greater proportion with approximately 30% speaking Ndebele. However for the Lower Gweru the principal language is Ndebele and is understood by virtually the whole population.

1.3.5 The socio- economic environment of Lower Gweru

Land use in Lower Gweru is typical of communal lands in Zimbabwe, with dry land crop production in the rainy season and animal rearing throughout the year. The main crops grown in the area are: maize, ground nuts and mbambaira (sweet potatoes), nuts and vegetables such as rape, covo, cabbages, onions and tomatoes Mugabe et al. (2009).Some farmers in areas with adequate water such as Madikane grow horticultural crops throughout the year. This is a commercial activity for farmers who sell their products in the urban part of Gweru district. Some of the villagers also engage in gold panning and other informal work, especially those who are not benefiting directly from the irrigation schemes. Farmers also engage in livestock rearing as a source of power for farming and as a sign of wealth and status.

1.4 Justification and Rationale of the Study

Poverty reduction is now one of the main goals of development yet progress against poverty stalled in many countries during the late 1990s and early 2000s. Of the 1.2 billion people defined as dollar –poor (i.e. with a per capita household income or consumption level below US $1-a-day in 1985 PPP, three quarters live in rural areas. Reviving the fight against poverty requires action on many fronts IFAD, (2001). A review of the evidence of past poverty reductions suggest that one important weapon

in investment, in agriculture. This research focuses on one aspect of agricultural technology: irrigation.

Literature on small irrigation schemes in Zimbabwe gives conflicting conclusions on the viability of irrigation with authors such as Mupawose (1984), Tafesse, (2003), Mpande (1984), Motsi et al., (2001) and Manzungu (1999)being critical of them whilst some scholars such as Chambers and Conway (1992) amongst others propagated for the irrigation schemes. This research seeks to identify the source of this conflict in order to make an independent determination. A number of studies have claimed that earlier irrigation schemes established by missionaries in the 1930s performed well in terms of agricultural performance and financial and economic viability FAO (2006). Food and Agricultural Organization (FAO) (2006), in its report titled Irrigation in Zimbabwe noted that the bulk of irrigation schemes established after independence are failed schemes. Amongst the noted failed schemes is the Lower Gweru Irrigation Scheme. The failure in performance of irrigation schemes is attributed to several factors ranging from economic factors to socio and institutional factors

In as far as the climate change debate is concerned the research seeks to assess the feasibility of using irrigation schemes as an adaptation strategy for climate change induced droughts which are expected to increase .The impact of climate change could be most felt by the rural populace of natural region IV and V of Zimbabwe. Evaporation rates are expected to peak up and rainfall variability is expected to drastically increase in these areas. Leaving the already vulnerable communities even more vulnerable to natural disasters which threatens both the social and cultural lives of these rural people not only in Zimbabwe but in Sub Saharan Africa, which according to the Intergovernmental Panel on Climate Change (IPCC) will be the worst affected. This makes research and development in irrigation agriculture an imperative for sustainable development.

Given the level of discrepancy between projects undertaken and the expected impact at a national level, this research seeks to independently evaluate the social and economic impacts of the Insukamini irrigation project. This research assesses the challenges faced by rural irrigators with a view to make recommendations that will drive forward irrigation development in Zimbabwe. This research also anticipates informing future donor and government planning and investments into irrigation

projects. It is the wish of the researcher that the completion of this study will contribute towards future policy and academic debates.

Furthermore the research assesses the impact of rural irrigation schemes. A comparison between rural irrigators and dry land farmers is made. This is done in order to understand the various distinctive livelihood patterns that exists in the two communities or groups and understand why these patterns exist. The aim is to identify knowledge gaps in rural livelihood security in irrigation communities.

1.5 Statement of the Problem

Zimbabwe has experienced food shortages due to several factors before and after independence, most notably in 1987, 1992, and in 2000.The crop failures have been a result of early rainfall failures, climate variation attributed to climate change in some cases and a lack of reliable and adequate water supplies by rural farmers to embark on irrigation farming in dry parts of the country. The colonial legislative framework made it difficult if not impossible for rural communities in mostly arid areas to participate in irrigation farming. The reduction in yield and output at farm level has led to a 70% shortfall in agricultural production to meet annual food requirements for the population. In 2002 Zimbabwe experienced the largest deficit in its food production since 1980 (FAO, 2002). This created severe food shortages which deteriorated into a famine and a humanitarian disaster .The cereal deficit in April 2002 to March 2003 marketing year was estimated at 1.65milion tons (Zimbabwe Vulnerability Assessment Committee Report, 2002). According to the Zimbabwe Emergency Food Assessment Report (2002), 486 000 tons of food aid was needed to meet food security requirements of 6 700 000 requiring food aid, 5 900 000 were in rural areas and 800 000 in urban areas. A total of 70 % of the rural populace was at risk of famine induced starvation. The scale of food aid was unprecedented in the history of Zimbabwe (WFP, 2002).

The Zimbabwe government since independence in 1980 embarked on a massive dam construction programme with a view to establish irrigation schemes for sustainable livelihood in rural areas. On the global arena the debate on climate change, rural livelihood security, rural development and sustainable development has brought the

issue of rural irrigation development to the fore. It is widely believed that irrigation schemes can play a pivotal role in rural development, act as a mitigation strategy to combat climate change induced droughts. However, no proper independent prognosis has been carried out to prove that irrigation schemes can act as a solution.

A lot of money has been invested in rural irrigation schemes with the aim of eradicating hunger and dependence on food relief, reducing rural poverty and bring about socio economic stability. After 30 years since this irrigation programme was introduced in Zimbabwe, the questions that arises are: are these irrigation schemes meeting human developmental needs, are they meeting the socio economic demands for which they were designed? Is there a better quality of life for irrigators and surrounding host communities? If not what are the challenges and what can be done to address these challenges? The same questions are asked about Insukamini Irrigation Scheme.

1.6 Research Questions

1. What are the social and economic impacts of irrigation schemes on rural livelihoods?
2. What is the impact of irrigation schemes in drought prone areas in the context of climate change?
3. Did the Lower Gweru irrigation scheme improve the quality of life for the rural Lower Gweru people?
4. What can be done to make irrigation schemes more viable?

1.7 Aims of the Study

The study assessed the socio economic impact of rural irrigation schemes in the light of conflicting reports of their performance. The assessment was done using a livelihood and developmental approach contrary to other assessment models used in the previous research with a view of giving a true value of rural irrigation schemes as assets of both social and human development. The sustainable livelihoods framework

forms the basis for understanding important concepts namely vulnerability context, capital assets transforming processes and structures, livelihood strategies and livelihood outcomes. The framework also informs the analysis of the study. A number of studies on irrigation assessment studies have applied the livelihood approaches in rural Africa. In addition many other studies examined the linkages between rural irrigation schemes without necessarily applying the livelihood framework.

The research also interrogated the findings by FAO (2007) that Insukamini Irrigation Scheme is a non performing irrigation scheme in light of numerous irrigation scheme competition awards it has received since it was commissioned to the people of Lower Gweru. The study also assessed the challenges and threats being faced by farmers in the irrigation scheme with a view to not only inform academic debate but also to inform government and the donor agencies who are the main actors in the Insukamini Irrigation Scheme.

In the wake of climate change and increased extreme weather patterns associated with it that is expected to affect the most vulnerable members of the third world countries , the study will also examine the feasibility of using rural irrigation schemes as a buffer to climate change related catastrophes such as droughts and increased aridity. In this regard the research will contribute towards the climate change debate.

This study is prompted by the need to help understand the linkage between irrigation development and poverty reduction, with a view of proposing recommendations on how to increase the positive impact of irrigation development projects on poverty alleviation. Through an assessment of the Insukamini project, it aims to provide a framework for analyzing the impacts of irrigation on social and economic life and review some evidence of these impacts. It is hoped that its findings and recommendations can help shaping future investment strategies in the field of irrigation. One hopes that the findings will also assist in informing future rural irrigation planning and development in the country and the world at large.

1.8 Objectives of the Study

The broad objective of the study is to assess the socio-economic impact of rural irrigation schemes.

1.8.1 To evaluate the social and economic impacts of irrigation schemes on rural livelihoods.

1.8.2 To assess the impact of irrigation schemes on drought prone areas in the context of climate change.

1.9 Organization and Structure of this Dissertation

This dissertation is divided into six chapters. The project starts by looking at rural livelihood challenges and how irrigation can be utilized to bust poverty in dry regions and bring about socio economic development. Chapter two is divided into two sections. The first section gives the macroeconomic spectrum of the irrigation scheme's establishment. The second part looks at the global irrigation scenario and its contribution. It narrows down to look at its significance in Sub Saharan Africa, SADC before narrowing down to Zimbabwean irrigation scenario looking at successes, failures and threats to irrigation development. Chapter three covers the methodology used in this research to gather field data , the analytical methods used and challenges faced during the period of gathering data and how these challenges were dealt with. The analytical method used to analyze gathered data is also covered in the last part of this chapter. Chapter four presents results and consists of mainly statistics, graphs and tables produced through analysis of primary data. Chapter five focuses on discussion of research findings discussion and results. It looks at the findings and their interpretation and significance from a theoretical, academic and practical perspective. Chapter six looks at the lessons, synthesis of the report and recommendations based on findings paving way for further areas of research and development

Chapter 2: Literature Review

The purpose of this literature review chapter is to provide a theoretical framework for the analysis and interpretation of results of this study. Government policy papers, government programmes related to rural development and agricultural programmes are analyzed in order to gain a deeper understanding of rural irrigation schemes and sustainability. Policy papers, reports and text books are to be reviewed, amongst other such documents to gain an in-depth understanding of irrigation and sustainability. Literature review was conducted to show knowledge gap to be filled by the research, provide a scientific frame work for data analysis and locate the study within existing scientific knowledge.

Literature review was divided into two segments with the first segment focused on making an understanding of the Zimbabwe's economic development spectrum since independence. This is an important part of research as it put irrigation development into the broader macro-economic spectrum hence bringing about relevance to rural irrigation development in Zimbabwe. The second segment focusses on irrigation development at a global, continental and national level. This highlights the academic and practical discussions on irrigation schemes.

2.1 Development in Zimbabwe: Theoretical Framework.

Development in Zimbabwe follows various geographic paradigms and theories. A number of theories and paradigms can be applied to Zimbabwe's development scenarios. According to Fair (1982) how one views the origins of spatial inequalities between and within countries depends to a large extent on the particular paradigm or framework of theoretical understanding that one chooses to adopt. In the latter half of twentieth century development thinking was dominated by the diffusionist or modernization paradigm (classical paradigm) and dependence paradigm. At the beginning of the 21st century other development paradigms, such as the neo liberal approach and the neo populist approach emerged. All these had influence on Zimbabwe's economic development.

The diffusionist or modernization paradigm emanates from various streams of thought in Western social science. The essence of thinking is that if, developing countries like Zimbabwe is to become developed then it must follow the path taken by the highly developed countries over the past 100 to 200 years Fair (1982). Developing countries must duplicate the experience of more developed countries for development to occur in their countries. In this paradigm, development is equated with economic growth and modernization. It was generally believed that the answer to all problems of the developing countries lay in increases of per capita income Todaro, (1993)

One of the theories that help understand the development path in Zimbabwe is the territorial approach that seeks to address weaknesses of modernism. Various terms are used to describe this approach for example Stohr and Taylor (1981) refer to it as the bottom up approach, while Gore (1984), uses the term neo populist approach. This approach emanated from developing countries and is participatory, bottom up, process led, appropriate, sustainable and flexible. The top down approach (modernization paradigm) on the other hand takes the position that local resources use and knowledge should be replaced by official, expert led knowledge which induces rural people to adopt officially sponsored innovations Blaike (1997).

2.2 Development Ideology and Macroeconomic Policies in Zimbabwe

In 1980, at independence, Zimbabwe inherited a fairly well diversified economy with an industrial base stronger than most Sub–Saharan African countries north of the Limpopo River. However the economy was dual in nature in the sense that while the modern sector was well developed there was a largely poor rural sector that employed about 80% of the labor force ZHDR (2003).The poor had limited access to education and health and the physical infrastructure where the majority lived was poor. The newly independent Government of Zimbabwe aimed at correcting the colonial imbalances that it had inherited. In pursuing this development objective, the Government of Zimbabwe drafted several policy plans. The first was ‘Growth With Equity’ strategy in 1981.This was followed by the ‘Zimbabwe Transitional National Development Plan’ 1982-1985 (ZTNDP) and the ‘Zimbabwe First Five Year National Development Plan 1986-1990 (FFYNDP).Under these development plans, priority

was given to poverty reduction, and Government spending was geared towards increased social sector expenditures. This involved expansion of rural infrastructure and redressing the social and economic inequalities that existed, including land reform Zwizwai (2007).

Zwizwai (2007), further notes that in the 1990s economic and social indicators as a reflection of the outcomes of the decades of the 1980 can now be evaluated in retrospect as having been much better than performance during the 1990s decade up to date. However, the high social sector expenditure of the 1980s was viewed to be unsustainable in the long run and this was partly because economic growth during this decade was erratic, with several low performance years being recorded during the recurring droughts. Thus on average, the economy grew at around 3 to 4 % during this decade, showing sign of stagnation.

The threats of stagnation according to Zwizwai and the expected eventual economic decline led government to abandon the Second Five Year National Development Plan 1991-1995 (SFYNDP), in favor of the Economic Structural Adjustment Programme (ESAP) that was adopted in 1991 in an effort to boost the country's economic performance at a time that the country enjoyed wide international support. The structural adjustment programme was aimed at restoring macro-economic stability through reduced government expenditure, trade liberalization and deregulation. The main aim of ESAP was to improve the living standards of the poor in Zimbabwe through the enhancement of real economic growth (Framework for Economic Reform Report 199-95(1999). Framework for Economic Reform Policy Report 1991-95 (1991) notes that The Government aimed at achieving economic growth through a number of macroeconomic policies and in essence , via shift towards a market system. This entails moving away from a highly regulated economy to one where market forces are allowed to play a more decisive role, while concurrently taking steps to alleviate any transitional social hardships which may arise from this transition.

Despite the seemingly timely intervention in the economy under ESAP, the decade of the 1990s generally saw a decline in economic growth and a worsening of the structural problems of high poverty and inequality. According to the first Poverty Assessment Study Survey (PASS I) of 1995, extreme poverty increased significantly during the ESAP period and 45% of households lived below the food poverty line (FPL)

in 1990 compared to 26% in 1990. With regards to general poverty, as measured by the total consumption poverty line this increased from around 40% in the late 1980s to 61 % by 1995.

Sichone (2003) notes that the more recent period, 1996 to 2003, has been marked by accelerated deterioration in the socio economic situation of the country as a result of several factors. It is important to note that during this phase, the economic reform mode including some cost recovery measures continued to be launched. ESAP was replaced with a home grown reform package, the Zimbabwe Programme for Economic and Social Transformation (ZIMPREST) 1996-2000, officially launched in April 1998. It is about this period when the Lower Gweru irrigation scheme was established. ZIMPREST was short lived as it failed to attract international financial institutions funding.

The Millennium Economic Recovery Programme (MERP) was launched in August 2001 as a short term 18-month economic recovery programme. In 2003 government launched yet another 12 month stabilization programme, the National Economic Revival Programme (NERP).The Macro Economic Policy Framework 2005-2006 and Towards Sustained Economic Growth is the current national development that provides the national short and to some extent medium term goals of Zimbabwe Zwizwai, (2007).

All the development models adopted by Zimbabwe exhibited traits of a welfare state heavily biased towards a free market economy regulated by market forces. It is important to note that according to a Preamble by His Excellency , The President of the Republic of Zimbabwe in April 2002 the economic models were predicated on the following broad considerations amongst others: an agriculture led economic growth and development thrust whose premise is stimulation of small scale agriculture through greater input and extension support; an emphasis on domestic indigenous capital, which augments local ownership of the economy and partners with friendly capital from non-traditional investments markets; enlarged role for direct or indirect State participation in the economy to cause investments in well-defined strategic areas for definite strategic outcomes and ensuring greater food supply , relief and security to beat current and future droughts. It is within this context and understanding that the Lower Gweru, amongst other rural irrigation schemes, was established.

2.3 Rural Irrigation Schemes Overview

There is a wide range of opinion amongst academics on the role that irrigation schemes can play in people's developmental lives. While some argue that it's an ultimate solution to rural development , others also argue that irrigation schemes in their format today cannot serve the intended purposes, others argue that there is need for a total approach altogether to bring about development to rural populace.

This part of the research will mainly focus on the research conducted by governments, NGOs, private companies and individuals on the impact of irrigation schemes particularly in developing countries where hunger and poverty are topical issues. The first focus will be on the analysis of the impact of irrigation schemes on communities in Asia who have invested extensively in irrigation over the past decades coming down to Africa and ultimately zeroing in to the impact of irrigation on SADC and ultimately on Zimbabwe. Attention is going to be given on both the positive and negative impacts of irrigation schemes in a comparative manner.

2.4 Global Programmes of Rural Agricultural Irrigation Schemes

Poverty reduction is now one of the main goals of development yet, progress against poverty stalled in many countries during the late 1990s and early 2000s. Of the 1.2 billion people as dollar poor i.e. (with per capita household income or consumption level below US $1 a day in 1985 PPP, three quarters live in rural areas .Reviving the fight against poverty requires action on many fronts IFAD, (2001) . A review of evidence of past poverty reductions suggest that one important weapon is investment in agriculture and specifically in irrigation (FAO, 2003).

The choice can be justified quite simply. There are huge regional differences in the proportion of cropland that is irrigated and these coincide with successes or failures in poverty reduction. In Africa only around 3% of cropland is irrigated and the region has experienced very little reduction in poverty in the 1990s (sub Saharan Africa had an estimated poverty headcount of 47.7% in 1990 and 46.3 % in 1998 (World Bank,

2000).In contrast, those regions that have the greatest proportion of cultivated area irrigated (namely East Asia and Asia Pacific and North Africa and Middle East) have experienced the greatest poverty reduction. In addition, 35-40% of cropland in Asia is irrigated and poverty reduction in the 1970s, the period immediately following the Green Revolution in which much initial investment in irrigation was made, was substantial. This was no coincidence, rather that differences across regions, countries and states within countries in irrigation is an important factor in determining rates of poverty reduction in many parts of India for example, is attributed to the availability of irrigation, which not only boosted agricultural production but also made possible the adoption of modern farming technology – seeds, fertilizers and pesticides – that further reduced poverty Ray et al. (1988).

The Technical Advisory Committee of the Consultative Group on International Agricultural Research (CGIAR) estimated that the average annual value of all crop production in developing countries for the years 1987 to 1989 was US$ 364 billion Yudelman, (1993) and Wallingford, (1997). Of this, US$ 2.4 billion was produced by people from the developing countries who depends on irrigated agriculture for food and employment. Even though the importance of irrigation seems is obvious, there has been a decline in investment in irrigation.

Irrigated agriculture produces 40% of food and agricultural commodities from 20 % of agricultural land. Thus, food security is critically dependent on irrigation, particularly in Asia where about 60% of food production is from irrigated land. Table 2.1 presents the relative contribution from irrigation across regions (World Food Summit 1996, Wallingford, 1997).

Table 2.0.1 Food Produce from irrigated land

Adapted from Wallingford, (1997)

Region	Food Produced from Irrigated Land %
ASIA	60
Pakistan	80
China	70
India	50
Indonesia	50
Middle East and North Africa	33
Egypt	98
Iran	50
Latin America	10
Chile and Peru (food crops for export)	50
Sub Saharan Africa	9

2.5 The Impact of Irrigation Schemes in Asia's food security

Asian Development Bank (2000) noted that agriculture in developing Asia as a whole has made remarkable progress over the past three decades. Between 1970 and 1995, cereal production more than doubled from over 300 million metric tons to 650 million metric tons, while the population increase during the same period was 60%.It notes that this remarkable growth in food production was largely attributed to irrigation growth in irrigated agriculture, coupled with high yielding varieties of crops and application of fertilizers and pesticides. Irrigation has greatly improved the incomes of

farmers with access to fertile and well drained lands, reliable water supplies, yield enhancing inputs, credits as well as other supporting services. It has also benefited the overall population by providing more food at reduced prices.

Although benefits are generally considered to be skewed in favour of those having access to fertile , well drained lands , reliable water supplies , and yield enhancing inputs, poor people have also benefited in terms of enhanced food security and incomes (marginal and small farmers , lower food pricing (mostly urban poor) and employment both rural and urban poor .In the period between 1965 and 1984 , the net irrigated area grew at a compared rate of 1.6% while food production was at 3% per year. Between the 1960s and the 1990s real grain prices fell by nearly 50% ADB (2000).

2.6 Socio Economic Impact of irrigation in Asia

There are huge regional differences in the proportion of cropland that is irrigated and these coincide with success or failures in poverty reduction. In Africa only around 3% of croplands is irrigated and the region has experienced very little reduction in poverty in the 1990s (Sub Saharan Africa had an estimated poverty head count of 47.7% in 1990 and 46.3%in 1998 World Bank, (2000).The significant poverty reduction in many parts of India for example is attributed to the availability of irrigation , which not only boosted agricultural production but also made possible the adoption of modern farming technology – fertilizers and pesticides that further reduced poverty (Ray et al. (1988).

Irrigation may lead to poverty reduction through increased crop yields, increased cropping areas and higher value crops (all favoring initial farmers , including poor small and surplus farmers) , by these means raising employment directly for farm workers , indirectly of other workers. Increased yields can mean increased food surplus, higher calorie intakes and better nutrition levels. There are also stability effects because of reduced reliance on rain fall – hence irrigation lowers the variance of output and employment and yields and helps to reduce adverse consequences of drought Dhawan, (1988).How ever irrigation may increase the covariance by crowding larger proportion of total output into nearby irrigated areas (because even these depends partly on rainfall and its variation).

Japan Bank of International Co-operation (2007) notes that an analysis of the indicators of agricultural performance reveals that crop intensification, land productivity of major field crops, gross value of production per hectare and degree of crop diversification is all higher in irrigated settings than in rain fed settings. Crop intensification in irrigated conditions enables households to cultivate both wet and dry seasons and therefore has a strong land augmentation effect. Per hectare labor employment is higher in irrigated settings than in rain fed settings such that access to irrigation infrastructure generates almost an extra month of employment during the wet season alone, when only labor use for crop production is accounted for. Further household level access to irrigation infrastructure reduces inter season variability in labor employment, both hired and family which implies that irrigation generates higher and stable employment throughout the year. Further, irrigation enables household to earn higher daily wages, and this difference in daily wages is sufficient to uplift people out of poverty.

The research by Japan Bank further notes that households in irrigated settings (as measured using housing index access electricity , and other infrastructures they also exhibit better health and lower incidence of malnutrition as measured using Body Mass Index (BMI) of household heads.

2.7 The Impact of Irrigation Schemes on Sub- Saharan Africa

Turning back to Africa Irrigation has long been seen as an option for improving rural livelihoods by increasing crop production, but massive investments throughout the 1970s and 80s in Sub Sahara Africa have not borne fruit. Food production targets were not met, development costs were extremely high in relation to returns and there are many technical management problems that remain unsolved. The decrease in real terms of world cereal prices over the past decades has made it difficult to invest in and maintain irrigated agriculture for basic grain crops as noted by Melvyn (2003).

During the past three decades Africa's food production has grown at the rate of 2% per year, whilst its population growth has been 3% .The number of malnourished children is expected to increase by 14 million during the next 25 years. According to IFPRI (2020 vision) , given these trends Sub– Saharan Africa would need to triple its

import of cereals from 9 million tons in 1990 to 29 million tons in 2020. One way to do this would be to expand irrigated area. At the same time however, Africa faces water scarcity problem. Africa is a dry continent and receives unstable rainfall. Costs of irrigation in Africa are also higher than in other parts of the world (FAO, 1986)

Melvyn (2003) further points out that most criticism was directed at the more formally structured irrigation schemes usually under the control of government body. Because of this attention turned in the 1980s to the informal sector small irrigation which is described as the bottom up or grass roots approach to development. There are many small holder success stories particularly where farmers have made the investments themselves. However, all has not gone smoothly where donors have tried to stimulate development. Donor funding agencies and national governments wishing to accelerate the development process still tend to use a top down approach where only lip service is paid to former participation.

Irrigation has numerous potential benefits in Africa. Most importantly it may contribute substantially to food security and economic progress, which in turn provide rural households with greater purchasing power for essential commodities, including improved access to health care delivery services and education. Frequently irrigation development also implies more general infrastructural improvements, better roads, (and thus better access for health services) rural electrification and sometimes housing improvements. The development of water projects and operation has however also a history of facilitating increased transmission of vector borne diseases (Service, 1991).The underlying reasons are the creation of new breeding sites and enhanced human vector contacts due to ecological and demographic changes. For example, surface irrigation which is mainly used for flooding of rice fields creates temporary shallow water bodies, which form ideal breeding sites for malaria vectors. From the 55 Anopheles species described worldwide acting as potential vectors (Lacey and Lacy, 1990), several are predominantly rice field breeders particularly on irrigation and drainage canals, and various ancillary hydraulic structures in irrigation systems can also become important foci of vector breeding if they provide the ecological conditions.

A focus on West Africa leads to the following points: For poverty reduction at a large scale the effects of irrigation on food production and prices, employment opportunities and rural non-farm markets are probably more important than direct benefit to irrigators

(Bhatpara et al. (2002). Agriculture is already failing to sustain livelihoods of millions in Ethiopia who rely on Productive Safety Net Programme (PSNP), and with increasing population, declining landholdings, wide spread land degradation and the expectation of increased future climate variability, even upgraded agriculture will not offer a way out of poverty for all. Irrigation development could however lead to new opportunities in agricultural trading and if increased wealth from irrigation leads to more demand for non-farm products in a growing non-farm economy. This has happened in Asia where irrigation areas have become nuclei of growth which attract investment in new infrastructure and services (Hussein and Hanjra, (2004). However, this depends upon transport, communication links between rural areas and market centers, the number of people able to irrigate and the demand for labor and non-food products which irrigation creates.

The government of Ethiopia has identified small scale irrigation as an important component of adaptation (GoE, 2010). A second RiPPLE study (Kaur et al., 2010) assessed the effectiveness small irrigation as a climate adaptation intervention in Ethiopia. The study found that small scale irrigation is a potentially valuable component of adaptation strategies as it increases agricultural productivity and households' ability to cope with climate variability. However accompanying measures are required to ensure (a) water resources themselves are resilient to a variable climate and (b) the design is proofed against extreme events.

RiPPLE study 2010 further noted that irrigating households reported an average 20% increase in annual incomes since adopting irrigation, and in some cases up to 300% , due to cultivation of higher value crops , intensified production and reduced losses. Nutrition was said to have improved as fruit and vegetable become locally available. The most successful households have increased their assets, particularly livestock which is important form of saving and wealth accumulation. Some have bought new farming equipment to further increase productivity. In this way irrigation can lead to an upward spiral of increased production and income.

In Morocco, the government considers small dams as a good alternative to large-scale irrigation development, substantially improving livelihoods in isolated rural areas. The small dams (finally) brought some benefits to previously neglected regions. Indeed Assif Taguenza small dam irrigating 80 ha led to an increase in the number of

livestock, mainly goats, from a few hundred to more than 10,000 two years after the construction of the dam Mahfoud (1989).

2.8 The Impact of Irrigation Schemes on SADC

A report by SADC (1992) reported that new smallholder irrigation schemes in Southern Africa region will not cover the cost of development and operation and are therefore uneconomical. The report further suggested that these schemes have a negligible impact on the national and household food security. In addition to that, Jansen (1993) further noted that almost all irrigation crops except cotton in marginal areas, is only profitable when it is subsidized by government.

In a follow up to the report in 1992, SADC extra-ordinary summit report on Agriculture and Food Security For Poverty eradication in the SADC region held in Dar e Salam Tanzania 15 May 2004 item 5.2.2.2 noted the following observations; Notwithstanding the competing and conflicting uses of water in the region, irrigated agriculture is still inadequate when considering its potential given available water and land resources. FAO (2006) estimates that Africa use about 5% of its total water resources for domestic and industrial use compared to 20% in Asia. For Sub-Sahara Africa situation is worse. The available water in the region must be used to support sustainable food security through sustainable irrigated agriculture. It is estimated that yields from irrigated agriculture are three times higher than yields from rain fed agriculture and yet only 4.5% of agricultural land is under irrigation. Irrigated agriculture should be promoted in all areas where it is viable. In the fight against food shortages , the initiatives should at all levels that is regional, national ,and at local levels where small dams, mini and micro scale irrigation projects should be promoted to contribute to poverty alleviation and food security.

However the experience in Zambia seems to contradict the notions pointed by SADC in 1992 and Jansen (1993). The Zambia Agribusiness Technical Assistance Centre (ZATAC) has promoted out grower schemes directly linked to ready markets through agribusiness. This strategy offers agribusiness a chance to increase their supply base and benefit from economies of scale without the associated capital investment. ZATAC also provides credit for irrigation equipment. For the first time in the history of Zambia,

smallholders now grow irrigated fresh vegetables for markets in Europe, thanks to the alliance between smallholder producers and agribusiness. The combination of market access and simple irrigation technology has released these farmers from the lower income poverty trap of rain fed agriculture (World Bank, 2005).

A similar positive scenario exists in South Africa. Most smallholder irrigation schemes are found in the former homelands of South Africa, where the incidence of poverty peaks (May, 2000; Aliber, 2003). In these socio-economic environments smallholder irrigation schemes present an attractive opportunity for the development of local livelihoods. According to Chambers and Conway (1992) livelihoods consist of four parts, namely, (i) people and their livelihood capabilities; (ii) assets, including both the tangible (resources and stores) and intangible (claims and access), which provide the material and social means that are used to construct livelihoods; (iii) activities, i.e. what people do; and (iv) a living, which refers to the outcomes of what people do. When viewed from this livelihood perspective, smallholder irrigation schemes are assets. They can be used to increase and diversify the livelihood activity of plant production, resulting in improved livelihood outcomes, either directly in the form of food or income for plot holders, or indirectly by providing full or partial livelihoods to people who provide goods and services in support of irrigated agriculture on these schemes.

2.9 State of irrigation in Zimbabwe

Agritex report (1999) noted that at independence in 1980 the new government of Zimbabwe recognised the role of irrigation in agricultural development, especially in improving the production of the smallholder farmers. The government increased its efforts to promote irrigation development in this sector, which had been neglected by the previous colonial government. In1983, steps were taken to develop new smallholder irrigation schemes and rehabilitate all the irrigation schemes, which were damaged during the Liberation War.

Zimbabwe has made tremendous strides in smallholder irrigation since 1980. From about 57 malfunctioning schemes covering 2,500 ha in 1980, over 180 formal irrigation schemes have been developed over the years in communal, resettlement and small-scale purchase areas, bringing the total area under smallholder irrigation today to

about 12,000 ha. In all, 155,500 ha are under irrigation, and therefore the area under smallholders is about 8.5 percent as of 1999 according to Agritex report (1999). Due to its informal nature micro-scale or garden irrigation in “dambos” or wetlands is not normally included in official estimates of the total irrigation command area. However, it is estimated that about 30,000 ha is under micro-scale irrigation in the country, mainly in the “dambos” or wetlands Agritex (2003). However the Fast Track Land Reform Programme altered this picture as shown on table 2.0.2 below.

Table 2.0.2 Overview of Zimbabwe irrigation sector in 2003 after agrarian reforms Adapted from ,Agritex (2003)

Farming Sector	**Area under irrigation**	**Area % of total**
Large (white) scale commercial	8 000	10
Parastatal ARDA Estates	7 620	10
A1 Farming Sector	7 600	10
A2 Farming Sector	12 500	16
Indigenous large scale commercial	9 250	12
Commercial and Resettlement	9 300	12
Small scale out growers	3 600	4
Informal /Micro scale	20 000	26
Total	77 870	100

Small irrigation schemes in Zimbabwe are of two basic categories: supplementary (part time irrigation) schemes and full production (full time irrigation) schemes. In the first category the irrigated plot size per household is typically 0.1-0, 5 ha and the farmers combine irrigation with dry land farming activities. Income derived from irrigation is used to supplement income from dry land production. In full time irrigation schemes plot size are typically 0, 5-2ha per household .Such plot sizes are meant to provide full time occupation with irrigation. Irrigation farmers on such schemes are not expected to be engaged also in dry land agriculture.

The main water source for smallholder schemes has been water stored in medium-sized and large dams. Other important sources has been river flow, deep motorised

bore-holes, sand abstraction systems, shallow wells and springs. Irrigation technologies in use in this sub-sector include: surface irrigation, which comprises 68% of the schemes, and sprinkler irrigation, which makes up 32% of the schemes. In terms of area, 89% of the area is under surface irrigation and 11% is sprinkler irrigated. Localized irrigation2 is not yet in use by the small-holder irrigation subsector.

In terms of management, there are three broad types of smallholder schemes: government-managed, farmer-managed and jointly managed schemes. Government-managed schemes are developed and maintained by the Department of Agricultural Technical and Extension Services (AGRITEX). In the new schemes there tends to be a shift away from this practice and towards farmer-managed projects. Farmer-managed schemes are developed by the government but owned and managed by the farmers' Irrigation Management Committees (IMCs) with minimal government interventions in terms of management. For jointly-managed schemes the farmers and government share the financial responsibility for operation and maintenance. For such schemes, the government is usually responsible for the head works (that is dam or weir, pumping station and conveyance system up to field edge), while farmers take responsibility for the infield infrastructure. In terms of scheme numbers, 50% of the smallholder schemes are farmer-managed, 32% are government-managed and 18% are jointly managed. However, in terms of area, the government is still managing a larger hectare, as most of the farmer-managed schemes tend to be small.

2.10 Socio-economic impact of irrigation schemes in Zimbabwe

This section deals with reviews of the current effort by government, non-governmental organisations and individuals to invest in irrigation with a view to analyse lessons and benefits and or weaknesses from established irrigation schemes. Since as seen earlier on there was huge development in irrigation schemes and the government's continuous investment in this sector seems to suggest that the irrigation schemes are providing necessary interventions required by the government.

In an apparent perceived show of belief in the potential positives of irrigation schemes, the Government of Zimbabwe has given priority to improving national and household food security as well as improving the standard of living and the incomes in the rural

areas Mudimu et al. (1989).In taking this initiative the government seeks to enable communal farmers to increase their production so that they can be food secure and also increase their participation in the market to generate income.

Since independence in 1980 the government has undertaken several initiatives to meet these priorities (Rukuni and Eicher, 1994), including the following,

- Improving physical infrastructure, particularly road network in communal areas.
- Guaranteeing incentive prices for food and cash crops.
- Encouraging irrigation development in semi-arid areas.

Thus over the years researchers have worked hard to answer changing questions about agriculture technology adoption in achieving food security Sen , (1998).Initially, policy makers and researchers in Africa have sought simple descriptive statistics about the diffusion of new seed varieties , irrigation and associated technologies such as fertilizer and machinery on commodity production , poverty and malnutrition , farm size and input use in agriculture , genetic diversity , environmental and a variety of social issues IFPRI (2001).Manzungu and Van Der Zaag, (1996) noted the emerging socio-economic value of irrigation. They noted that the value of the informal irrigation land as garden sites for production of vegetables in urban and peri-urban areas has already been confirmed by FAO in 2005.

Once they were considered women activities but perceptions have changed due to high socio-economic conditions prevailing in Zimbabwe. Gardening activities are now important sources of family, food and income. It is also likely that these informal irrigation sites would grow in importance due to the dietary nutrition requirements needed to mitigate effects of the HIV/AIDS pandemic. The Europe Aid (2011) reported the benefits of irrigation schemes. Through its partnership with Zimbabwe Ministry of Agriculture to the tune of six million Euros since 2008 significant benefits were reported by benefitting communities' .Through the partnership in irrigation development that benefitted 90 communities and 3600 beneficiaries. The project managed to reduce hunger per year from an average of 6months to 0 months. Increase in maize yield from 1.1 tons to 4.5 tons. Income provided by irrigation enabled beneficiaries to pay for children's school fess resulting in a school dropout decreasing from 13% to almost 0 % and a generally better nutrition to for example Gondo irrigation scheme.

2.11 Financial and Economic Benefits of Irrigation Schemes in Zimbabwe

Agritex (1999) also highlighted the unparalleled importance of irrigation schemes in Zimbabwe as it has financial and economic benefits at local and national level. In its evaluation of five irrigation schemes namely: Chitora, Hama, Mavhaire, Mzinyathi and Wenimbi. Agritex noted that small irrigation schemes can be reliable sources of income. The observation was that farmers in these schemes were getting monthly income as high as Z$ 5 833 per farmer from plots of 1ha while dry land incomes were Z$ 1 000 per month per 6 ha plot size. The incomes were higher than the minimum wage Z$ 400 per month paid to unskilled workers and the minimum wage of Z$ 600 per month paid for skilled labourers in the agriculture industry. Agritex further noted that from a social perspective view, a farmer in an irrigation scheme is certainly better off than labourers in the urban industries who are faced with a lot other demands like: rent, water and electricity charges on their incomes. This was reason enough for government to channel more resources to small holder irrigation development.

The above notion is however disputed by Mupawose (1984) who questioned the economic viability of small holder irrigation schemes in Zimbabwe. Mupawose pointed out that certain small holder schemes have failed and were underutilized. This he attributed to poor management and a lack of inputs and irrigation experience by the farmers. In the same report Mupawose advocated for the reduction of subsidies on small holder irrigation and indicated that irrigation development has become expensive. The suggestion is that some form of cost recovery should be employed in these schemes.

2.12 Irrigation impact on drought and food security

According to FAO (1997) Zimbabwe's food situation is characterised by food insecurity at national level but food insecurity at micro level. The major area of concern is the availability of food at household level. The five selected irrigation schemes were found to act as source of food security for the participants and surrounding communities though increased productivity, stable production and increased incomes. Some of the

schemes like Murara and Hama Mavhaire in Manicaland are located in harsh climatic regions where people cannot grow enough to feed themselves because of unfavorable weather conditions. Farmers participating in irrigation schemes never ran out of food unlike their dry land counterparts. The payment of hired labor in kind by most schemes also ensures food security and better nutrition.

Dhloldo (1997) made the following findings in a research on irrigation firstly that the Government of Zimbabwe has spent large amounts of money since 1980 on drought relief. Irrigation development can contribute towards drought savings. The importance of irrigation in drought relief savings can be better illustrated by a comparative analysis of the cost of a drought relief programme and the investment required in irrigation to obtain a similar relief. Consider 1,000 families living in NR V, where rainfall is erratic, unreliable and inadequate for any meaningful dry land cultivation. The aim of the drought relief programme is to supply at least 550 kg annually to each family of six persons. If these families were placed on a drought relief programme they would require 550 tons of maize per annum. The government expenditure in 1998 to purchase this quantity of maize, at Z$2,400 per ton, would be Z$1.32 million. The estimated transport cost would be Z$110,000 and the administrative cost would amount to another Z$200,000, making a total annual drought relief cost of Z$1.63 million.

The question now is, can small-holder irrigation schemes produce the equivalent of drought relief and at what cost? If an average yield of 6 t/ha is assumed for maize in the smallholder schemes, 92 ha would be needed to produce 550 tons annually. The total cost of developing 92 ha at Z$70,000 per hectare in 1998 was Z$6.44 million. The annual financial equivalent (which is obtained by multiplying the investment cost by the capital recovery factor for 20 years at a 9.75% discount rate) is Z$0.74 million. The production cost for maize produced on 92 ha is about Z$0.37 million. This means the total annual cost of producing maize is Z$1.11 million.

From the above analysis the cost of irrigation is Z$0.52 million less than the cost of drought relief. Furthermore, the experience with drought relief is that it does not get to people who need it most. In fact, under normal circumstances, a complete drought

relief package includes other commodities such as beans which if included can double the cost of drought relief, thereby making irrigation much more attractive. Clearly smallholder irrigation is important as a development strategy since it results in government savings and ensures access to food by smallholder farmers. Farmers enjoy the human dignity of producing their own food instead of continuous food hand-outs from the government.

2.13 Social Impact of irrigation schemes in Zimbabwe

There seems to be not much review on the impact of irrigation schemes on societal relations. However some scholars have made evaluations on the relations between irrigators and dry land farmers which is at most acrimonious. Bratton (1978) carried out a study on the Nyamaropa irrigation scheme in Manicaland which was introduced during the colonial period and made the following observations. In addition to Nyamaropa irrigation scheme bringing cash crops to the area it also brought also with it new agencies of change such as buyers of tobacco , cotton and maize. In addition, new forms of governance were introduced in the form of local government structures operating alongside the long established tribal authorities comprising chiefs, headmen of neighborhoods and kraal heads. Some of these were African leaders appointed by colonial authorities to help administer reserves especially, in tax collection and land allocation.

On the other hand Magadlela (1995) conducted research on the same irrigation scheme of Nyamaropa and noted that the Nyamaropa irrigation scheme is a product of various interventions resulting in a social and cultural melting pot. Out of this melting pot many conflicts about present and future management of the scheme especially with regard to water distribution and seasonal cropping patterns exists. Expansion of the scheme to give more dry land farmers to irrigated plots and the introduction of a block system divide the irrigation community into two conflicting camps headed by two different types of local leadership. Another conflict sometimes latent and sometimes open is between various belief systems. The local perception held by headman and his people of the role of ancestors is not always accepted by irrigators in whose view local traditions stifle development progress. Most irrigators become members of the many churches in and around irrigation schemes.

2.14 Challenges Facing Rural Irrigation Schemes

Regardless of the evidence pointing to the benefits of irrigation globally, alarming statistics, evidence indicate that investment in irrigation has begun to decline. Data on irrigated areas, globally and across regions, show that the rate of growth in irrigated areas has declined, and has been accompanied by a decline in lending for irrigation by international donors Mark et al. (1993). However, linking evidence on irrigated areas to irrigation investments is difficult as one needs to take account of proportions of initial irrigated cropland. Diminishing returns to irrigation in investment are surely less likely if these proportions are very small to start with. Also, one needs to distinguish between gross and net change in irrigated areas. A lot of once irrigated area becomes non irrigated due to (a) 'losing land from agriculture to urban and other uses or loss of irrigated land due to in adequate water management practices (salinization , water logging); (b) losing water – falling water tables , deteriorating management (more seepage) of irrigation systems and increasing pressure to divert water from agriculture to urban – domestic consumption and industrial uses ; (c) the effect of global warming in increasing evaporation rates (as well as increasing variability of rainfall in the inter- tropical convergence zone). For all these and other reasons annual growth of irrigated area exceeds the net increase of food requirements, especially in countries with much or old irrigation systems. Globally irrigated area rose to an annual average of 2.0% in the 1960s, of 2.4 % in the 1970s and fell to 0.9% in the 1980s. Regional figures, with the exception of Africa, show a similar pattern of growth of irrigated area peaking in the 1960s and 1970s, and declining in the 1980s. In the forthcoming decades, this trend will continue and it's expected that annual growth of irrigated land will be of the order of 0.7% (FAO, 2002)

There has been a large decline in real lending by major donors (World Bank and Japanese Overseas Development Fund) for irrigation projects in South and South East Asia, since the 1970s and early 1980s, when it peaked. By 1986-87 World Bank lending was only around 40% of peak lending by other donor agencies shows similar trends. (FAO, 2003) which is a worrying development as climate change is going to inflict further strain on global food demands.

Trends in public expenditure on irrigation in selected Asian countries also show a decline in real irrigation expenditure in the late 1980s. Annual expenditure in China and Sri Lanka was cut by nearly 50% in late 1980s. In the Philippines the level in the late 1980s was only a 1/3 of that in early 1980s. Expenditure peaked later in Bangladesh, Indonesia and Thailand, but these counties also show a decline in irrigation investment. In India, public sector investment in irrigation has been stagnant or declining since the mid-1980s.

2.15 Irrigation and its challenges in Zimbabwe

According to Motsi et al. (2001) in Zimbabwe irrigation is also facing some serious challenges. Studies carried out seems to mirror different picture hence the need for further studies to arrive at consensus or to arrive at a more agreeable position. Poor water management, unclear irrigation scheduling, inefficient water use at schemes and plot levels are a major cause of concern for the success of small holder irrigation schemes in Africa (Motsi et al., 2001) Studies found that inequitable water allocation often results in farmers close to water sources achieving crop yields twice compared to those located at the ends of distribution channels Manzungu, (1999); Pazvakavambwa and Van Der Zaag, 2002: Samakande, (2002). In addition due to poor water management, water delivery to tail end farmers was unpredictable, and thus adversely affecting their crop yields. At plot level , some farmers have been observed to apply 50-150% more water than needed by the crops although excess water depressed crop yields due to water logging , erosion of land and soil salinization Seckler , (1999); Motsi et al.,(2001);Tafase, (2003). Environmental factors such as: water scarcity, poor soil fertility, poor water quality, land degradation, temperature, pests and diseases also adversely affecting production. Thus environmental factors such as: water scarcity, poor soil fertility , poor water quality, land degradation , temperature , pests and diseases are also adversely affecting crop production .Thus environmental factors such as: water scarcity ,poor water quality , land degradation , planted area, temperature , soil fertility, pests and diseases have adversely affected crop production in some smallholder schemes in Zimbabwe.(Manzungu and van der Zaag , 1996; Mate 1996).

A study on small irrigation schemes by various organizations and individuals listed below also highlighted the challenges faced by these irrigation schemes in order for them to contribute meaningfully to the development of the agricultural industry. Several studies on smallholder irrigation schemes in developing countries have observed that these schemes are under performing partly due to inadequate inputs and inaccessible markets (Makadho, 1994; Rukuni, 1994; Chancellor and Hide, 1997; FAO, 2000). In some cases government policies on land tenure and water allocation do not create a conducive environment for successful operation of smallholder irrigation schemes (Tafesse, 2003). Mpande (1984), Motsi et al. (2001) and Manzungu (1999) ascribed the failure of the smallholder schemes in Africa to substandard infrastructure, unclear irrigation scheduling and inefficient water use.

In addition to the above the sanctions imposed on Zimbabwe affecting that have resulted in some institutions involved in agriculture such as Agribank has negatively affected irrigation in Zimbabwe as financing is in adequate threatening the irrigation based agriculture. The failure by the power utility ZESA to supply power to farmers has also compounded the challenges being faced by irrigators. ZBC news (2012).

Chapter 3 : Research Methodology

3.1 Introduction

This chapter sets out to highlight the procedure that was taken by the researcher in gathering data for the research. It highlights the specific steps that were taken by the researcher in gathering data, interacted with the researched community and how data was handled. The second part highlights the challenges encountered in the acquisition of data and ways these were handled those that could be contained. The last part of the chapter focuses on the methods used in interpreting and synthesizing gathered data and the tools that were used in the analysis of data.

3.2 Research Design

The qualitative research methodology formed the basis of this study, although a quantitative research design was also employed thus the approach fell in both quantitative and qualitative paradigms .The two approaches are complimentary, providing different perspectives and answering different specific questions within any one broad area RDSU (2003).

In this case, social research in a development project context on the socio-economic impact of the irrigation is quite complex, and therefore requires the use of methods that elicit the dynamism of numerous intricate processes of social interaction Nemarundwe, (2003).In addition, qualitative research is inherently multi-dimensional method in design Denzin and Lincoln, (2000) and Flick, (1998) and this enabled use of triangulation to validate data gathered through face to face questionnaire survey, personal interviews, direct observation and remote sensing. In the same respect, (RDSU, 2003) states that qualitative research may also help to understand the findings of qualitative research. In this way, the researcher endeavored to offset the potential biases associated with quantitative research, mainly, such as being subject to researcher bias.

3.3 Field Management and Procedure

Field work was conducted in three stages. The first stage was a visit to the project to identify the stakeholders and to familiarize with the research area and work out on the logistics. During this stage the researcher also made appointment for a meeting with all the irrigation stakeholders.

The second stage was the visit to conduct a meeting with the project team leadership and local traditional and political leadership to seek permission to undertake the research. The same meeting was used to be used to explain the aim and objectives of the research and to also highlight the research process in its entirety. Introductory letters and research tools were issued out to the leadership to familiarize and get a better understanding of what the researcher wanted to do and achieve. This opportunity was also used to select the research population. After that the questionnaire was tested.

The third stage was undertaken after two days where questionnaire administration and interviews were undertaken over a ten day period from the 1st of June 2012 to the 10th of June 2012. Data analysis ensued three weeks after field work.

3.4 Sampling Procedure

A strategic random sampling method was used to ensure that all the three blocks' are fairly represented in the study i.e. block A, B and block C. Block A was determined to have 28.66% of the irrigators hence 9/30 irrigating respondents were taken from this block, block B 36, 59% and 11 respondents were to be chosen from this block and lastly bock C represents 34.76% of the irrigators and a total of 10 respondents were to come from this block. The irrigation management committee members were deliberately targeted for both extensive interviews and to respond to the self-administered questionnaires as part of various block samples. All in all 30 respondents were taken for sampling purposes. The numbers were to be doubled up to cater for the two research methods used that is interviews and self-administered questionnaire.

The next stage was to select the irrigators who were going to act as respondents for the research. On an introductory and explanatory meeting conducted with the irrigation management committee irrigators in the presence of community, political leadership and government representatives. Irrigators were asked to volunteer to participate in the research and were asked to group according to their blocks. A hat was used to randomly select 18, 22, and 20 respondents from block A, B and C respectively. An irrigation Committee member was included in each of the samples. The numbers were to be divided by two, with some part of the sample being for self-administered questionnaire and the half for interviews. The volunteers not chosen were thanked for showing interest in the research. Those who were chosen to participate in the research were given UNISA approved consent forms for scrutiny which were to be collected on the set day for research.

To gather data for the control group of non-irrigators, a strategic random sampling method was used where a tenth of each house was chosen in the neighboring ward that is not participating in the irrigation scheme. Men and women, youth and the middle aged were selected so as to be able to understand how experiences differ according to gender and age.

3.5 Primary Data Sources and Data Collection

The research objectives and broad research questions were used to identify data requirements and a suitable data collection method. The different data collection methods are described each in detail in the following section.

No single research method can capture all dimensions of a complex research problem; it is therefore, prudent to combine two or more methods drawing conclusion drawing from a synthesis of the results (Ulin et al.,2002).It has already been highlighted that triangulation of multiple method was used for this research. Each source provides a reality check on the other sources, while at the same time providing additional insights about issues, relationships, discourses and practices of farmers. Specific research methods used include in interviews with NGO, government agencies and irrigators, questionnaire household surveys and secondary data review.

3.5.1 The Questionnaire survey

The questionnaire was divided into themes and specific information for each theme was collected. Information gathered using the questionnaire included; demographic information, quality of life i.e. (health information, life expectancy, education levels, and wealth accumulation patterns, to mention but a few components of Human Development Index), farm employment data, production statistics, etc. The questionnaire was first tested against vague language and errors through a pilot administering before final administration.

This method was used due to its several advantages to achieve the aims of the research. One of the advantages of self-administered questionnaires is the ability to provide a better indication of the respondent`s real feelings. The researcher has the ability to tell whether the researcher is telling the truth or is lying. It also afforded the researcher the opportunity to explain questions that might not have been understood by the respondent. In addition to that the researcher controls the environment and was able to monitor the state in which the respondent was responding to the questionnaire. For example if the respondent is drunk or ill or not in a sober state the responses given might be altered by these factors. In addition, this also assists in minimizing refusal bias which might distort the ultimate result. Generally this method is 50% cheaper than other methods as the researcher doesn't can do it alone and can control pace of the events. Another batch of questionnaires was administered to the control group of non-irrigators using the same method.

3.5.2 Direct Interviews

The researcher conducted face to face interviews to gather information from irrigators, community leaders, government and nongovernmental representatives that are working in the area. An interview is a short term secondary social interaction between the researcher and the respondent for the explicit purpose of the researcher obtaining information about the irrigation project. The same approach as used in questionnaires to send explanatory letters before the actual interviews was employed. Information

was obtained in a structured conversation in which the researcher asked pre- arranged questions and answers were recorded. The project has 120 irrigators with only 30 irrigators who participated in the interviews in the manner prescribed earlier on.

Both the questionnaire and interviews were conducted with the help of extension officers from the particular area. These extension officers were given a day training in order to understand the objectives of the study and its importance. A summary of the research had earlier on been posted to these extension officers. Involvement of extension officers was important to help locate the selected households within each extension unit. Another advantage of using these extension officers is that they had experience in questionnaire administration as they often work with other researchers in various other projects linked to the extension department.

Table 3.1 Interviewee List

Interviewee	**Reason for interview**
Headman	To give a general overview of the socio economic impact of the scheme
Environmental Health Technician	To give a health and social perspective to on the impact of the scheme.
Agricultural Extension Officer	To understand the operational side of the irrigation scheme
Chief Nursing Officer	Gaining an understanding of the nutritional impact of the irrigation scheme
Local School Head	So as to better understand the impact of irrigation on education and quality of life
CARE International Field Officer	Donor agency providing food relief in the area aim was to understand the impact on food security in the area

3.5.3 Direct Observation

For the purposes of this research site visits were conducted .Remote sensing equipment and Google Earth used for the collection of data. Direct observation was solely aimed at ground truthing. This enabled the researcher to compare data gathered through questionnaires and other methods for example to have a first-hand impression of the developments that have taken place since the development of the irrigation scheme.

3.5.4 Photography

During the field survey the researcher obtained images(using a digital camera) mainly those of crops and various activities in and around the irrigation scheme. The images were taken to consider the successes and challenges in and around the irrigation scheme. Video was also recorded for the irrigation for analysis. Permission had been obtained prior in the introductory meeting with the farmers and irrigation committee.

3.6 Secondary Data

Published data was sought to gather information that is not readily available and also for a sneak view of past statistical history of things such as grain production, environmental history. This was done so as to make a comparison with present scenario and draw conclusions on the impact of the scheme.

Base line surveys to gather demographic data and socio economic data of, census records and Human Development reports was reviewed for the purpose of the research. Other documents reviewed included medical records, records of Grain Marketing Board and state of the province environmental reports with permission from the authorities.

A request of minutes of meeting of the irrigation management board was made to get an insight to the life of the irrigation scheme. This assisted in identifying challenges being faced by the irrigators and also the successes and identification of areas for improvement.

The local clinic provided the researcher with the some records on nutritional status of the community it serves and records related to water borne diseases for analysis and reading.

3.7 Challenges faced During Fieldwork.

There were a few challenges faced during the field work process. Prominent was managing expectations during data collection, especially from non-irrigators who were adamant that the researcher was hiding behind studies but was in actual fact a donor agent who would soon return with benefits for those in need. Consequently farmers tended to under report their harvests and assets. This was solved to some extent by physical verification and checking of official documents such as cattle dipping cards and Grain Marketing Board cards where these existed. Triangulation with other methods was employed to address this bias.

The other challenge was that farmers kept no records of their farming expenses and production records. This led to longer than expected data collection time as farmers would sometimes call in for help from their children and other relatives. This was across the board. The other challenge was the difficulty encountered in location of extension officers and other stakeholders as they are not stationed at the project. In the end lots of time was spend driving to find them which proved costly on time and resources.

3.8 Analytical Framework

Data collected for the study through qualitative methods was analyzed using a thematic approach. The thematic approach entailed encoding of this data according to the themes that had already been developed for the study based on objectives of the study, relevant literature reviewed for the study and those emerging from the data collection process from irrigators. Data was categorized into two categories social and economic impacts.

Questionnaire data was entered and analyzed in the Statistical Package for the Social Sciences (SPSS). Data was cleaned and analyzed through descriptive frequencies.

Further to that Microsoft Excel was used to make certain tables and graphs. To produce graphs and tables information was entered onto an excel spread-sheet and a command was instigated to produce graphs where a desired graph was chosen.

A health 24 calculator was used to input and analyse Body Mass Index. BMI or Quetelet Index is a heuristic proxy for human body fat based on an individual's weight and height. Body Mass Index is defined as the individual's body mass divided by the square of his or her height. The formulae universally used in medicine produce a unit measure of kg/m². BMI = mass (kg) divided by (height (m) ² .A BMI of 18.5 to 25 may indicate optimal weight; a BMI lower than 18.5 suggests a person is underweight while a number 25 may indicate a person is overweight; a person may have a BMI below 18, 5 due to disease; a number above 30 suggests the person is obese (over 40, morbidly obese) World Health Organisation (2012). All 30 people sampled from the irrigation scheme had between 18, 7 to 23kg/m². Information on respondents on weight and height was entered into the web calculator and automatically generated t and the BMI value of each respondent was tabled.

3.9 The Sustainability Livelihoods Approach

The sustainable livelihoods framework forms the basis for understanding important concepts namely vulnerability context, capital assets transforming processes and structures, livelihood strategies and livelihood outcomes. The framework also informs the analysis of the study. A number of studies on irrigation assessment studies have applied the livelihood approaches in rural Africa. In addition many other studies examined the linkages between rural irrigation schemes without necessarily applying the livelihood framework. The livelihood approach evolved from the 1980s and succeeded in winning the attention of key policy makers in donor institutions in the early 1990s the Department of International Development (DFID) in 1997.At this time the frame work succeeded in finding its way because of two broad factors, a broad international climate which favoured people centred approaches and a specific need to mark out a new phase of development practice in DFID Solesburg, (2003).

Although the framework has been widely applied within the field of development projects, it also has its relevance in irrigation and rural development projects; Burton et al. (2003).

3.10 Summary

A combination of methods was used to gather data from the irrigating community and surrounding non irrigating community. The methods used ranges from primary collection methods to secondary collection methods. These complemented each other to bring about a true picture of the irrigation activities. The two methods complemented each other to cater for shortfalls in other methods. Self-administered questionnaires, personal interviews with irrigators and stakeholders were the main gathering tools for data.

The researcher used various tools to analyze collected data, combining traditional methods and technology such as the excel sheets, social science statistical package and web based programmes to analyze data and generate the research report. This analyzed data is going to be displayed in the following chapter to show impact of the scheme and trends.

Chapter 4 : Empirical Results

4.1 Introduction

This chapter is a build up from last chapter and comprises mainly of graphs, statistics and tables on the research findings. It mirrors the Lower Gweru Insukamini community post irrigation establishment. This allows for impact assessment to be made on the effects of the scheme to the community and the surrounding areas. A parallel of the irrigating farmers is drawn to assess the significance so as not to overly depend on secondary data. This chapter is closely knitted to the following chapter which is aimed at reading the data and placing it in the context of the research.

4.2 Socio-economic environment

Lower Gweru's Insukamini area has a population of about 5008 people who are serviced by Makepesi Clinic that provide basic health care to the population. During the pre-independence period the Insukamini was used as a District Administrative centre a situation that changed after the independence of Zimbabwe in 1980. The disbanding of the centre as an administrative centre left the area devoid of any meaningful economic activity. This changed after the construction of the Insukamini Dam and the consequent establishment of Insukamini Irrigation Scheme in 1986 and 1987 respectively. These developments led to a semi peri-urban environment that exists in Insukamini today. The establishment of the irrigation scheme led to a development of agro-based activities such as farming, such as selling of vegetables and green mealies. Some petty fishing business also exists which acts as a source of income. The Insukamini community is serviced by two business centers Insukamini Business center and Makepesi Business Centre. These two centers provides farmers with grocery shops , grinding mills , butchery, night clubs/bars, that service the irrigating community , dry land farmers and some revelers who enjoy the tranquil country side from the nearby City of Gweru. Insukamini has two walking distance primary and secondary schools Insukamini Secondary School and Mkoba Primary School respectively.

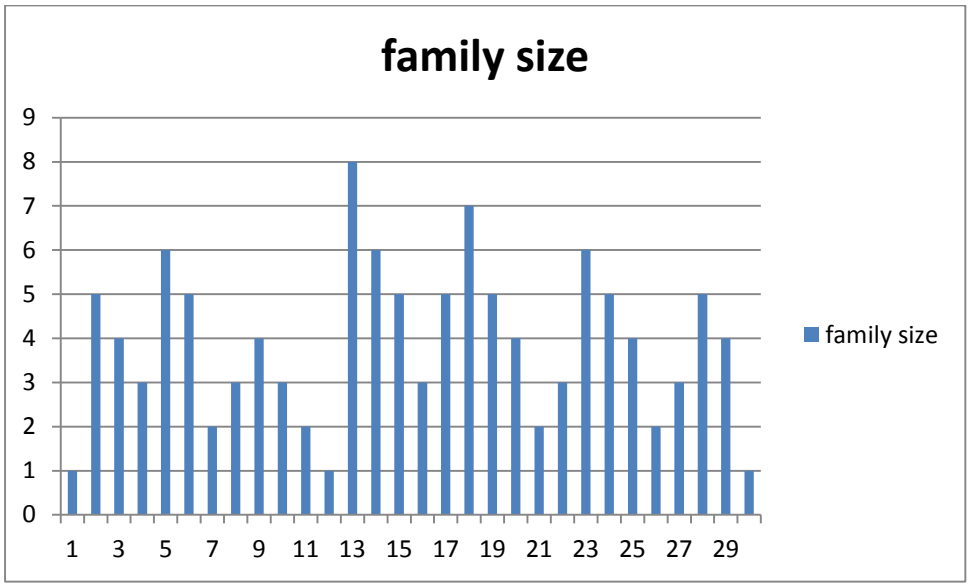
4.3 Household Characteristics

The irrigation scheme comprises of 120 households. The 120 members have plots on the irrigation scheme whose size ranges from a quarter of a hectare to half a hectare. The irrigators practise commercial farming (irrigation) and they are involved in farming activities throughout the year through multi cropping of food crops and cash crops. Summer and winter cropping exists with some farmers having three cropping schedules per year.

Farming is the main economic activity if not only the activity undertaken by farmers and extra income comes from family members who are working in surrounding towns of Kwekwe , Gweru, Bulawayo and Harare and some who are working outside the country for example in Botswana and South Africa. Irrigators however indicated that they hardly ask for outside help unless it is a family emergency as they are coping enough with the income that they get from the irrigation scheme.

The majority of households in Insukamini are small scale or subsistence producers with limited non-agricultural activities. The majority of farmers are involved in both dry land and in market gardening of vegetables, fruits and other such cash crops. This small scale farming is heavily reliant on family labour for production. Extra labour is however hired to fill up the demand on mostly small irrigation schemes. The other source of income for a few villagers is gold panning and some petty fishing using fishing lines. Fish is later consumed or sold on the road to motorists going or coming from the nearby City of Gweru.

Figure 4.1 Household Size



Most households have on average small families' sizes between 3 and 5 in the majority of cases. The average family size is 4. It can be concluded that most Insukamini households had enough labor to produce given the size of their plots. A larger family size also means that a variety of labour capacity is available in the form of young, middle aged and elderly members (Hayes et al., 1997). Increasing family size tends to provide households with required labour for agricultural production, while on the other hand larger family puts pressure on agricultural production (Paddy, 2003).

4.4 Age of Household head

Hofferth (2003) argues that the higher the age of the household head, the more stable the economy of the farm household, because older people have also relatively richer experiences of the social and physical environments as well as greater experience of farming. Moreover, older household heads are expected to have better access to land than younger heads, because younger men either have to wait for land distribution, or have to share land with their families. The average age of the respondents of irrigators is 40 years with the majority of respondents 75% of householders being married which

is much higher compared to sampled non irrigators. It has to be appreciated however that the majority of the 120 irrigators are women comprising 57, 9% of the total irrigators with 42.1 % being men.

4.5 Community Body Mass Index

The BMI is the heuristic proxy for human body fat based on an individual's weight and height. Its understanding is crucial in the examination of community's health and nutritional status of the community. Through calculation of BMI the impact of irrigation on nutritional uptake is better understood. The nutritional status of the researched community is important in determining the health status of irrigators. This has significance on person days spent on the field.

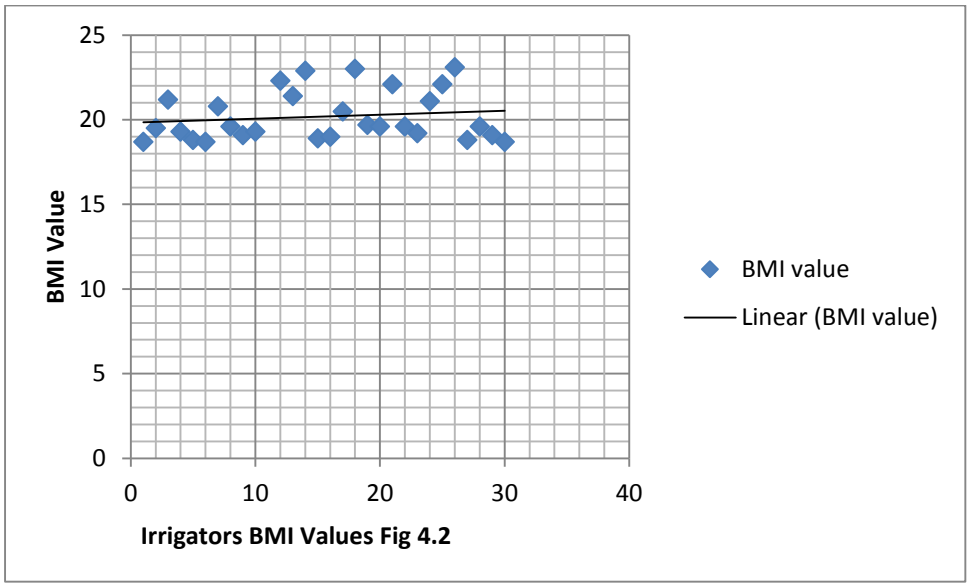


Figure 4.2 Irrigators BMI Values

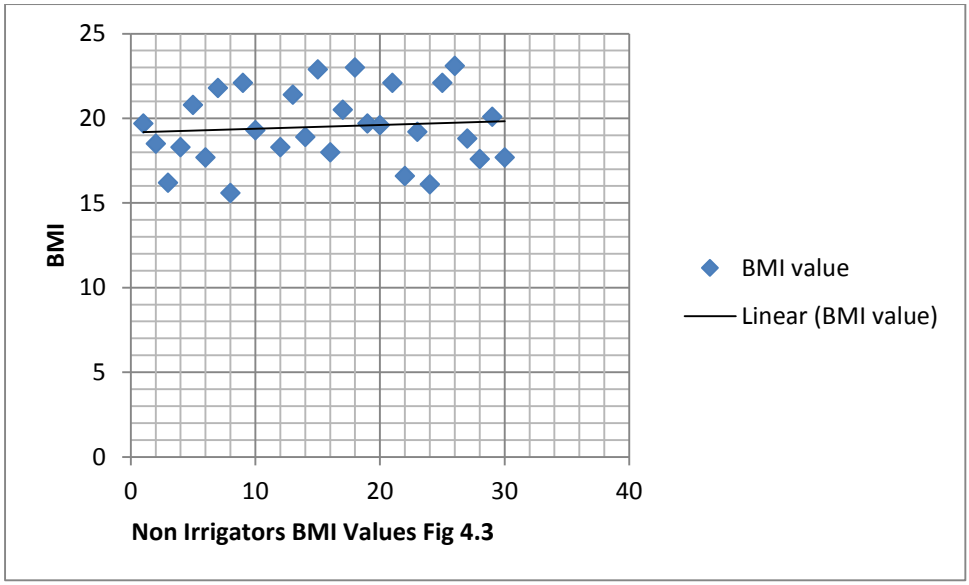


Figure 4.3 Non Irrigators BMI Values

4.6 Education levels of Irrigators and Dry land farmers

Education status especially that of the head of the household could lead to the awareness of the possible advantages of modernizing agriculture by means of technological inputs , enable them to read agricultural literature and input instructions and would lead to better decision-making Najafi , (2003).The education levels of the irrigators and non-irrigators is represented by the following graph.

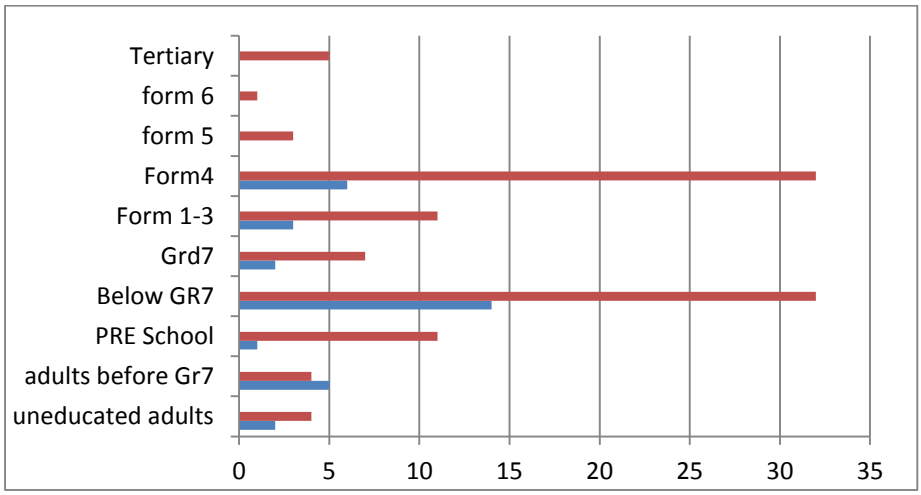


Figure 4.4 Education Levels Irrigators and Dry land Farmers

Figure 4.4 (series 2 irrigators) indicates that of all the adults interviewed, 4% of them did not attend school and the same percentage didn't reach Grade 7 with the bulk of people in adulthood having reached Form 4 accounting for up to 29% .The study indicated that there is a large population of Insukamini which is comprised of a young population. The graph resembles that of a developing society in a population pyramid of demographics. More than 52% of the sampled population comprises of children under the age of 18.The situation amongst non-irrigators is a bit different with the sampled population levels depicting a less educated populace especially amongst the adult population. The graph indicates that the irrigators' families are better educated than the dry land farmers. Education is an essential component of farming as it empowers them to make informed decisions as widely believed. Education has a positive impact on the operations of a farm or irrigation scheme.

4.7 Livestock

The sampled population indicated that the dominant livestock in Insukamini is cattle. The sampled population reveals that there is a larger population as compared to other livestock. Cattle serve as a source of traction in many developing countries, thereby significantly affecting households' crop production. Animal traction power enables households to cultivate greater areas of land and to execute agricultural operations timely (Goverech and Jayne, 1999) which might be the reason for its popularity with the exception of poultry .Figure 4.5 shows distribution of animal population amongst farmers in Insukamini before scheme and post scheme establishment respectively.

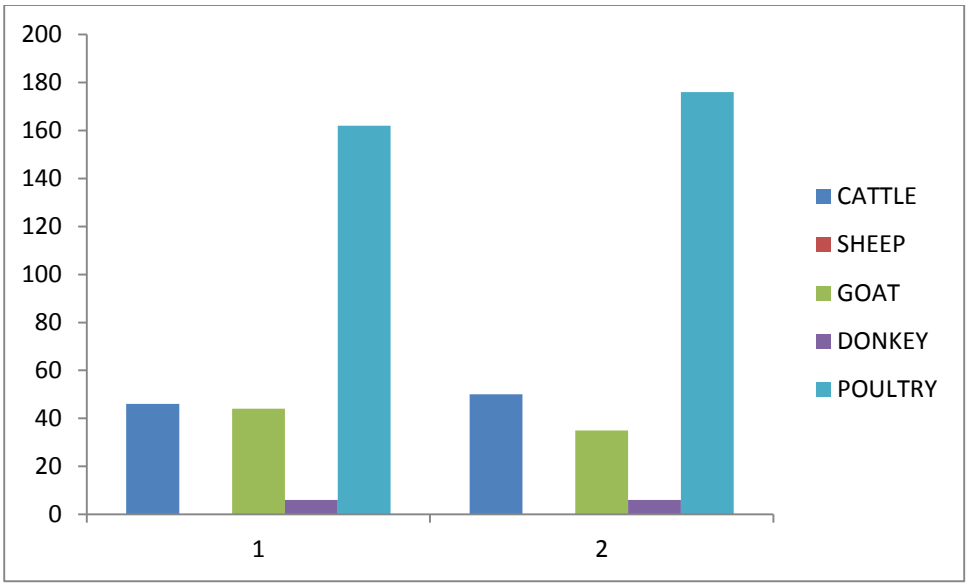


Figure 4.5 Livestock Ownership Irrigators

Tables 4.1 and 4.2 present the average population of animal and poultry distribution per household for both irrigators and non-irrigators.

Table 4.1 Average livestock ownership per family irrigators

Livestock	**Average Population/Family before Irrigation**	**Average Population After irrigation involvement**
Cattle	3.1	3.3
Sheep	0	0
Goats	2.9	2.3
Donkeys	0.4	0.4
Poultry	10.7	11.7

Table 4.2 Average Livestock ownership dry land farmers

Livestock	Average Population Per Family
Cattle	1.13
Sheep	0
Goats	1.13
Donkeys	0.63
Poultry	5.4

Table 4.1 and 4.2 highlights the significance of the Insukamini irrigation scheme as it has led to an increase in the average livestock population per family. Amongst irrigators the average population of livestock increased when farmers joined the scheme for all livestock types except for goats although the average population remains higher than that of non-irrigators. This highlights the central role played by irrigation scheme in boosting livestock population. Livestock act as a form of wealth and a buffer for hunger and un-for seen disasters.

4.8 Assets Ownership

The majority of households have access to agricultural implements. The hoe, watering can and the plough are the most common implements and in most cases these were found to be the only agricultural implements in excess to household sizes meaning that these are cheaper and or more important (central to agricultural production) than other implements used in communal areas. Farmers still use the ox drawn plough to till their land and the hoe is used for weeding. Important to note was the fact that these assets are more amongst irrigators than non-irrigators. One of the farmers bought a car from the proceeds gained from the irrigation scheme.

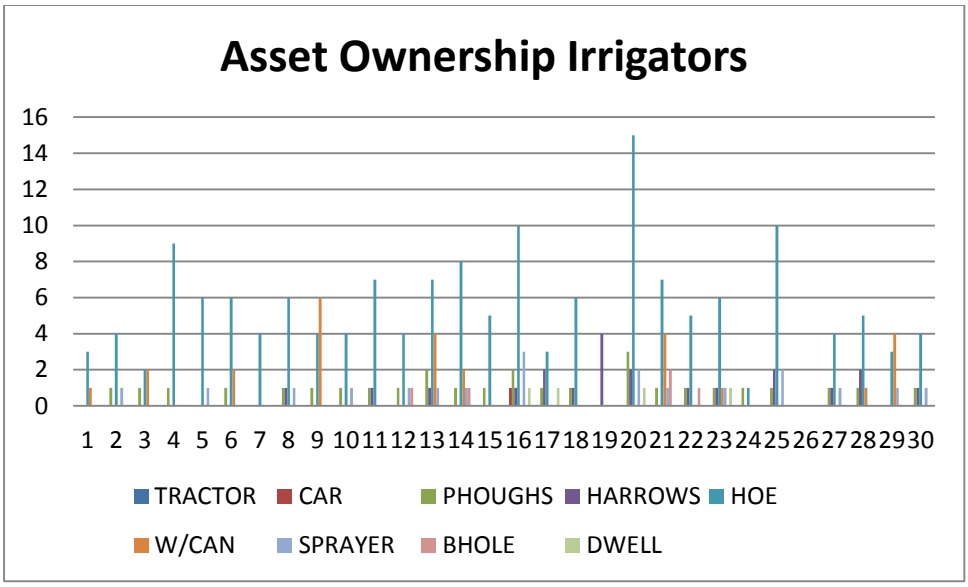


Figure 4.6 Assets Ownership Irrigators

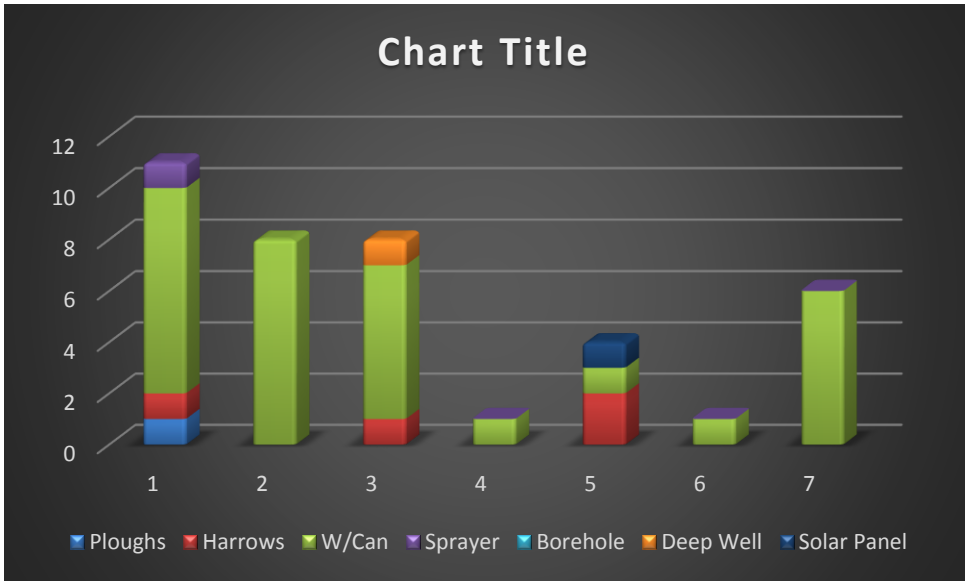


Figure 4.7 Assets Ownership: Non Irrigators

Figures 4.6 and 4.8 highlight the significance of irrigation schemes in the acquisition of household assets, tools and equipment. Due to better income generated from irrigation schemes irrigators can afford purchase of assets leading to improved infrastructure at home and better quality of life as opposed to dry land farmers.

4.9 Crops Grown by Households

The type of crops grown depends on the type of farming a farmer is involved in. Irrigators are more into cash crops and vegetables whereas the other dry farmers or crops grown on dry land are largely dependent on season. Those grown on dry land include the following: sorghum, millet, maize, ground nuts, sweet potatoes are the most common crops. Irrigation scheme production concentrates on maize, tomatoes, onions, garlic, cabbages, beans, peas, rape, butter nuts, carrots and sweet potatoes. Maize is the most preferred crop because it's the staple food and palatable. Green maize cobs however have a ready market anytime of the year in the nearby Gweru City which makes them a favorite for farmers. Production costs for maize are lower than for other crops.

Sorghum and millet are grown by farmers practicing dry land farming because these are suitable for climatic conditions in the area. Small grains (sorghum and millet) are drought resistant crops capable of surviving under low rains in the area, thus dry land farmers have put part of their land to these crops. The growing of cash crops and staple food such as maize by irrigators enables irrigating farmers to have better returns and ensures food household food security and consumption of palatable preferred food by irrigators. Drought resistant crops are not a crop of choice even for dry land farmers as they are considered traditional and not palatable to eat. An extension of irrigation scheme will ensure that all the people around Insukamini can afford choice food at all times.

Figure 4.8 shows the sampled response to crops grown under irrigation and dry land.

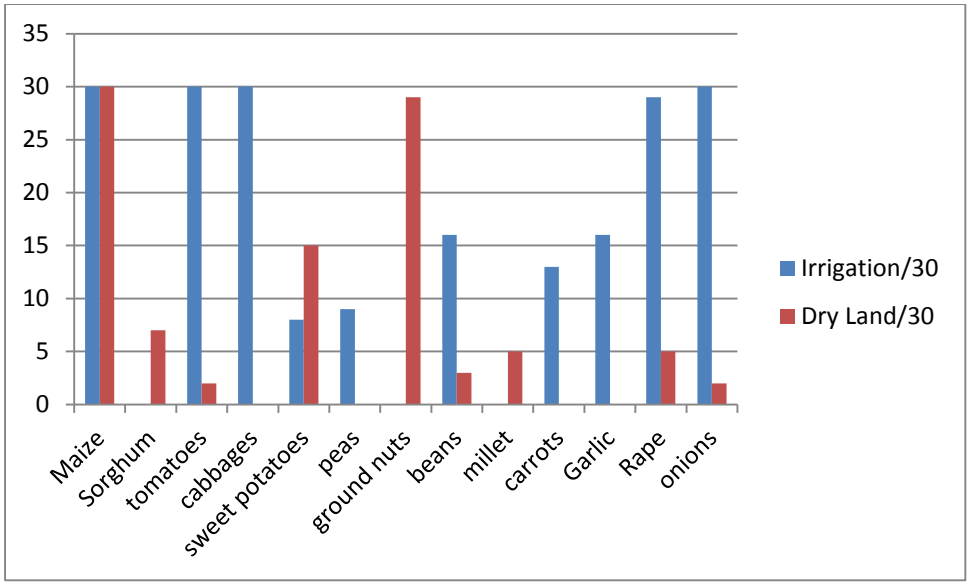


Figure 4.8 Crops Grown in Lower Gweru

4.10 Produce Marketing

Major constraints that undermine the expansion of rural irrigation production has been an important focus of attention, as poor and unreliable agricultural production becomes a constraint for an effective agricultural marketing system Zenda, (2002). While a poor marketing system become a cause for poor agricultural production, efficient and effective marketing systems are taken as the stimulus of high production Zenda, (2002). Most farmers cited access to a market as a major challenge due to transport limitations. Farmers indicated that there was no organized marketing system in place to assist farmers. Transport availability was reported as the major challenge to get produce to the market in Gweru, Bulawayo or Beitbridge where produce can fetch better prices. The indication was that sometimes crops such as tomatoes perish when there are transport challenges leading to losses by farmers. About 37 % of irrigators indicated that in such cases they sell products to hawkers to cut on transport cost though the prices are generally subdued in these cases. Some of these hawkers then carry these products to afore said towns and sell them at much higher prices. Respondents indicated that at times they sell crops to GMB when there is a surplus of production on both irrigation and dry land plots.

Table 4.3 Market channels utilized by farmers

Category	Respondents out of 30
Hawkers	30
Local Sales	30
GMB	5
Shops	20
Urban Deliveries	30
Didn't Sell	3

4.11 Summary

This chapter has presented results as gathered and acquired from the field covering the socio-economic and related issues that were being researched. It also highlighted the significance of the gathered data to the development of irrigation scheme. The following chapter however will focus on interpreting the results and their meaning or significance of each researched variable on the overall study. Parallels are drawn with previous studies to put the debate into context.

Chapter 5 : Results and Discussion

5.1 Introduction

This chapter is divided into two parts with the first part consolidating analysis of results and making comments on the results and their implications not only on development in Zimbabwe. This is done to put the research into perspective and in the process draw lessons. This part is set to respond to the research questions and responds to the aims of the research. An analysis of the impact of the research is made in both the social and economic practical and theoretical perspective.

The second part of this chapter focuses on analyzing the challenges that are faced by the irrigation scheme from an academic and practical perspective so as to pave way from recommendations in the following chapter.

5.2 Socio-economic impact of the Irrigation scheme

This section seeks to make an interpretation of the social and economic data that was gathered from the field and highlight its significance. The social and economic data is discussed within the broader national and international development taking the practical and theoretical framework into context.

5.2.1 Gender and Irrigation

The research noted the high level of participation of women in the irrigation scheme. During the five days of research the researcher noted that 4/5 people seen participating in the irrigation scheme were women. The statistics gathered from irrigation records show that a total of 70/121 registered irrigators are women accounting 57.9 % of irrigators are women. Of significance is the fact that the irrigation committee comprises of 6 women out of the 10 committee members. Two women hold very high posts in the committee, one being a vice chairperson and the other woman is a treasurer for the scheme.

Human Development Index is a measure of gender based disadvantage in three dimensions namely; reproductive health, empowerment and labor market. The index shows the loss in potential human development due to inequality between female and male achievements in the stated dimensions. The HDI scale lies between 0 and 1. Zero when women and man fare equally and 1 where one gender fares as poorly in all measured dimensions (HDI 2011 Technical Notes).The implication is therefore that rural irrigation schemes have a positive impact on the Human Development Index of a country as it enhances women's participation in labor and leadership positions. Rural irrigation schemes affect the Gender Inequality Index positively.

Given the demographic structure of the research area, it was noted that irrigation schemes in rural areas play a pivotal role in empowering women and brings the subject of gender equality to the fore. Irrigation schemes in rural areas are important in raising the Labor Market Participation Rate (LFPR) as evidenced by events on the ground. The LFPR for women in Insukamini irrigation schemes was noted to be quite high as compared to other societies and economic sectors which are dominated by man.

It can therefore be concluded that rural irrigation schemes allow for economic participation of women making them better economic actors and society leaders earning women respect and recognition in society. This ensures gender equity. Women in rural irrigation schemes undergoes intensive training in areas such as health, farming, project management, micro-economics making them better decision makers not only in farming areas but in other sectors of life i.e. in regard to social , economic and or political life.

5.2.2 Impact of Irrigation on Education

An interesting pattern was noted during research on education. Evidence revealed that children from participating families have a higher chance of completing school than non-irrigators. This phenomenon can be a result of availability of funds for the children from such families to go to school. This was also confirmed by the Headmaster of a local school, who indicated that the attendance rate of students from families in irrigation schemes was higher as compared to those from dry land famers who struggled to pay the minimal school fees that is charged by the school. The

following graphs presents a picture of Education levels amongst irrigators and non-irrigators respectively.

Education is also important given the fact that there is a general consensus that an educated person is more able to process information and use it to inform decisions, in addition to enabling the individual to perform tasks more efficiently than a less educated individual. Studies indicate that education may enhance farm productivity directly by improving the quality of labor. In addition, education is important to farm production, especially in a rapidly changing technological or economic environment Sharada, (1999) and Shultz, (1975).

After the analysis of data it was noted that the average amount of time spent in school by children from families in irrigation was on average 11.5 years compared to 10.9 years amongst non-irrigators in comparison to a national average of national level of 11 years in school UNDP (2011). The dropout rate for irrigators' children from school was 0.01% compared to 1.2% for non-irrigators

As Education is an important indicator of Human Development it's therefore correct to conclude that rural irrigation contribute towards a higher Human Development Index. Human Development Index (HDI) is a summary measure of human development. It measures the average achievement in a country in the three basic dimensions of human development: a long and healthy life, access to knowledge (education), and a decent standard of living. The HDI is the geometric mean of normalized indices measuring achievements in each dimension, Klugman et al.(2011).The HDI is the geometric mean of the three dimension indices: (I life⅓· I Education ⅓· I Income ⅓·).By affording an opportunity for learners to spend more time in school through rural irrigation direct or indirectly raises the country's Human Development Index.

During the survey it was noted that a number of parents from irrigation scheme take their children to schools in the nearest town due to availability of disposable income. This affords their children a better quality of education, increasing chances of those students to further education in tertiary institutions. This is an important contribution to the community and national development as it contributes towards a national skilled labor force.

5.2.3 Irrigation impact on Health

The research found that the establishment of irrigation scheme plays a pivotal role on the health of the irrigators and communities around the irrigation scheme. The research through the calculation of BMI of people participating in the irrigation of the ages from 20-65 years of age to have an optimal weight as compared to the non-irrigators. At least 3% of dry land farmers were reported to be under weight. BMI or Quetelet Index is a heuristic proxy for human body fat based on an individual's weight and height. Body Mass Index is defined as the individual's body mass divided by the square of his or her height. The formulae universally used in medicine produces a unit measure of kg/m².

BMI = mass (kg) divided by (height (m) ² .A BMI of 18.5 to 25 may indicate optimal weight; a BMI lower than 18.5 suggests a person is underweight while a number 25 may indicate a person is overweight; a person may have a BMI below 18, 5 due to disease; a number above 30 suggests the person is obese (over 40, morbidly obese) World Health Organisation, (2012). All 30 people sampled in the irrigation scheme had between 18, 7 to 23kg/m² as seen in figure 4.2 and 4.3.

BMI was calculated using the Health 24 calculator on their website Health24, (2013)

From the graphs presented (fig 4.2 and fig 4.3) it is clear that irrigators are healthier in terms of BMI hence irrigators contributes towards health security and ensures livelihood security. In essence given the above evidence it is fair to conclude that rural irrigation schemes contributes towards human and livelihood sustainability of rural communities. Irrigating communities have a better access to nutritious food and a bit of disposable income helping them to better access food ensuring food security.

The research found that due to the irrigation activities the community had a better nutrition. Out of a population 5008 served by Insukamini clinic only 15 children were on plumpy nut which has been donated by the donor agency Oxfam GB. Plumpy nut is a ready to use therapeutic food (RUTF), alongside other RUTFs such as BP-100, a solid form of the therapeutic milk. It's used to treat malnutrition in famine situations and can be administered at home without medical supervision. All the 15 Children suffering from malnutrition come from families that aren't involved in irrigation scheme in any way.

A rural irrigations scheme reduces the burden on government and donor agency to provide nutrition. Through improved nutritional uptake irrigation affords rural communities to help boost Human Development Index as Health is the third indicator looked at when calculating HDI. Given the amount of manual work undertaken in rural irrigation schemes irrigation due to lack of technology such as tractors and other farming implements; 30% of irrigators complained of chest pains.

Another phenomenon that was reported by the Environmental Health Technician was the fact that there is a highest HIV prevalence rate amongst irrigators than the non-irrigating community. Due to sensitivity of the information no statistical data was provided to back up this claim. This factor requires further research to explore reasons why this is so. A scrutiny of research done previously indicated that on farms where farming is taken as a full time job the prevalent rate for HIV and AIDS is higher than in other sectors of the economy. This situation is true for farms in Zimbabwe and South Africa.

It was also found that though not severe from the Female Health Technician who has been working with famers that there was a problem of schistosomiasis. Boelee, and Madsen, (2006) noted that schistomiasis is endemic in 46 African countries. They further noted that after being infected by larvae emerging from human excreta and urine deposited in water, fresh water snails act as intermediate hosts. They in turn produce larvae that enter through the skin of people who are exposed to the contaminated water. Many surface irrigation systems in Africa create favorable snail breeding conditions that facilitate the transmission of schistosomiasis which seems to be the case in the irrigation as surface irrigation system is used. The disease is however not fatal and can be controlled by environmental and chemical means (molluscides) and improved sanitation.

5.2.4 Economic impact of Insukamini irrigation scheme

The research found that the irrigators have a higher amount of disposable income as compared to other sectors of the economy. It was difficult to quantify the exact profits being made by farmers due to poor record keeping by farmers and the diverse product marketing being used by farmers. On average the famers form the records that were

checked indicated that on average depending on crops they grew and plot size amongst others indicated that they get between $3500.00 and $ 5000.00 per cropping season and realize profits of between $2000 and $3500.00.All farmers who participated in the irrigation scheme who indicated they had borrowed either inputs from government GMB or Agribank to finance indicated that they managed to repay all that they had borrowed without defaulting. This can be read to mean that irrigating families are financial secure as compared to non-irrigators.

The monetary gains reported by farmers are way higher than the farm wages between $ 30 and $ 45 a month and other general employees working in other sectors of the economy who earn on average $130 per month. The other group of workers some working in the urban areas have other expenses to pay such as rentals and food resulting in diminished disposable income. Rural irrigators who earn between $4000.00 and $7000.00 are way better off than other general workers. In this regard one would say that rural irrigation schemes play an important role in ensuring sustainable income for families and communities.

According to Zimstats first quarter report of 2012 food poverty datum line in February 2012 for 5 persons per household per month in Midlands Province where Insukamini is found is $157.48 and a national average of $ 161.56.Data from the field indicate that irrigating families have an income of between $333.33 and $583.33.These figures indicate that irrigating families are living way over the poverty datum line for both the province and the national figure. In essence families participating in irrigation schemes are relatively better off.

Manzungu and Van Der Zaag, (1996) reiterated the economic significance of irrigation schemes citing that rural irrigation schemes were considered as women activities but perceptions have changed due to high socio-economic conditions prevailing in Zimbabwe. Gardening and irrigation activities are important sources of family, food and income. IFAD, (2001) and FAO, (2003) reiterated the significance of irrigation schemes noting that poverty reduction is now one of the main goals of development yet progress against poverty stalled in many countries during the late 1990s and early 2000s .Of the 1.2billion people as dollar poor i.e. (with per capita household income or consumption level below US $1 a day in 1985 per person per day, three quarters

live in rural areas. Reviving the fight for poverty reductions suggests that one important weapon is investment in agriculture and specifically in irrigation.

The positive impact of the irrigation scheme was noted within the irrigating community whose lives have been positively affected by the participation in the irrigation scheme. The research found out that rural irrigation schemes which are commercialized affords the farmers to break the cycle of poverty. Farmers participating in irrigation schemes were found to be living above the poverty datum line and are better off than other farmers and general workers. Irrigators on average have an income of between US$ 333.33 and US$583.33 per month are way better off than other general workers. The higher disposable income earned by irrigators enable them to live a better quality of life. Farmers irrigating were capable of building better houses and furnish their homes to match some urban houses with television, radio and telephone sets being bought by farmers. One farmer was able to purchase a car which is an asset that carries a status in many African countries.

Development of irrigation is an important asset in not only in fighting poverty in rural areas but they can assist and act as growth points. Unlike other areas Insukamini Irrigation Scheme is supported by a thriving business center where farmers purchase their daily requirements. The business center employs people of multiple skills and hence the consequent ripple effect of the irrigation scheme. Irrigation schemes in that light affords rural communities to embark on sustainable projects not only in agriculture but in other economic sectors. This notion is supported by Hussein and Hanjra, (2004) who noted that Irrigation development could lead to new opportunities in agricultural trading and if increased wealth from irrigation leads to more demand in Asia where irrigation areas have become the nuclei of growth which attracts investments in new infrastructure and services.

A successful irrigation scheme leads to general infrastructural development not only for the irrigators but for the communities which hosts these schemes. The lower Gweru as a consequent of the irrigation scheme realized better communication and transport networks as compared to the generality of rural areas which do not have irrigation schemes. Melvyn 2003 reiterated this by highlighting that irrigation has numerous potential benefits in Africa .Most importantly it may contribute substantially to food security and economic progress, which in turn provide rural households with greater

purchasing power for essential commodities, including improved access to health care delivery services and education. Frequently irrigation development also implies more general infrastructural improvements, better roads (thus better access for health services) rural electrification and sometimes housing improvements.

The Japan Bank of International Cooperation (2007) supported this by pointing out that households in irrigated settings (as measured using housing index access electricity and other infrastructure. They also exhibit better health and lower incidence of malnutrition as measured using Body Mass Index (BMI) of household heads.

An adoption of various strategies such as rural irrigation schemes, growing drought resistant crops such as sorghum, sweet potatoes and rapoko, etc. will go a long way in reducing hunger and poverty amongst rural communities.

The irrigation scheme employs security guards from the local community on a 12 month basis and other general workers for farm activities hence reduces the unemployment levels of the community and provides for much needed jobs. The employees can better care for their families. This assertion is core shared by Dhawan (1998) who noted that irrigation causes stability effects because of reduced reliance on rain fall – hence irrigation lowers variance of output and employment and yields and helps to reduce adverse consequences of drought. This is further reiterated by Japan Bank of International Cooperation, (2007) that crop intensification in irrigated conditions enables households to cultivate both wet and dry seasons therefore has a strong land management effect. Per hectare labor employment is higher in irrigated settings than in rain fed settings such that access to irrigation infrastructure generates almost an extra month of employment during the wet season alone, when only labor use for crop production is accounted for. Further household level access to irrigation infrastructure reduces inter season variability in labor employment , both hired and family which implies that irrigation generates higher and stable employment throughout the year. Further, irrigation enables households to earn higher daily wages, and this difference in daily wages is sufficient to uplift people out of poverty.

5.2.5 The Impact of irrigation on rural employment patterns

The agriculture industry is the largest single employer in Zimbabwe employing 780 000 people as of December 2010 which is the latest statistics available Zimstats First Quarterly Report, (2012).The data from the field indicates that rural irrigation schemes plays a pivotal role in terms of rural employment. Irrigators provide an employment opportunity for the unemployed unskilled and semi-skilled laborers in rural communities throughout the year. This increases the population that is economical active in rural areas. Irrigators employ non irrigators to work as security guards for their crops in the evening mostly and to assist in other irrigation activities such as land clearance, weeding and mostly harvesting. Rural irrigation schemes create a multiplier effect due to increased incomes. Shops and grocers and small bakeries are opened to service farmers as noted by the research. The need for better housing and other facilities that were constructed also created employment opportunities in the construction industry and the earlier mentioned sectors. Irrigation schemes also create entrepreneurial opportunities for non-farmers such as petty traders for green irrigation produce as evidenced by events on the ground in Insukamini.

Figure 5.5 shows a group of general laborers employed to extend the fields for irrigation in Insukamini.

Figure 5.1 Irrigation Expansion underway

5.2.6 Impact of Irrigation Scheme on quality of life

Quality of life as noted through increased revenue and improved nutrition that rural irrigation schemes has led to improved rural livelihood in Insukamini. Quality of life as defined in terms of Human Development Index, developed by Alkire et al. (20100.The tool which cites indicators of standard living as access to electricity , access to clean water , adequacy of sanitation, house floor types , fuel used for cooking (dung, wood or charcoal), ownership of a car, truck ,or any vehicle , ownership of assets such bicycle , motor cycle , radio , refrigerator, telephone or television.

Through increased economic activities necessitated by the irrigation scheme 100% of irrigators reported that they had access to tap water or borehole water. This was against a back drop of 80 % of non-irrigators who indicated they had such access the deprivation to clean water however extended as one moved away to communities far away from the irrigation scheme. This demonstrated the significance of the irrigation scheme in as much as the improvement of people's standard of life is concerned.

One of the bases of growth and poverty reduction is access to assets Brooks et al. (2005). The research also found that 75% of homes of irrigators had electricity and

that they relied on either electricity or paraffin stoves for cooking in comparison to 5 % of homes with electricity among non-irrigators who heavily relied on fire wood for cooking. All irrigators' homes had either television or television and had one or two mobile phones for communication. The area within a radius of the irrigation scheme had access to all three mobile phone operators in the country; Econet wireless Zimbabwe, Telecel Zimbabwe and Netone. Moving further away from the scheme signal was lost indicating no coverage for them. Communication technology is a vital vehicle for development in this day. It necessitates both voice and data communication. Farmers can use it to market and compare prices for their commodities and to research on best farming methods enhancing productivity. In this regard one can conclude that the irrigation scheme helped in improving the quality of life for the Lower Gweru community in and around the irrigation scheme.

In terms of housing, the research noted that 85% of respondents had clean floors made out of concrete and cement. The majority of respondents indicated that their houses were either under asbestos roofing or corrugated iron sheets. The bulk of Lower Gweru however has fewer asbestos roofing and corrugated iron sheets with the bulk of the houses there predominantly being under grass thatching. In this regard it has to be said that irrigation has helped in improving the people's quality of life.

The irrigation scheme is linked by a narrow tarred road that is in bad condition. This road makes communication easier with Gweru town. The tar ends a little more than 10km from the irrigation scheme. The transportation of inputs and agricultural produce is made easier through an improved road network system. However the benefits of a better road system extend to other sectors of people's lives.

5.3 Sustainable Livelihoods

5.3.1 Impact of irrigation on food security

According to the World Food Summit of (WHO 1996) of1996 as existing when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life. The concept of food security includes both physical and economic access to food that meets people's dietary needs as well as their food preferences .Food security is built on three pillars:

- Food availability: sufficient quantities of food available on a consistent basis.
- Food access: having sufficient resources to obtain appropriate foods for a nutritious diet.
- Food use: appropriate use based on knowledge of basic nutrition and care as well as adequate water and sanitation.

The research found out that all the irrigators were food secure even in years of meteorological drought as they are able to produce enough food for their families and there is always a surplus to sell to non-irrigators and to the neighboring town of Gweru. All 30 irrigators who participated in the questionnaire indicated that they have never been food insecure since they started irrigation. However all irrigators reported that they faced food shortages during the time they were not involved in the irrigation scheme in major drought years of 1992, and in 2008 amongst other years. They also reported that in drought years they either borrowed food or got government hand-outs and donor food to survive. It was noted that donor agencies in drought years delivered food that was not familiar to the farmers such as yellow maize and bulgur wheat.

The picture was quite revealing amongst non-irrigators who reported that they are not producing enough food due to endemic droughts. Out of the 30 respondents 25 indicated that they face hunger at an alarming rate. The 25 dry land farmers indicated that this year they were already running out of food stocks as the March harvest was not adequate to cover their daily food requirements until next year. This was confirmed by Agritex Officials, Environmental Health Technician and CARE International a nongovernmental organisation operating in the area who said they were exploring ways to get food for the rain fed farmers. Some farmers indicated that they had already asked for help from their relatives to give them money so as to purchase food from the irrigation scheme which always produces surplus food. Some farmers said that they were looking for contract work at the irrigation scheme in exchange for food.

Whilst all irrigators indicated that they either have tap water or use deep wells from their yards for household water use non irrigators indicated challenges in getting fresh water during the late dry season. Distance travelled to fetch water during droughts and late into the year increased, posing sanitation challenges.

The food security of irrigators can be attributed to several factors. Irrigators have access to water throughout the year and they receive a lot of support from government

through farming extension services. Since the farmers are organised they have been given resident agricultural extension officers who advices farmers on various farming methods and farming best practice methods.

Irrigation farmers are involved in intensive farming. They plant a variety of High Yield crops. This enables them to get maximum yield per unit area. Not only do these famers make use of HYVs but they also make use of chemicals and fertilizers as they approach irrigation as a business to ensure that they get a maximum yield. Irrigation farmers also plant cash crops; allowing them to make huge profits from their plots and then use the money to supplement other foods and also to get cash for other family projects. This is in sharp contrast to dry land farmers who solely depend on drought resistant crops which produces not such a big harvest per unit area. Small grains are grown such as raphoko and sorghum to try and mitigate the mid-season drought faced in the area. Due to mid-season droughts, dry land farmers cannot make use of fertilizers as rains are not always adequate to make this possible. This further hampers the quality of harvest dry land farmers get.

The Asian Development Bank (2000) and FAO, (1997) noted that farmers participating in irrigation schemes never ran out of food unlike dry land farmers that's irrigation ensuring household food security. This factor was proven in the Insukamini irrigation scheme where farmers indicated that they had food throughout the year as they are farming throughout the year. The research found that whilst irrigators reported food security the other dry land farmers indicated the variations in climate change saw them vulnerable to hunger. During the interview that was conducted in June 2012 dry land farmers indicated that their March harvest had run out barely three months after harvesting. This indicates the level of vulnerability of dry land farmers to hunger and food insecurity amongst dry land farmers as compared to irrigators. With the extreme weather system expected to be on the increase due to climate change, it will be advisable to invest more in small rural irrigation schemes to deal with issues of poverty and hunger.

The fact that the irrigators are food secure a, finding supported by Dhloldo, (1997) that an irrigation scheme reduces the burden of expensive food imports through ensuring food security. It will be learnt that irrigation is an important strategy in ensuring food security since it results in government savings and ensures access to food by

smallholder farmers. Farmers in Insukamini enjoy the human dignity of producing their own food instead of continuous food hand-outs from the government and donor agencies.

The research found out that the BMI of irrigators was optimal ranging between 18.7 and 23kg/m^2.This further supports the notion that the irrigators have a better nutritional status as compared to non-irrigators which reported malnutrition of 3% amongst the researched population. This supports the argument that was put forward by Dhawan, (1998) who noted that irrigation are important assets as it may lead to poverty reduction via increased cropping yields, increased cropping areas and higher value crops. Increased yields can mean increased food surplus, higher calories and better nutrition levels. This notion is far true as compared to the irrigation scheme as farmers have since embarked on the cultivation of high yield variety crops and hybrids in the irrigation scheme such as the cultivation of a variety of hybrid seed maize, hybrid tomato 9009, cabbage hybrid seed 3301, 3311 and 3316 and butternut squash hybrid amongst other hybrids that are being used in the irrigation scheme. Increased harvest has ensured not only an improved nutrition for the irrigators but for the surrounding communities.

The irrigators since they use high variety yielding crops they are capable of producing enough food for their families and enough surpluses to sell to the local and regional market. The neighboring communities now access cheaper food commodities as reported by the African Development Bank 2000 that noted that rural irrigation is skewed in favor of those having access to fertile, well drained lands, reliable water supplies, and yield enhancing inputs poor people have also benefitted in terms of enhanced food security and incomes (marginal and small farmers, lower food pricing mostly urban poor and employment both rural and urban poor. This scenario is present in the Lower Gweru area and the greater Gweru area with people driving 45km to buy food and vegetables from the irrigation scheme at a whole sale price which was found to be times three lower than at the Gweru's Kudzanai crop market and Harare's Mbare Musika Crop market. However food at the Insukamini was 25% cheaper than at the retail markets. The irrigation provides a cheaper alternative for the poor urbanites in Gweru and much so for the surrounding communities of Lower Gweru.

The availability of cheaper easily accessible food has led to much lower incidents of malnutrition with only 15/5008 people only suffering from malnutrition. Dependence of on government hand-outs and donor support is greatly reduced due to the successes of the Insukamini irrigation scheme. Against this back drop the research seeks to recommend the construction and adoption of the Insukamini Irrigation scheme throughout the country to assist in eradicating poverty alleviation, ensuring food security and mitigate the impacts of climate variation and climate change.

Since irrigation schemes afford farmers an opportunity to produce their own food it is important to note that the irrigators have buffers from global food price fluctuations which are a threat to most societies. The communities are to some level immune to the food price fluctuations that are caused by political instability, changes in fuel prices unlike other farmers such as dry land farmers.

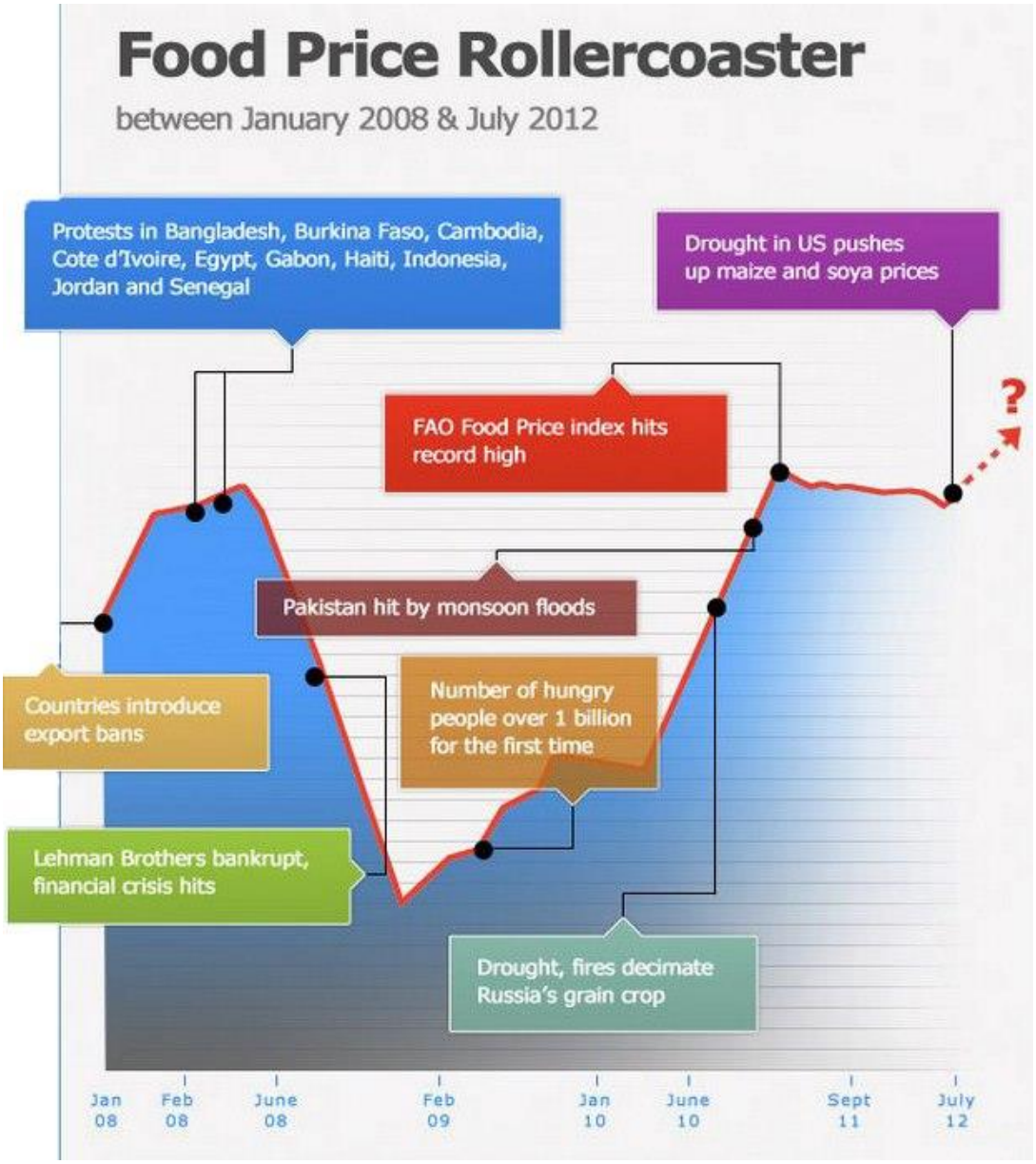


Figure 5.2 Food Price Regime: Adapted from the World Food Programme (2012)

Fluctuations in food prices tend to affect the marginalized rural communities the worst, and farmers in irrigation schemes can use irrigation as buffers from global food market fluctuations. Further, irrigators plant crops throughout the year thus maximizing on the land whilst dry land farmers can only grow crops in summer. In the light of the above field findings it will be best to highlight that rural irrigation goes a long way in ensuring household food security.

The irrigation scheme of Insukamini ensures food security by acting on four critical drives: greater agricultural productivity of small holder farmers; more effective nutrition

supply especially for children; greater household resilience to cope with shocks; and wide popular participation and empowerment, especially of women and rural poor. These drives change, by ending the ravages of hunger and malnourishment, nurtures capabilities and conditions for human development. It has created a well-nourished and empowered population which has in turn sought education, participates in society expanding human potential. Rural irrigation schemes can sustain virtuous cycle of higher human development and enhanced food security.

5.3.2 Impact of irrigation on livestock

The research found that there is a positive relationship between livestock and irrigation scheme. There was a general increase in population size of livestock for families involved in the irrigation scheme. This can be attributed to the fact that irrigators are no longer reliant on livestock as a source of income in difficult times, payment of school fees, payment of medical bills, and purchasing of food stocks during droughts amongst other such pertinent expenses.

Average cattle average population per family for example during pre-irrigation participation is fig3.1 and post participation is fig3.3 whilst for non-irrigators on the other hand is way too low at a family average of 1.13. For the irrigators however it will be realized that they managed to increase their herd by 0.2 which is a plus. For goats, however there is a decline for those that participate in the irrigation scheme. Pre irrigation participation indicates an average population of 2.9. The post irrigation figure is 2.3 indicating a drop of 0.6.This research could explain this phenomenon. Poultry figures on the other hand indicate a positive relationship for those in the irrigation scheme. Pre irrigation figures indicates a population average figure of 10.7 and post average figure per family of 11.7 indicating a positive increase of 1. Average figure for non-irrigators is however is pretty low at 5.4. It can be concluded that irrigation schemes have a positive impact on livestock farming and contribute therefore to the rural families' general wealth.

Tables 4.1 and 4.2 draws a comparison of population dynamics for livestock in Insukamini and its surrounding areas who acted as a control group for the research.

Table 4.1 and 4.2 shows a series comparison of livestock population for the period farmers were involved in the irrigation and for the period they were not involved in the irrigation scheme. The significance of irrigation schemes cannot be over emphasized to bring about a better life for the rural populace. The wealth of rural communities is generally measured by the number of livestock since livestock is the most important indicator of wealth in rural areas. At family level livestock is expected to be a buffer from unseen events and quickly converted into cash. Livestock do not only provide food for household but also a number of products which could be sold or consumed by household members to provide nutrition , income , traction and fuel. Products from livestock include draught power meat, milk eggs, manure which is used as fertilizer or fuel, fiber and hides. When crop failure occurs because of rainfall shortage, the level of one's resources (livestock) is very important to combat food shortages Kang'ara et al. (2001). This has a positive effect on food security.

5.4 Irrigation and Climate Change: Impact and implications

Climate change is a defining challenge of our times. Its impact and implications are global, far reaching and largely irreversible. Climate change is already increasing the risk of exposure to hunger, malnutrition and food insecurity among the poorest and most vulnerable people. Natural disasters are becoming more frequent and intense, land and water are becoming more scarce and difficult to access, and increases in agricultural productivity are becoming more difficult to achieve. By 2050 the number of people at risk of hunger as a result of climate change is expected to increase by 10 to 20 % more than would be expected without climate change; and the number of malnourished children is expected to increase by 24 million – 21 % more than without climate change. Sub- Saharan Africa is likely to be the worst affected region Perry et al. (2009).

The impact of climate change on both food price and crop production is seen in the negative with or without the use of agricultural technology. It is important to note that the impact of climate change on agricultural production in irrigation schemes is much lower as compared to that where rain fed is practised. It is anticipated that climate

change will further render rural communities even more vulnerable to poverty and hunger.

Intergovernmental Pannel on Climate Change, (2009) study projected the response of rice , wheat and maize to climatic variability under the SRES A2 scenario using the National Centre for Atmospheric Research (NCAR) CCM3 and the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) MK3.0 models (International Food Policy Research Institute [IFPRI] , (2009) and Nelson et al . (2009).The results incorporate the biophysical effects of climate change on crop production, the changes in crop production .Table below presents the results for the biophysical effect of the two scenarios, with and without carbon dioxide fertilization on production of the three crops modelled with the Decision Support System for Agro technology Transfer (DSSAT). Irrigated and rain fed wheat and irrigated rice are especially hit hard.

Table 5.3 below highlight the impact of climate change on crop production, including biophysical effects, % change in production compared with a reference scenario with no climate change in 2050.

Table 5.1 Expected impact of climate change on irrigation and non-irrigation farming

	CSIRO NoCF	CSIRO CF	NCAR NoCF	NCAR CF
Maize ,irrigated				
East Asia and the Pacific	-8.19	-7.75	-9.40	-8.81
Europe and Central Asia	-12.61	-12.58	-13.68	-13.63
Latin America and the Caribbean	-23.89	-23.47	-24.04	-23.65
Middle East and North Africa	-30.51	-30.85	-31.23	-31.32
South Asia	-25.99	-24.44	-25.33	-23.80
Sub-Saharan Africa	-39.67	-39.55	-39.53	-39.36
Developing Countries	-15.67	-15.16	-16.39	-15.78
Developed Countries	-3.22	-3.19	-10.55	-10.40
World	-8.86	-8.61	-13.19	-12.84
Maize ,rainfed				
East Asia and the Pacific	-19.03	-17.29	-13.70	-12.21
Europe and Central Asia	-24.40	-19.41	-74.80	-72.68
Latin America and the Caribbean	-11.24	-8.89	-12.96	-10.98
Middle East and North Africa	-24.54	-23.00	-57.40	-57.14

South Asia	-36.83	-34.78	-25.50	-22.95
Sub-Saharan Africa	-14.64	-14.80	-15.15	-15.32
Developing Countries	-15.56	-13.90	-16.57	-15.20
Developed Countries	-6.04	-2.23	-14.67	-7.20
World	-12.73	-9.11	-16.01	-12.83
Rice, irrigated				
East Asia and the Pacific	-21.94	-6.33	-28.31	-11.64
Europe and Central Asia	-32.96	-19.80	-40.62	-26.06
Latin America and the Caribbean	-24.91	-20.74	-20.06	-13.80
Middle East and North Africa	-46.50	-37.18	-56.74	-47.46
South Asia	-19.79	-3.12	-23.69	-6.23
Sub-Saharan Africa	-39.43	-27.75	-41.28	-29.28
Developing Countries	-22.61	-7.60	-27.26	-11.32
Developed Countries	-17.27	-5.00	-19.00	-6.84
World	-22.30	-7.44	-26.78	-11.05
Rice , Rain fed				
East Asia and the Pacific	-8.46	-0.88	-10.84	-2.60
Europe and Central Asia	-31.00	-25.70	-36.89	-6.34
Latin America and the Caribbean	-20.66	-15.14	-25.76	-19.56
Middle East and North Africa	-100	-100	-100	-100
South Asia	-16.41	-11.33	-12.62	-8.46
Sub-Saharan Africa	-11.48	-9.19	-10.05	-7.59
Developing Countries	-13.09	-7.11	-12.70	-6.79
Developed Countries	-30.50	-26.82	-34.59	-30.45
World	-13.13	-7.15	-12.75	-6.84
Wheat ,irrigated				
East Asia and the Pacific	-19.22	-13.92	-24.42	-19.15
Europe and Central Asia	-46.77	-43.22	-53.39	-50.43
Latin America and the Caribbean	-21.47	-16.56	-26.11	-20.94
Middle East and North Africa	-30.13	-24.57	-35.49	-30.45
South Asia	-50.12	-41.84	-57.67	-50.28
Sub-Saharan Africa	-34.45	-30.14	-34.00	-28.61
Developing Countries	-37.49	-30.96	-43.85	-37.85
Developed Countries	-22.59	-18.94	-28.91	-25.34
World	-35.54	-29.39	-41.89	-36.21
Wheat rainfed				
East Asia and the Pacific	-34.42	-27.18	-39.14	-34.13
Europe and Central Asia	-46.61	-41.74	-51.27	-46.55
Latin America and the Caribbean	-4.91	-4.31	-3.06	-3.99
Middle East and North Africa	-20.26	-10.86	-24.28	-16.01

South Asia	-54.67	-42.05	-57.73	-45.95
Sub-Saharan Africa	-32.82	-23.58	-33.78	-27.31
Developing Countries	-30.99	-23.35	-33.78	-27.31
Developed Countries	-17.11	-11.95	-22.11	-16.74
World	-24.52	-18.03	-28.34	-22.38

Source: Nelson et al. (2009).

The table makes an important conclusion in that it furthers the fact that irrigations can reduce by 50% the challenges of food insecurity, malnutrition and hunger amongst rural people. Rural farmers tend to benefit in the price increase that will go along with the anticipated climate change.

Given the potential to produce enough food at household and community level in the Insukamini Irrigation Scheme, one would ordinarily recommend the adoption of rural irrigation schemes as buffers from climate change induced food shortages. If the impacts are not curtailed families will not only be hungry but they will be poorer as a lot of resources will be spent on purchasing food as studies indicate that climate change will reduce agricultural production in most of the world as we have seen happening in USA and the consequent increase in food prices and increased food insecurity and malnutrition. Developing countries will be hit harder than developed countries, and most food insecure regions – Sub Saharan Africa and South Asia – will be the hit the hardest and adaptation practices such as rural irrigation will halve this impact Perry et al., (2009).

5.4 Challenges and Opportunities for sustainable livelihoods

The research found some challenges that needs to be looked into by stakeholders to improve rural irrigation agriculture operational efficiency that are quite specific to the scheme. If some of these aspects are addressed rural irrigation schemes will become even more beneficial to host communities and surrounding areas.

5.4.1 Input Challenges

The Irrigation committee indicated that there were challenges that they were facing securing inputs such as seeds and chemicals are causing unnecessary inconveniences for farmers. Since irrigation farmers make use of hybrid seeds especially for vegetables, they found it difficult to secure the seeds easily. At times farmers had to travel to as far as Harare to get hybrid seeds and even there farmers and the extension officers said that it was difficult to secure seeds. This was attributed to seed companies which they blamed for causing artificial shortages. The claim was that seed houses are exporting seeds to South Africa where they make better profits. These exports were then imported back into the country at inflated prices. Farmers then had to import seeds at exorbitant prices. Farmers indicated that seed hybrids such as cabbage seed number 3301, 3311, 3316 were not readily available on the local market. For tomatoes they find it difficult to get tomato seed 9009 and for butter nut the squash seed was problematic to acquire yet these are seeds they require to ensure a maximum yield. They said that the above mentioned are in demand as they are better adapted to their environment and are not as vulnerable to crop diseases. Farmers indicated that they are guaranteed a good harvest with the above seed varieties yet they aren't readily available on the; local market. If farmers can get the seed they require it would enable them to cut on chemical costs maximising on profit and ultimately their disposable income.

The other challenge farmers grapple with is that of lack of representation at government level. Whilst other farming groups have representation at government level with formal unions that represent them and push for their interests the rural irrigators have no specific representation. There are basically two farmer Unions in Zimbabwe that are all based on racial composition of members with one representing the white farmers by and large and the other one representing black farmers. The Zimbabwe Commercial Farmers' Union (CFU). CFU amongst others:

- provides legal advice to its members on issues ranging from acquisition of equipment and materials , stock theft ,Labour, environmental matters of civil and criminal nature,
- Lobby and advocacy around certain policies and regulations which undermine the viability of agricultural production and competitiveness of the agricultural production and competitiveness of the agricultural sector (e.g. ZINWA i.e.

inappropriate and expensive environmental licenses and many other similar challenges to viability.

- Advocacy to ZESA and lobby for improved power supply and more affordable power supply to farmers.
- Provide assistance in writing projects proposals.
- Reports to policy makers and policy recommendations (e.g. representations at Parliamentary Portfolio hearings).
- Providing HIV and AIDS, Gender training programmes that are geared to improve knowledge and skills awareness campaigns and reinforce prevention and education through effective awareness campaigns and outreach programmes and farms.
- Providing extension services , research , production handbooks , liaison with producers , field days , discussion groups advice and crop and livestock problems , advice on product marketing , representation at industry meetings , and representation at industry meetings and representing local , regional and international forums.
- Provide wide ranging discounts (over 370 registered companies) through Discount Club to anybody who subscribes to the Club.
- Providing Preferential Trading Partnerships which aim is to boost commercially produced crop and livestock output by putting into operation a multifaceted financing input procurement , and marketing scheme designed to benefit all preferential trading partners involved in the farming members , participants from the banking and insurance sectors, input supplies and crop livestock markets ZFU, (2012)

The Zimbabwe Commercial Farmers Union is a registered farmers' Union. It was started on the initiative of large scale indigenous commercial farmers who entered the business of commercial farming after independence. The Union operated as an association from 1990 until it was registered as an indigenous Commercial Farmers union in 1996. The union has since changed its name to Zimbabwe Commercial Farmers Union (ZFCU) and its mandate is to serve commercial farmers irrespective of farm size ZFU, (2012).

It is however, important to note is that rural irrigators are not represented by any of the commercial farmers unions that have been discussed whose role in shaping farming activities is undoubtedly needed by these famers to increase their operational efficiency. If irrigators can get as many benefits and access to research knowledge and cheaper inputs such as those being enjoyed by commercial farmers they will be able to engage in better agricultural activities.

The research found that irrigators were not benefiting from government programmes aimed at assisting farmers hence need for proper representation. For example the extension officer for Insukamini Irrigation Scheme was not benefiting from the government's Agro Dealer Scheme. The scheme was aimed at providing agro inputs in local shops countrywide. Agro dealers were to access cheap loans from Agribank to supply local shops in their local areas. This benefit did not trickle down to Insukamini Irrigators due to corruption where banks were diverting the funds to general dealers for their benefit according to reports.

5.4.2 Market Access and Pricing.

The research found that farmers were facing serious challenges to get their crops to the market and in the end they were underselling their crops. This affects negatively the farmers' profit margins. The farmers attributed this to lack of transport to move their products to the market. Those who managed to get their crops to the market witnessed that they were able to sell at times the price they sell at the scheme. Farmers felt that those who come to buy at the scheme were robbing them as they often dictate the price of purchase. Farmers also cried foul over contract farming companies as most often they were short changed. This has to be addressed if viability and profitability are to be improved.

5.4.3 The Challenges with Loans and Contract Farming

The research further found that farmers were being duped into contracts that they did not quite grasp and at the end they are sitting with debts that they are not supposed

to pay. During the field work the researcher witnessed at first-hand the conflict between a donor agency CARE International and farmers. Farmers were coerced into taking beans seed at a loan where farmers were to grow beans and then give back a percentage of the yield to the donor Agency come creditor. At the meeting it was clear that farmers signed a contract they did not quite understand as there was a harsh exchange of words as CARE came to demand its share of the harvest regardless of the fact that the beans crop was affected by frost and a consequent crop failure. CARE was adamant that it wanted to be paid back its credit and farmers felt that this was unfair. Farmers in the irrigation scheme are not covered by an insurance making them vulnerable to natural disasters and such loan arrangements. Farmers have to be somehow advised when getting into dubious deals as they tend to impoverish them. Figure 5.9 depicts the crop at the center of dispute and the meeting which was held to find a solution.

Figure 5.3 The crop at the centre of dispute between CARE International and Insukamini Irrigators

5.4.3 Water Logging and Water Management Challenges.

Apart from the previously mentioned challenges it was witnessed that some sections of the irrigation scheme were severely affected by water logging. This affects harvest negatively as crops cannot do well under water. This problem talks to engineering

challenges of the irrigation scheme. Since canals are used some sections of the canal are not properly done leading to water seeping into nearby plots. In the end these farmers do not get as good harvest as the rest of the farmers.

Figure 5.4 Crop under water

The research also established that a lot of water which farmers were paying for was ending up being wasted through seepage and wasteful ways. At the end of the canals there is no diversionary to direct back the water into the system. Water is allowed to freely flow into the surrounding forest. This water has caused erosion and it can be reused or put to good use as it is water that farmers are paying for.

5.4.4 Droughts and Related Challenges

Due to increased incidence of drought induced by climate change and climate variation there are fears that the irrigation scheme is under threat. The extension officer indicated that there was not enough rains for the past three years that had led to the dam water levels falling significantly. The extension officer indicated that evaporation rates and withdrawing rates were higher in years of drought. Due to rainfall variability irrigators were now almost forced to irrigate throughout the year. The dam, according

to sources initially could supply the irrigation scheme for three full years of drought but since the irrigation have been expanded due to rising demands there were fears that if there is not enough rains this year irrigation might be stopped. This will pose serious challenges not only for irrigators but for the people around the scheme who depend on irrigation for sustenance. The extension officers recommended that there be new measures to manage water and to use it efficiently for the sustenance of the scheme. The indication is that flooding method has to be phased out to pave way for better water management systems such as drip irrigation.

The farmers also complained that due to increased droughts imposed by climate variation and climate change cases of theft soared during these period. Farmers complained of crops and livestock theft. This has led to an additional cost for security. Farmers noted that they paid a monthly fee to the people that are employed by the scheme to guard the irrigation scheme during the night. Even then farmers reported that crop theft though reduced but was still going on. In conclusion then it is fair to say that though the irrigation scheme is performing well , however, there are tactical moves that needs to be taken to make the scheme even more viable. Though some of these cases may seem small and insignificant there is need to address them whilst there is time as they might develop into even bigger problems in future.

5.5 Summary

The chapter made important findings with regards to the importance of Insukamini Irrigation Scheme. It was found that irrigation schemes have an important role to play in shaping rural livelihoods. The Insukamini Irrigation Scheme significantly managed to change the rural livelihoods through various ways that include food security, income generation through which livelihoods can be empowered to delve into other sectors of people's lives such as health and education. Human development is fostered by irrigation schemes and women are empowered.

Regardless of the important roles that have been played by Insukamini Irrigation Scheme there are imminent challenges which threaten the scheme which needs to be addressed to improve the operational efficiency of the scheme and other schemes elsewhere. The challenges range from natural disasters such as climate change and related climate change related weather patterns to those that are human in nature.

Challenges cover both national planning challenges and local challenges that require attention. The coming chapter will provide some solutions to challenges farmers are facing in order to better the rural irrigation development.

Chapter 6 : Conclusion and Recommendations

6.1 Introduction

This chapter is divided into two segments. The first part of this chapter is focused on summing up the research project looking specifically at the main findings of the research project and lessons that can be drawn from Insukamini Irrigation Scheme. The second part of the research focuses on analyzing the challenges facing rural irrigation schemes global and locally and finishing off with recommendations on both future development and future studies. Recommendations are presented based on current developments and practices at the Insukamini Irrigation Scheme. Recommendations are also framed taking into consideration the international experiences and practices on irrigation schemes for sustainable livelihoods. Some recommendations are quite specific to the scheme whilst others are general to cater for all rural farmers.

6.2 General Conclusions

The study identified a number of social and economic significance of irrigation schemes both at national and international levels. Irrigation schemes in Zimbabwe present generally a mixed picture of success and failure. Irrigation schemes generally provide opportunities for development for rural communities and assist in the reduction of poverty. The irrigation scheme affords marginalized communities an opportunity to enter into the main stream economy. It enables the irrigators and the surrounding communities an opportunity to produce enough food for their families and extra food that can be sold to neighboring communities ensuring both community and household food security.

The research found that though there is a decline in irrigation funding globally there is need to vouch for more funding for irrigation schemes as they assist also greatly in employment creation. In most countries irrigation scheme provides employment opportunities for the largely unemployed rural people. Employment is both direct and indirect through employment of people to work on the farms and indirectly where it

creates a ripple effect in the economy for other sectors of the economy. In essence irrigation developments if well managed they result in community economic development.

The irrigation system in Zimbabwe is still developing. The irrigation schemes like in other part of the world are at various stages of development with some doing well and some failing to meet their expected impact. The reason for these scenarios in the irrigation schemes in Zimbabwe are varied ranging from technological factors, management issues and implementation factors. Irrigation schemes use various technologies ranging from drip irrigation system, overhead sprinkler system, flooding and others. However it is important to note that the Zimbabwean Government embarked on a dam construction soon after independence in a bid to promote irrigation in the country and ensure not only water security but also food security for its large rural population.

The construction of Insukamini dam and the consequent construction of Lower Gweru/ Insukamini the irrigation scheme was a welcome development in the area as it was aimed at improving the quality of life for irrigators and neighboring communities. The other main aim of the establishment of the irrigation scheme was to ensure household and community food security to the rural populace of Lower Gweru who are located in one of the arid regions of Zimbabwe, reduce rural to urban migration and to create an economical active population that is less reliant on donor funding. The sole aim was to reduce dependency of the Lower Gweru people on government hand-outs.

The research found that since the inception of the irrigation scheme in Lower Gweru so many lives have been transformed both socially and economically. The main benefactors of the irrigation scheme are the irrigators, their families and the community of Lower Gweru. Making use of mainly self-administered questionnaires, interviews and field observation research found out that the quality of life for people of Lower Gweru was greatly improved through establishment of the scheme. Regardless of challenges faced by irrigators the scheme is a success in terms of having met the aims and objectives which it was designed for.

The findings from the research indicates that the first major benefit of the irrigation scheme was that it afforded farmers an opportunity to increase food output per square area. This was achieved through the production of hybrid crops, growing of cash crops.

Cropping season was increased from a single cropping season to two cropping seasons a year. Farmers through irrigation scheme started taking farming as a business where they would make an investment and expect certain level of profit margin. The use of chemicals and fertilizers ensured an increased harvest per unit area.

The increased crop production per unit area made available enough food for irrigators' families and the surrounding communities this resulted in food security, reduced food prices around the Lower Gweru community. Food security resulted in improved nutrition for the irrigators and resulted in a health community as indicated by good levels of BMI.

The research also noted that the produced surplus food by irrigators was sold to nearby communities and the surrounding area. This ensured an extended food security for nearby communities as they were able to access food at a cheaper price. The accumulated funds from crops sales by farmers was channeled towards other developmental activities for the irrigators' families such as construction of better houses with corrugated iron roofs, and cemented floors, drilling of boreholes at irrigator's houses, purchase farming tools and equipment, purchasing of livestock such as cattle, goats, chickens, etc. Other uses of irrigation profits were the acquisition of medicine and sending children to school. This led to improved standard of living for irrigators and, an improved Human Development Index for the irrigating community.

Research also found that the irrigation scheme resulted in the development of better infrastructure for the community through the construction of tarred roads, setting up of base stations for cellular networks resulting in an improved standard of living through transport, communication and information technology. There was a ripple effect of the scheme on other sectors of the economy due to goods demand by the irrigators. Entrepreneurship opportunities also arose as a result of irrigation establishment in the form of welders, grinders, builders, establishment of small businesses, etc. The irrigation employs local unskilled and semi-skilled labour reducing unemployment in the neighboring communities. Benefits of irrigation scheme also are extended to the employees of the irrigation scheme who work as general hands and as security guards on the farms.

The other findings were that farmers face a basket of challenges which if addressed may increase the irrigation's operational efficiency and translate into more benefits for the irrigators and the community. Some of the challenges faced by the irrigators are stock and livestock theft, market failure, shortage and sometimes un-availability of inputs due to supply constraints. Farmers indicated that they face challenges in accessing inputs which are at times too expensive or not available from local market hampering their farming activities. With regard to market access farmers indicated that due to lack of transport to ferry commodities to the agricultural commodity market in Gweru in the majority of cases they were forced to undersell their produce to cunning middle man who buys from the irrigation scheme , undermining their profit margins. Theft was identified as a challenge amongst farmers as they had to employ security to guard their fields day and night to safe guard their crops. Livestock however was considered to be much more endangered as there were no mechanisms to guard them throughout the year. Livestock stolen was sold to the Gweru urban people with farmers loosing on much needed pull power and in cash terms.

There were other environmental factors that posed challenges to the scheme in the long and short run. The dam was under threat from siltation which poses a direct threat on the dam and the only source of water for the scheme. The issue of climate change was also considered a big threat as the water levels are fast falling as a result of reduced precipitation and increased evapotranspiration.

What is clear from the research study was the indisputable positive impacts of rural irrigation scheme Insukamini. The positive socio economic impact of the irrigation scheme are not only limited to the irrigators but affects all the hinterlands of the scheme. There was consensus amongst irrigators' stakeholders and non-irrigators that if development is to be spread to outskirts beyond cities, towns and growth points especially in drier parts of the country irrigation scheme are the way to go. Rural irrigation scheme from the evidence gathered during the field survey can provide the key not only to poverty reduction but can as the key in ensuring rural development. Through irrigation schemes government can ultimately be able to achieve the Millennium Development Goals.

The socio economic significance can never be over emphasized. However there are few recommendations that need to be taken into account pertaining future

development of rural irrigation schemes and studies. Rural Sub- Saharan Africa's food security and human development enormously depends on agriculture. Agriculture determines food availability, the first link in food security chain. It is the main source of income and employment for a majority of Africans, especially the poor and thus directly human development. Completing the circle, income and employment strengthen food security by enabling people to purchase or produce food. Agriculture also shapes how Sub- Saharan Africa uses its land and water – and how sustainably. Irrigation productivity is the key driver for of sustainable agricultural progress.

6.3 Recommendations

Having spent some time in the field conducting research the researcher have made some observations and come up with a number of recommendations about further research and policy making in the area of rural irrigation and development.

1. Evaluation of irrigation projects funded by government or NGOs with poverty reduction objectives need to cover not just economic and technical impacts on the poor .In particular project evaluations should examine the impact on yields , output , and crop mix on different types of irrigation beneficiaries , perhaps classified by farm size income or income group. Employment effects need to be separated into short run construction related effects and long run agricultural related effects on surrounding non irrigated areas should thoroughly be investigated. Ideally a pre and post evaluation must be done using two surveys or recall techniques.
2. Research focused rural irrigation needs to prioritise poverty reduction and livelihood security as much as average increase in yields and outputs. Hence research also need to focus on technology most appropriate for different types of poor users and poor beneficiaries. Technology that creates demand for labor rather than replacing it is most likely to be appropriate so as to spread the benefits of the irrigation scheme even to non-irrigation actors.
3. Much more research is needed into the poverty impacts of irrigation projects to provide more detail on which types of irrigation are of greatest benefit to

different types of poor people in different agro-ecological regions and institutional settings.

4. The GoZ amongst other must find ways in which to provide the right seed packs and other inputs to rural farmers in a cost effective way so as to ensure continuity and viability of rural irrigation schemes. Benefits that are being enjoyed by large scale commercial farmers through their unions must be extended to rural irrigators. There is need for the government to increase the amount of government funding and to disburse funds that are meant to benefit farmers in time so as to pace up with farmer requirements. Farmers who deliver their produce to the state controlled GMB need to be paid on time to allow them to plan for the following seasons. The current scenario resulting in farmers receiving payments for delivered produce cannot be acceptable as it is not sustainable.
5. Ways have to be sought to provide rural irrigators small home factories for packaging and processing of their products so as to value add their harvest for maximum benefits and extension of employment to nonfarm actors so as to further reduce rural to urban migration.
6. Further research can be done to assess the impact of irrigation on sexual and reproductive health so as to address the issues and concerns earlier highlighted about irrigation schemes and HIV and AIDS.

The research noted a pattern which couldn't be explained by this research which can provide opportunity for further. It was noted from a number of people who were interviewed for research who are irrigators, that a high percentage of them are married as compared to non-irrigators where most of them are single. Further research is needed to find answers as to why this is the case.

Government and development agencies are encouraged to move away from traditional methods of farming that are not sensitive to water management and conservation such as flooding method that is currently being used at the scheme. Movement must be towards water saving methods such as drip irrigation. This is important as the severity of climate change is intensifying worldwide. Most dam life span projections were done when evaporation rates were pretty low and a lot has changed. There is increased cases of droughts and aridity meaning if rural irrigation schemes are to survive there is need to adopt water saving methods.

6.3.1 Capacity Development

Capacity development and facilitation and facilitation of dialogue between farmers , distributers , agro processors and marketing agencies is required to ensure success of irrigation schemes. This approach can be used to improve adherence to standards relating to quality and volume, as well as timelines in the delivery of agricultural produce. Productive dialogue is central to examining agribusiness companies pricing incentives with a view to encourage irrigation farmers to produce higher quality products in a timely manner. In addition, establishing long term contracts and viable partnerships between farmers and agribusiness companies that ensure the provision of training, technical support to farmers and any farmer organisation will prove to be fruitful.

Other options for improving connections between farmers and markets include increasing and sustaining government /public sector support to develop and implement policies and guidelines that encourage investments in private agribusiness ventures while protecting producers, facilitate information generation on production and post-production technologies, provide marketing infrastructure and information systems ; and put in place fiscal incentives that are supportive of research and development not only for enhancing on farm productivity, but product development based research and innovation to facilitate off- farm growth of agro- industries and marketing (International Assessment of Agricultural Knowledge , Science and Technology Development (SSA) Report , 2009).

6.3.2 Market Development and Access

The state of under- development in Zimbabwe, low levels of market integration and poor infrastructure continue to cripple the competitiveness of irrigation agriculture. Zimbabweans (the majority of whom live in rural areas) are poorly served by both input

and output markets. Without well-functioning input markets, development in irrigation farming will not benefit Zimbabwean farmers to the maximum as seeds, fertilizers, tools and other inputs remain largely out of reach for the majority, due to high input prices resulting from in efficiencies created by high transactional costs and information asymmetry. Similarly, low prices in output markets prevent producers from earning income conducive to poverty alleviation and stimulating a demand for a non-farm products, a necessary condition for industrial growth and a structural transformation of Zimbabwean economy. Improving the functioning of Zimbabwean market is vital to reversing the stagnant state of irrigation agricultural productivity and to increasing incomes for the poor, well-functioning markets can reduce the food bill of urban populations , the majority of whom are food insecure and spending a large proportion of their incomes on food. This creates a win, win situation with farmers whose irrigation profitability increases as a consequent.

Interventions for enhancing the performance of Zimbabwean markets and hence linking producers to the markets must ensure that markets work for the poor, by developing markets where markets do not exist and improving infrastructure where markets do not function properly due to infrastructural related constraints MA, (2005). Markets are rudimentary especially in environments characterized by low population density, dispersed rural households and a poor rural road network. In addition to ensuring that markets exist and function, addressing challenges related to market exclusion for irrigators is crucial. These constraints include inadequate productive assets and collateral, social attitudes barring women from participating in them, un-favorable terms of trade including poor output prices remain a challenge in Zimbabwean agricultural market. The situation is exacerbated by a lack of bargaining power by the irrigators and rural farmers and poor access to information.

It has to be appreciated that there is no single solution to rural development and sustainability but an integrated approach and people centered approach will achieve the desired results. Government and donor agencies have to invest in rural development which suffered during years of structural adjustments (SAPS) that was aimed at developing urban centers at the expense of rural areas. Development of rural irrigation schemes and agriculture will ease budgets on social spending as rural areas are capable of producing enough to trigger development and feed the urbanites. The issue of agricultural subsidies given in developed countries and are non-existent in

developing countries have to be visited so as to ensure agricultural development in Zimbabwe and other developing African countries. An agricultural subsidy in developed countries stifles agricultural growth in developing countries. More funding for agricultural research in rural areas and funding for climate adaptation methods in Zimbabwe has to be availed .An integration of indigenous knowledge systems and investigations into the use of GMO in the wake of climate change might be what the country needs to reduce poverty and hunger in rural areas.

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APPENDIX A

Irrigators' Questionnaire

Socio-economic impact of Lower Gweru irrigation scheme.

Thank you for participating in this questionnaire.

The information that you give is going to be strictly used for the purpose of this research. No information will be disclosed to a third party without your consent.

If for any reason you feel you no longer want to be a part of this process feels free to say so

Date of Interview: ...../06/2012

BIOGRAPHY

Questionnaire Code ☐ Sex Female ☐ Male ☐

Age

Ward ☐ Marital Status ☐ ☐

Family Size ☐ Ward ☐

Height ☐ Weight ☐

1. How long have you lived in the village?
2. How long have you participated in the irrigation scheme

HOUSEHOLD CONSUMPTION

Household composition, education and occupation (Choose from under notes after the table.

No	Name	Sex	Age (year)	Marital status	Relationship to HH-head	Years of School	Primary	secondary	Tertiary

Variable Code:

Sex 1= Male 2= Female

Marital Status: 1=Single 2=Married 3=Divorced 4=Widowed 99=NA

Relationship to household head 1=Self 2=Husband 3=Wife 4=Daughter 5=Son
6=Grandchild 7=Parent 8=Labourer 9=Sister 10=Brother
11=Step Child 12=Others

Educational Level: 0=Illiterate 1=Pre-school 2=Grade 7 3=Form 2 4=Form 4
5=Form 6 6=Diploma 7=Degree 8=Others 99=Children Underage

Occupation: 1=Farmer 2=Trader 3=Housewife 4=Professional 5=Construction
6=Craft work 7=Student 8=Domestic work 9=others (Specify) 99=NA

Household Assets

1.2.1. Number of buildings owned by household:

Building No.	Type of roof	Type of floor	Initial cost US$	Date of Construction	Present value

1.2.2. Assets and investments:

Asset type	Do you have any of the following assets 1=yes; 0=no	How many do you have	Asset(s) Value in US$	Year Acquired
Tractor				
Car				
Ploughs				
Harrows				
Hoe				
Watering can				
Sprayer				
Borehole				
Others				

1.3. Plot or allocated field/land

Land Utilisation	Code	Area (ha)
Homestead	1	
Rain fed cultivated	2	
Irrigated land	3	
Fallow land	4	
Pasture land	5	
Others	6	

1.4. Livestock ownership statistics as of 2011/2012

Animal type	Code	Population at entry	Population 2011	Value in US$
Cattle				
Sheep				
Goat				
Donkey				
Poultry				
Others				

Cattle = <1year, 6< months, young bull and heifer =-1year, matured cattle =>3years

1.5. Infrastructural accessibility

Time taken from place of residence to access services and or infrastructure.

Accessibility to closest	walking	Vehicle	Source of supply
Inputs supply shop			
Veterinary services			
Clinic/hospital			
Crop markets			
Schools			
Milling			
Others (specify)			

Source Code: 1=cooperatives, 2=private 3=government service 5= shops

1.6. Water Supply

What is your primary source of water for domestic use during wet and dry seasons?

Water Use	Season	Main water source: 1=river 2=dam 3= borehole 4=tap	Period of water availability	Water quality 1=good 2=bad 3=average	Distance to water point
Human	Wet				
	Dry				
livestock	Wet				
	Dry				

SECTION B: Socio economic information

2.1. What are the main objectives of using irrigation? (Categorise according to your evaluation)

1= Generate cash income 2=household food security 3=livestock food production

4= others (specify) _____

2.2 How many plots do you have under (1) Irrigation

Rain fed

2.3 What are the health challenges you are facing as a consequent of your participation in the irrigation scheme? _____

_____

2.4 What economic challenges are you facing as farmers in your area? _____

_____

2.5 Are you always capable of producing enough food for your family? _____

2.6 Which didn't you produce enough food for household consumption and why?

_____

2.7 In that year how did you cover for the food shortage? 1= Borrowed food crops 2 = Purchased food 3= government relief 4= NGO relief assistance 5 = Others Specify

2.8 What challenges are you having at the irrigation scheme? Rank out from 1- 5.

Challenge	Ranking
Water	
Land	
Labour	
Inputs	
Marketing	
Crop disease	
Theft	
Others	

2.9 What conflicts are you facing in the irrigation scheme? _____

2.11. How are your relations with the rain fed farmers? _____

2.11. How are conflicts resolved within the irrigation community?

_____

2.12. What land developments have you undertaken? _____

_____

2.13. How much did these land developments cost you?

SECTION C

3. What is the approximate distance of main water source from centre of the plot? ☐

3.1 How is water transported from the main source to the field? _____

3.2 What irrigation method is used?

3.3 How are irrigation cycles determined? 1= wait for signs of moisture stress 2= when till the soil is dry 3= irrigate every day 4= follow prescribed irrigation cycle ☐

3.4 Does water availability a limitation in cultivated area?

3.5 Does the amount of water received affect the type of crops you grow? 1=YES 2=NO

3.6 If yes which crops do you give priority to ?Rank in order of priority.1st _____

2nd _____

3rd _____

4th _____

3.7 Who make decision on irrigation cycle? _____

3.8 How much do you pay for using water? ☐

3.9 How often do you pay for water? 1= Monthly 2= seasonally 3= annual

SECTION D Production information

4.1 Production statistics for the last two seasons.

Plot	crop	Plot area	Seed cost	season	Irrigated 1=yes 2=no	Pesticides costs	Fertilizers costs	Total yield	Earnings in US $	Tonnage sold	Receipts in US $

Crop code 1=maize 2=beans 3=wheat 4=potatoes 5=cabbages 6= rape

7=spinach 8=tomatoes 9=onions 10 =carrots 11Others

4.2 **Labor Source**

Source of labor	Labor type	Filed clearing	Ploughing	planting	Application of fertilizer	watering	weeding	harvesting	guarding	Others specify
Family										
Hired										
Exchange labor										

SECTION E Irrigation financing

5.1 What is the major determinant of your prices? 1=Radio information 2=Newspaper 3=traders market 4=fellow farmers 6=extension officers 7= GMB 8 Others (specify)

5.2 Where do you acquire your inputs? _____

5.3 Where did you get finance to start your irrigation scheme project? _____

_____

_____

5.4 Have you ever borrowed to finance agriculture? 1=Yes 2=No

5.5 If Yes from where? _____

5.6 What was the loan for? _____

5.7 What security was needed? _____

5.8 Was the loan received in cash or kind? _____

5.9 How much was the loan value in $? _____

5.10 How are you servicing the debt? _____

5.11 What extension services do you receive from government? _____

_____

Thank you for your cooperation

Total Duration

Interview Guide: Socio Economic Impact of Lower Gweru Irrigation Scheme in Zimbabwe

Questions to be asked pertain to the following aspects of the irrigation scheme:

- demographic aspects
- community employment patterns
- trade and commerce patterns
- infrastructural development prior and post scheme establishment
- household food security issues prior and post scheme establishment
- wealth accumulation pattern prior and post irrigation scheme establishment
- transport logistics to the market and in the transportation of inputs
- Gender duties as a consequent of scheme establishment.
- technical and financial assistance sources
- employment patterns within plots
- Inheritance matters skills development in relationship to the irrigation schemes among other issues.
- Relationships and interaction between irrigators and non-irrigators.

APPENDIX B

Questionnaire

STAKEHOLDER'S QUESTIONNAIRE

Research Into

The socio-economic impact of Lower Gweru Irrigation Scheme

Date of Interview: _____/06/ 2012

Name of Government Institution Represented_____

Position of Respondent _____

Years working in the Community _____

1. What is the nature of your relationship with the irrigators?

_____

_____

2. Do you have any direct bearing on the irrigation scheme if so what is it?

_____

_____

3. What developments have you seen taking place attributed to this irrigation development?

_____

_____

4. How has irrigation development shaped livelihoods of the community?

_____

_____

5. How would you evaluate the irrigation development and how?

_____

_____

6. How do you compare livelihoods of irrigators and non-irrigators?

_____

_____

7. What improvements do you think are needed to boost irrigation production?

_____

_____

8. What problems are endemic to the scheme?

_____

_____

9. Do you think there is need to develop more irrigation schemes?

_____

_____

10. Why to any of the answers above?

_____

_____

11. What support structures are required in your opinion do you think are needed by irrigators?

_____

_____

12. What socio-economic challenges do you see in non-irrigators which are extinct amongst irrigators?

_____

_____

13. How does drought affect the Lower Gweru people?

_____

_____

14. Are irrigators immune to droughts and food insecurity?

_____

_____

15. Why are they immune or not immune?

_____

_____

16. Are there any health problems unique to irrigators

_____

_____

17. What conflicts have arisen as result of the irrigation scheme?

_____

_____

18. What criminal or social ills/tendencies are endemic within the irrigation community?

_____

_____

19. Who are the perpetrators of the above criminal activities?

_____

_____

20. Any general commentary on the irrigation scheme as a whole?

_____

_____

21. How is the relationship between dry land farmers and the irrigators and how does it affect farming in the irrigation?

_____

_____

THANK YOU FOR YOUR TIME.

TIME SPENT _____