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THE EFFECTIVENESS OF IRRIGATION SCHEMES IN ENHANCING HOUSEHOLD FOOD SECURITY IN MBERENGWA DISTRICT: A CASE STUDY OF MUNDI-MATAGA IRRIGATION SCHEME.

BY

EDSON MACHEZA

B1128048

SUPERVISOR: MR MAPONGA

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APPROVAL FORM

The undersigned certify that they have read this project and have approved its submission for marking after confirming that it conforms to the department requirements.

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Supervisor Date

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Co-Supervisor Date

DECLARATION FORM

I, Edson Macheza, declare that this project is herein my own and has not been copied or lifted from any source without acknowledgement.

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DEDICATION

To my brother Mr Edias Macheza.

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GOD BLESS.

ABSTRACT

Irrigation development is considered as an intervention measure to food insecurity in drought prone Mberengwa district. The main goal of this study was to evaluate a small scale irrigation scheme on household food security in Mberengwa, a subsistence-based farming community in the Midlands Province (Zimbabwe). A total of sixty household heads adequately represented farmers from Mundi-Mataga irrigation scheme as homogenous community via simple random sampling technique. Interview schedules and questionnaires were used to source information on food security situations before and after introducing the irrigation scheme and the effects of the challenges faced. The idea is to understand the magnitude and nature of the effect that irrigation has on yields and crop revenue. Also it sought to describe the relationship among irrigation status, yields and household crop revenue. Finally, the research sought to understand the impact that irrigation has on incomes in poor areas. The analysis shows that irrigation contributes to increases in productivity for almost all crops and in income for farmers in the irrigation scheme. The importance of crop income in poor areas and the strong relationship between crop revenue and irrigation provides evidence of the importance of irrigation in past and future alleviation of hunger in Mberengwa district. It also shows that in the majority of the farmers who invested in the irrigation, returns are positive even after accounting for increases in capital and production costs. Evidence concluded that although issues of hunger continue to exist in the district, irrigation enhanced household food security therefore it can be helpful if a further research be conducted to determine why hunger continued in the area whilst irrigation intervention measures put in place are effective.

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LIST OF ACRONYMS

AGRITEX	Agricultural Technical and Extension Services
ARDA	Agricultural Rural Development Authority
CARD	Center for Agricultural and Rural Development
CFSVA	Comprehensive Food Security and Vulnerability Assessment
CGIAR	Consultative Group on International Agricultural Research
FAO	Food and Agricultural Organisation
FSI	Food Security Interventions
GMB	Grain Marketing Board
IFAD	International Fund for Agricultural Development
IFDC	International Fertilizer Development Cooperation
MAHFP	Months of Adequate Household Food Provisioning
SPSS	Statistical Packages for Social Scientists
SSA	Sub-Saharan Africa
WFP	World Food Programme
ZESA	Zimbabwe Electricity Supply Authority
ZIMVAC	Zimbabwe Vulnerability Assessment Committee
ZINWA	Zimbabwe National Water Authority

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CHAPTER ONE

INTRODUCTION

1.1. Background to the Study

Achieving food security is one of the primary goals for human and sustainable development the world over (Rukuni et al, 2006). This can be seen from the 2000 World Summit outcome, prioritising eradication of extreme hunger and poverty as goal one out of a total of eight identified goals (FAO, 2003). Furthermore, the post MDGs era which is Sustainable Development Goals with now 17 of them still identify food security as the first priority. At household level, food security implies physical and economic access to food that is adequate in terms of quantity, nutritional quality, safety and cultural acceptability to meet each person's needs (Mutasa, 2011). According to Peter (2011), food enters at household level in a variety of ways, where in some cases a household can produce food when it has got human and material resources to do so and such households are said to have direct access to food and some buy when they cannot produce for themselves. In Mberengwa district, authorities had seen irrigation as a way to improve food availability for the communities through own production. Feresu (2010), says irrigation farming contributes 20% to Zimbabwe's total agricultural production. The inception of smallholder irrigation scheme was done by the government in a bid to maintain and promote sustainable food availability among rural households in the community (Chazovachii, 2012), which is drought prone. However schemes need to be assessed in order to determine whether the intended thrust is achieved.

Despite increased investments in irrigation projects in Mberengwa district,(Ministry of Agriculture, Mechanisation and Irrigation Development, 2013), it has been observed that there is a critical cereal deficit therefore there was need to assess whether irrigation schemes are effective in this area. Major deficits were recorded in Mberengwa district, which was approximately 17% of the total grain deficit in the province (ZIM VAC, 2012). Changing weather patterns across the globe has magnified the importance of agricultural development and investment and particularly the poor southern and south-east and west of Zimbabwe where in a couple of seasons food security is compromised due to erratic rains which are normally experienced. Over the past decades, food production levels in most parts of Mberengwa have been declining or remained stagnant (ZIM VAC, 2012), posing more challenges to food security status though the district realised an increase in the number of

farmers practicing irrigation. With increasing number of irrigation farming activities, the assumption is that, the prevalence of food insecurity should have been lowering. In Mberengwa district, Mundi-Mataga irrigation scheme which accommodates 200 plot holders was established in 2005 as a remedy to avert drought effects by boosting productivity in the district however, issues of hunger and food insecurity are still increasing in the community.

1.2. Statement of the Problem

Mberengwa has been experiencing high food insecurity for decades (ZIMVAC, 2011) due to the nature of the physical environment in which the community is located and is vulnerable to drought phenomena. Although nationally, causes of food insecurity include drought, poor rainfall distribution, socio-political and economic factors Mberengwa is often affected by hunger due to drought effects. The district lies in Zimbabwe's Midlands Province where a number of irrigation schemes were introduced between 1980 and 2005 targeting at enhancing food security (Rukuni et al, 2006) through increased food productivity. Despite the fact that more irrigation schemes are being developed and adopted in Mberengwa district it has been noted that the level of food insecurity still persists (ZIMVAC, 2014). There are increasing numbers of food insecure households although more are engaged in irrigation agriculture (ZIMVAC, 2014). It becomes difficult to realise improved household food security due to continued increase in the incidences of food insecurity in the area. Most researches done on irrigation and food security focuses on a global, regional, and national or community level and not at household level and it becomes important to look on the relationships between the two variables in question at household level. The study therefore seeks to assess the effectiveness of irrigation schemes in enhancing household food security in Mberengwa district so that successful and viable interventions can be adopted for improved food security in Mberengwa district. These would help in the successful implementation of appropriate interventions for improved food security at household level.

1.3. Aim

To evaluate Mundi-Mataga Irrigation Scheme in enhancing household food security in Mberengwa district.

1.3.1. Specific objectives

- To determine the contribution of irrigation schemes in Mberengwa district.
- To determine the relationship between access to irrigation facilities and crop output in Mberengwa district.

- To determine major constraints for the sustainability of Mundi-Mataga Irrigation Scheme

1.4. Research Hypothesis

Food production increases with access to irrigation.

1.5. Rationale and Significance of the Study

Food security has some ripple effects to the living conditions of the people especially in rural areas. In the selected wards of community, farmers are producing lower yields in their fields and as a result they do not have adequate food for consumption. In trying to reduce food insecurity in the selected community small scale irrigation schemes were introduced. The finding of this study is useful to the various stakeholders like district administrative authority and farmers themselves for the study provides recommendations and measures to enhance production of the farmers in the area. This benefits various Mberengwa communities though differently but all will constitute to the achievement of improved food security through adoption of appropriate measures by each of the identified groups.

The researcher also acquires skills and an in depth understanding about the significance of irrigated agriculture as a livelihood strategy on improving household food security as one of the policy tools to promote development. Also besides gaining a practical application of the knowledge gained, the research offered a platform to identify some gaps by other researchers like the issues of marketing, service provision like electricity and water authorities who also have an impact on the sustenance of irrigated agriculture, hence improved research skills. The research can be published through the university website for access to other students or through an accredited journal gaining the university a credit on service provision.

It will be a teaching material aiding on skills development to the learners reference on issues that pertain to food security and irrigation farming. It will also be a tool for policy formulation and implementation to AGRITEX and other administrative authorities since there are some recommendations that will be made with respect to the research findings.

1.6. Limitations

The research faced the challenge of language barriers since questionnaires were distributed in English however those with problems were assisted completion of questionnaires through interpretation.

There was a problem in accessing some of the key informants for more data and the research relied on available sources for analysis and conclusions.

The research also faced a challenge of insufficient farmer records before they engaged into irrigation agriculture, however the problem was addressed by reliance on secondary data from AGRITEX farmer productivity estimations.

1.7. Scope of the study

The study area is in Mberengwa District ward 26 in Midlands Province. Mundi-Mataga irrigation scheme is a government initiative to address the effects of drought in Mberengwa district. Although it is geographically located in ward 26, it also accommodates farmers from ward 19 and 27.The study assesses the effectiveness of irrigation schemes in enhancing household food security in Mundi-Mataga irrigation scheme. The scheme was developed by the government of Zimbabwe through the Ministry of Agriculture, Mechanisation and Irrigation Development in 2005 in a bid to improve food security through increased productivity.

The scheme is located approximately 115km from Zvishavane town. It is located in agro-ecological region IV which is characterised by low rainfall averaging to 400mm per year, low run off and higher rates of evaporation (Feresu, 2010). Mundi –Mataga irrigation scheme supports about 200 plot holders on some 130 hectors of irrigable land. The soil type is a mixture of loam and clay. The slope is slightly gentle on the larger area of the irrigation land enabling the flooding irrigation used in the scheme possible. The furthest distance travelled by farmers in the scheme is 5km. It is also located at the fringes of Mataga growth point which offers a prospective market for some fresh produce like tomatoes and vegetables which are other crops grown in the scheme 2.1km away. The scheme itself is 1.6km away from the dam and water is drawn using a canal.

While food security broadly considers such components that include availability, access and entitlements (utilisation), irrigation has an impact on productivity. In this regard the research's main thrust is to assess the effectiveness of these irrigation projects in sustaining food supply to farming households. Irrigation can be conceptualised as a technology intervention to enhance crop production by artificially closing gaps from rainfall. In this regard, irrigation becomes a vehicle for rural development through an enhanced food supply.

Since the study focuses on the effectiveness of irrigation schemes in enhancing household food security, a comparative evaluation was done on two time periods which are farmers' food security status before they engaged in the irrigation scheme and after they engaged in

the scheme. The assessment ranges from 2002 to 2009 to determine the changes in the trends that would be used in drawing the conclusions.

1.8. Definition of Terms

Food security- is the availability of adequate food in ones' household or home which one has access to.

Irrigation- is the supply of water to agricultural crops through a canal (flooding system) to raise crops in moisture stressed Mberengwa community.

Household- is a family or housing unit that produces own food in Mundi-Mataga irrigation scheme.

1.9. Summary

Despite implementation of a considerable number of irrigation schemes as drought mitigation strategies in Mberengwa district, households are still experiencing food shortages. In this regard it is necessary to evaluate these irrigation schemes in order to find answers to the set objectives. The set hypothesis is an aid in drawing conclusions. In order to achieve that the next chapter considers literature to identify any gaps between the available information and the prevailing situation so as to determine root causes to the problem area. The next chapter is focusing on literature review. Thus the chapter considers literature on major concepts and the relationship between food unavailability and irrigation agriculture.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction

This chapter reviews existing literature on smallholder irrigation schemes generally from a global perspective to more local levels that is within the borders of Zimbabwe. It highlights some major concepts including food security, history and implications of irrigation on food security and other researchers' findings and views.

2.2. The Concept of Food Security

Multiple factors from natural events and human induced activities have given enough signals to the research community to ignite conscious efforts to ensure sustainable food security worldwide. The World Food Program (CFSVA Report, 2009) indicates that assessing the level of food security is driven by inter-related agro-environmental, socio-economic and biological factors which impacts in one way or another the food security status of various communities. Varied definitions and explanations of food security are focused on food availability, accessibility and utilisation. Hoddinott (1999) indicated that there are approximately 200 definitions of food security which evolved over time. The varied definitions are a result of the perspective in which food insecurity is understood and interpreted by various sources. Since food security takes various dimensions at various levels, the distinction between these is necessary in understanding the concept of food security. Tafesse (2003) sees it very necessary to distinguish food security between commonly focused areas like national and household level hence approaches to delineate boundaries to these are different which most literature do not acknowledge. This is useful in determining food insecurity at different levels, availability focuses on sufficient quantities and quality whereas access considers affordability, functioning and policies (Tafesse, 2003) so in this scenario availability is an important measure at household level whereas at community and other the element of access comes in because will be considering a macro level where various socio-economic and political interferences can be experienced. Having this distinction helps in evaluation of mitigation interventions made.

At national level food security is defined as the condition where the nation procures and sustains food needed to support its population with minimum per capita nutritional standards (Hart *et al*, 2003). On the other hand at household level food security refers to the availability of food in one's household or home which one has access to. Household food security

definition was used in this research. It defines food security as the physical availability of adequate stock of food in one's household or home where one has access to. The definition is based on Hoddinott's argument (1999) which states that availability is the key function of domestic production and food security. Thus the household is food secure when its members do not live in hunger or fear of starvation.

Households commonly acquire food through purchases or own production (Ewumbu, 2011). In Mberengwa community households mostly rely on own production for food. Their food security is based upon the adequate stock of produced food crops (AGRITEX, 2010). Food crop cultivation to meet the household needs depend on the human and relevant material resources available however; shortage of some critical inputs to sustained production distorts the sustainability of adopted strategies. According to FAO (2010) the level of household food security depends on the income and assets base of the family thus it can differ for a homogeneous community due to these differences. In Zimbabwe there are not specific and accepted measures of food security at varied levels and if ways of monitoring exist they do not distinguish food security at various levels for monitoring and evaluation purposes. These gaps restrict the ability for policy interventions to address actual barriers to achieve improved food security environment. Households in Mberengwa community attempt to reach their food needs through own production and reliance on rain fed smallholder farming which makes them susceptible to food insecurity due to prevailing climatic conditions which resembles arid or semi-arid conditions which are unsuitable for crop productivity.

Chazovachii (2012) indicates that climate change and unpredictable weather patterns are changing farming activities and negatively impacting on the food security situation that is, inadequate food production. This initiated the need for new better strategies for improving food availability like mechanisation which was adopted by the community, however with mechanisation the cases of increased food insecurity in Mberengwa still persists which means there are some anomalies facing the food security status of the area. According to Food and Environment (2013), food insecurity exists when people do not have adequate, physical, social and economic access to food. In the given condition of food security it is noted that physical availability is a precondition for access thus addressing availability can lead to improved access. CGIAR (2013) about 870 million, of which 853 million from developing countries were estimated to be food insecure during the period of 2010 to 2012 so it is not only a local phenomenon but also a global issue. Food insecurity can be categorised into two forms that is, chronic and transitory food insecurity. Chronic food insecurity, is when a

household or family lacks minimum requirements of the people for a period of time to extended periods of time, extended periods of poverty, lack of assets and lack of access to productive or financial resources (Feresu, 2010). Transitory food insecurity is the sudden lack or reduction in the ability to produce or access minimum requirements of food due to short term shocks or fluctuations in food access and availability (Feresu, 2010). Most rural communities suffer from both however due to socio-economic, political and environmental incapabilities they end up trapped into chronic food insecurity.

Distinguishing between the two is often missing in literature however it is important to indicate the form of insecurity as that can help evaluation of policy interventions made. Bagson and Kuunder (2013), are of the view that, although households in many developing countries attempt to reach their food needs through rain fed agriculture, in some cases this is inadequate for their food requirements. Climate change and unpredictable weather patterns are changing farming activities and negatively affect food security at different households. It had been noted that, poor households are particularly at risk because of the limited access to income and resources, (ZIMVAC, 2011). This is so because of the unpredictable dynamics of rainfall patterns, poor agricultural financing and climate effects which had posed serious consequences on food productivity. National governments need interventions if people are to be rescued from this trap which can promote vicious cycle. Stinger (2000), aired the view that, during the 1990s, food security issues pushed their way back onto crowded international fora which focused much attention in seemingly never ending race between food production and population increases. That included the access dimension by millions of households, (Stinger,2000) for instance in Kenya and Malawi where household food security was influenced by total household income but this differs in other economies depending on the source of insecurity so knowledge on the source of insecurity determine type of intervention.

Thus knowledge on these gaps enables appropriate policy interventions to boost food security of any community. FAO (2007) noted that severe droughts and sharp increases in prices in the 1960s and 1970s led to green revolution. This focused on increased productivity through mechanisation and expansion of irrigation schemes to avert the problems of food insecurity. However, Beldier, *et al* (2007), is of the view that food insecurity remains a persistent feature in developing countries. There is evidence that, for many developing countries increasing productivity is the key to reduce food insecurity so it can be concluded that major causes arise from unavailabity of food which can then compromise access and utilization. The World Bank (2010) in its findings agrees that there are unproportional changes between population

and agricultural shifts by indicating that population growth is increasing and the agricultural production is lagging posing significant challenges to food security affecting both food availability and affordability.

2.3. Policy Responses to Food Insecurity in Zimbabwe

A policy is a deliberate plan of action to guide decisions geared towards achieving rational outcome through methods or strategies to pursue those goals (Hunger and Wheelen, 2007). Applicability and scope of a policy gives focus towards the desired targets while avoiding unintended consequences. Policy response to food security by Zimbabwean government is biased on interventions and concerns on all aspects of food production, supply, distribution and consumption to ensure availability and access to enough food for all the people (Kari, 2010). The government pursues strategies aiming at increasing food availability and access as central to accelerating economic growth and improving food security,(Chazovachii, 2012). The policy interventions promote food security and respond to the needs of the poor and the food insecure mainly emphasising food production and supplies. Some of the policies, initiatives and programmes formulated and implemented as responses to food insecurity since 1980 include irrigation. These emphasised on the necessity to intensify the production of foodstuffs, particularly maize and other grains to enable the country to achieve food self-sufficiency, (Mutasa, 2011), the need to promote drought tolerant crop varieties to enhance food security.

2.4. History of irrigation

Irrigation agriculture is a very ancient practice which was practised after the realization that there had been recurrent droughts in Egypt and many dry parts could not reserve enough food for the whole year (Manzungu and van de Zaag, 2006). Irrigation therefore facilitated the growing of crops in the flood plains of the Nile valley so that supplementary food could be accessed. According to Scoones, (2013), expanding population and the failure of rain fed agriculture to meet food security needs in periods of drought of the 20th century had resulted in concerns at the highest policy levels to act towards sustainable agriculture investment. Peret (2006), argues that as a result this became a worldwide practice to boost food insufficiency. In Zimbabwe, due to irrigation there was an increase in crop production in almost every year hence became the attracting feature for the country to increase irrigated lands. Recent years has seen an increase in the use of irrigation to facilitate cultivation in semi-arid and arid regions of Zimbabwe mostly in the southern and south eastern parts which

often receive erratic rains which cannot support agriculture even in good rainfall years (Rukuni *et al*, 2006).

According to Chazovachii (2012), the development of large and small irrigation schemes in the communal areas of Mberengwa flourished after independence. This led to the establishment of irrigation schemes like Chimwe-Chegato, Biri, Chingechuru and Vurasha irrigation schemes in the district. Also a decade ago Mundi-Mataga irrigation scheme was introduced in the district accommodating 200 plot holders. This was prompted by the realisation that the existing schemes were failing to eradicate the effects of hunger therefore there was need to increase irrigation farming. Investment in irrigation can continue in the district as there exist high potential to establish more dams but the current situation resembles irrigation schemes do not adequately improve food security in the community. Therefore there is need to determine the reliability of these irrigation schemes to the food insecurity situation in the area. Moreover, to have better policy interventions there is need to evaluate the effect of adopted strategies so as to determine a further step in policy interventions at more local level.

2.5. Types of Irrigation.

According to FAO (2003), irrigation agriculture is a complex situation to the problem of food insecurity. Irrigation is the supply of water to agricultural crops by artificial means designed to permit agriculture in arid regions to offset drought in these regions (Chazovachii, 2012). They can also be applicable to areas where total seasonal rainfall is adequate but on average it maybe poorly distributed and it can vary from year to year. Irrigations can be classified according to their sizes and or types of crops which are grown in them. In this regard it is necessary to determine whether some forms of irrigation are applicable to other areas than to some areas. According to Field and Collier (2009), irrigations are of different typologies and these differ from country to country and or region to region. They can be classified according to their sizes, type of ownership among others. In Zimbabwe, irrigations are classified into three types which are formal schemes, informal schemes and parastatal schemes, (Manzungu and Van de Zaag, 2006). Formal irrigations are the ones which are initiated by the government, informal schemes are the ones which are run by the farmers themselves and those under parastatal are the ones which are controlled by ARDA (Manzungu and Van de Zaag, 2006). Most schemes including those in Mberengwa are informal schemes like Panganai in (Masvingo) also an informal small scale irrigation scheme irrigation which

researches acknowledged that it is effective in enhancing household food security. So there is need to determine whether Mundi-Mataga scheme can have similar results.

According to Beldier, *et al*, (2007), by independence, Zimbabwe had about 150 000 hectares under formal irrigation schemes of which 68% of this was in the large scale commercial farming areas, another 20% was linked to commercial estates, 7% of ARDA and only 3% were smallholder irrigation schemes. The need to improve food security at household level especially in the country's rural communities initiated a rapid increase in small holder irrigation projects (Rukuni *et al*, 2006). So irrigation can be viewed as an insurance against occasional food shortages from drought (I.F.D.C 2013). FAO (2007) had noted that irrigations do not only raise the yields of specific crops, but also prolongs the effective crop growing period in areas with dry season thus to areas which are at risk of drought like Mberengwa. By assuring reliable water throughout the year, production can be intensified thus raising productivity and improving the livelihoods of those in irrigation and also others who can purchase from those in the irrigation (Mangisoni, 2008). However there could be challenges which can be compromising the sustainability of irrigation either due to type or size which could have a greater impact on irrigation performance and identification of these is crucial if irrigation is to be sustainable.

2.6. Roles of irrigation in increasing crop productivity.

Sasson (2012), at the World food summit of 1996, FAO had estimated that, 60% of the extra food which is required will come from irrigated agriculture and this had assumed to be the call on the effectiveness of irrigation agriculture in sustaining future world food supplies. Even though, only 16% of the world's food croplands are irrigated, those irrigated crops produce 36% of the world's food, (World Food Programme, 2009). Irrigation is considered to be an important factor for agriculture and food security. Table 2.1 shows the percentage of food produced on irrigated land by different regions. It is clear that while Sub Sahara Africa can practice irrigation there are likely to be some embedded challenges which need to be identified by researchers to find out why the contribution of irrigation schemes is very low.

Also Zimbabwe is trapped within SSA region with very low irrigation contribution towards food production. However from other regions it is clear that irrigation significantly contribute towards food security thus the information for Asia, Pakistan, China and Egypt for example, on the table 2.1 agrees that irrigations are effective in enhancing food security. Knowledge gaps however still exist with regard to Africa south of Sahara, (CGIAR, 2013) as resembled

by table 2.1. It is clear that while Sub Sahara Africa can practice irrigation there are likely to be some embedded challenges which need to be identified by researchers to find out why the contribution of irrigation schemes is very low. Also Zimbabwe is trapped within SSA region with very low irrigation contribution towards food production. However from other regions it is clear that irrigation significantly contribute towards food security thus the information for Asia, Pakistan, China and Egypt for example, on the table 2.1 agrees that irrigations are effective in enhancing food security. Table 2.1 is a regional analysis of the impact of irrigation on food productivity.

Table 2.1. Regional Analysis of Irrigation and Food Security: FAO (2007)

Region	Percentage of food from irrigation
Asia	60
Pakistan	80
China	70
India	50
Indonesia	50
Middle East and North Africa	33
Iran	50
Egypt	98
Latin America	10
Sub-Saharan Africa	9

From a regional perspective, SSA is facing the risk of food insecurity though it practices irrigation like any other needy regions as given in table 2.1. This is a clear indication although irrigation can be practiced its sustainability lies behind some other factors which needs are being overlooked however having great impacts on irrigation performance that might include socio-economic and political issues. From information in table 2.1assessment of the effectiveness of irrigation schemes is very necessary because it is a monitoring and evaluation tool to determine whether adopted strategies have an impact for example specifically in Mberengwa district because it is clear that similar problems might need different approaches. Some scholars like Bagson and Kuunder (2013) pointed out that, irrigation allows land to be on average, twice productive as rain fed agriculture. Musa (2010), also added that irrigations encourage higher yields, cropping intensity and diversification

towards higher value crops and they can increase production by at least threefold. This means that, they are potentially able to enhance food security. However, from table 2.1 it can be viewed that food insecurity is even a challenge to the SSA region although irrigation is being practiced. Earlier on, Hanjra and Qureshi, (2009) suggested that, the smallholder irrigation schemes had the assurance of food security at household level for smallholder communal farmers.

The irrigation schemes do not only meet the intended objectives of increased food security, but also benefit the surrounding communities, who are not in the irrigation schemes (Mutasa, 2011). In concurrence, Rukuni *et al* (2006) reported that the areas surrounding the schemes tend to provide a ready market for the food crops. The study by Rukuni and Eicher (1994) showed that maize, beans, and vegetables had the greatest demand and were most prevalent on the schemes. About 70%percent of the maize sales were done locally. A cost benefit analysis performed by Peter (2011) indicated that irrigation increased household food security significantly to drought prone areas. The same study also revealed that irrigation did not only improve the food security position of the level of the irrigators, but also the rest of the community benefited from these schemes that means through irrigation, food production is controlled and the output is much higher than rain fed which is not controlled.

2.7. Impact of Irrigation on Food Security

Irrigation schemes enhance household food security through increased productivity thus they act as insurance to areas at risk of food insecurity through insufficient food production. Irrigation farming has become a relief to the poor and disadvantaged especially in the developing countries (Chivizhe *et al*, 2008). More so, it is a welfare enhancing agent because it fosters the cultivation of early maturing crops for both household consumption and sale. Through irrigation people are able to afford food and access varied dietary requirements through production of various crops. Whilst irrigation is the key to increasing agricultural productivity, because today's irrigation development aggregate food supply contribution is sometimes overlooked evaluations of policies and projects focus on identifying problems rather than benefits (Kari, 2010). However, on the other hand irrigations enthusiasts should not exaggerate the contributions of irrigations to food security and neglect other influences on global food growth. Figure 2.1 is a framework on the impact of irrigation agriculture and food availability for household consumption. According to Sasson (2012) cash earned from the sale of produce from the irrigation project in irrigation can be used to meet some of the basic needs of the people. Consequently, there is some level of improvement in rural

infrastructure situation because of functional irrigation projects in some rural areas (Chazovachii, 2012) though the irrigation projects might not be able to attract high developments like industrialization.

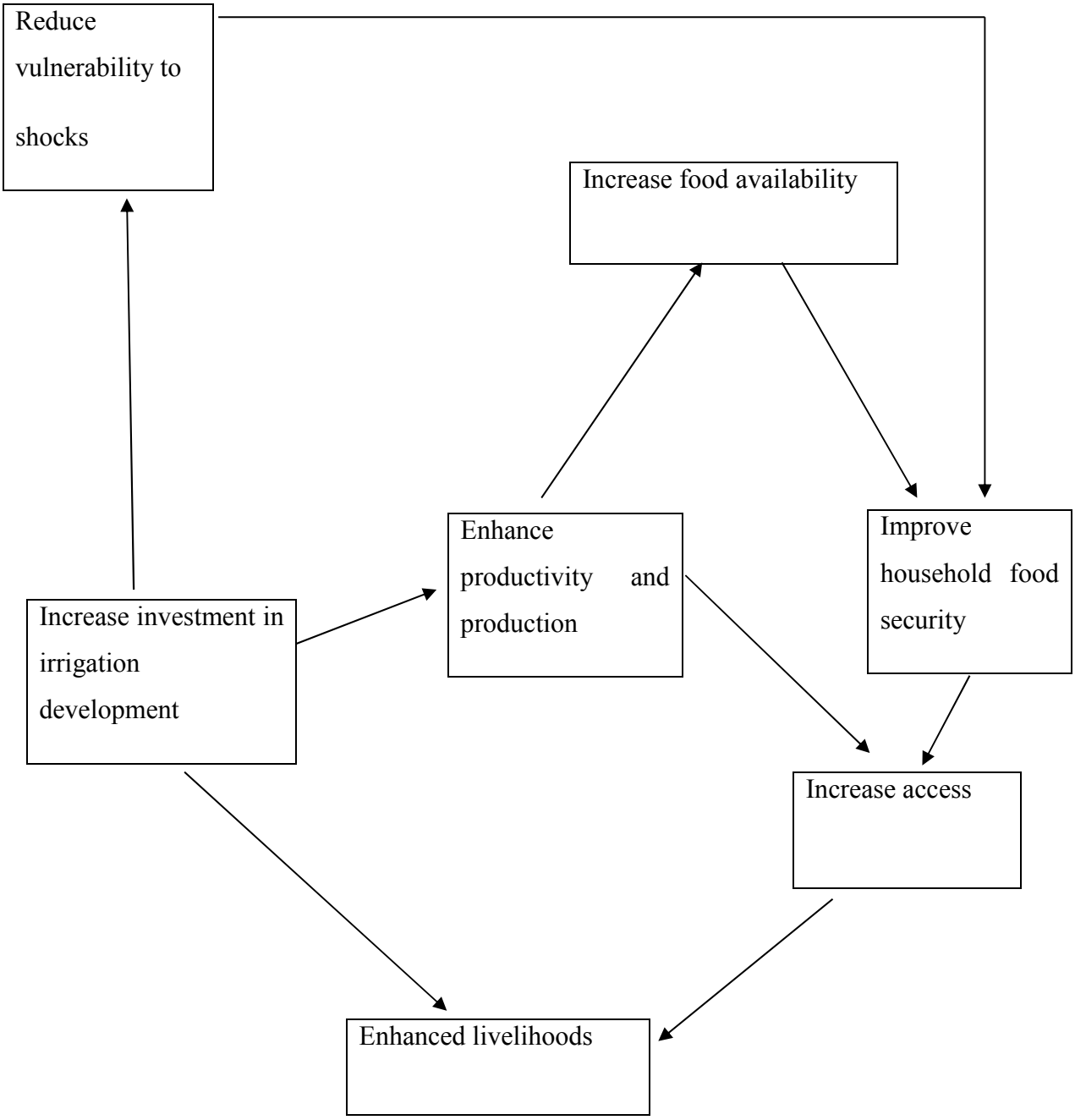


Figure 2.1: **Impact of Irrigation on Household Food Security Framework**.-(Hunger and Wheelan, 2007)

Irrigation increases the availability of food by enabling production throughout a year thus the growing to harvesting seasonal gap is reduced. Indirectly, this enables food stability and access to adequate food to farming households thus it improves the food security status through increased household food supply as shown in Figure 2.1. According to Musa, *et al* (2010), irrigations encourage higher yields, cropping intensity and diversification and they can increase production by at least threefold. This means that, they are potentially able to enhance food security by making more crop output, enabling diversification thereby offering an incentive for better nutrition than people relying on a single crop which is the staple food crop. With reference to Figure 2.1, availability of adequate food is one of the major components of food security and this is directly affected by irrigation agriculture. Irrigation agriculture boost production of food, thus in this context increased production makes more food available. Thus irrigation becomes very important regarding food security issues. Availability of adequate food focuses on physical existence of food, sufficient quantities and production of necessary food of which all can be necessitated by irrigation use. It also has an impact on access as availability of adequate food stabilises demand according to economic law of demand and supply. On the Figure 2.1, irrigation promotes food security justifying the arguments by many highlighted authors like Chazovachii, (2012), Scoones (2013) and FAO (2007) who argued that irrigation enhances food security.

However, the limiting factor in many developing countries is the high cost element in the construction of irrigation schemes and the necessary technical expertise to manage the schemes and the judicious use of the water available. In Zimbabwe, there are sites designated as suitable for irrigation schemes but like any other developing economies investment in irrigation schemes is dwindling due to various reasons like lack of financial resources (Feresu, 2010). However, there are non-governmental organizations in some rural areas in Zimbabwe gradually introducing rural dwellers to food crops cultivation via small irrigation schemes. According to FAO (2007) irrigation farming is a source of livelihoods for rural dwellers and (Chazovachii, 2012) also source of income for disadvantaged rural people.

According to Stinger, (2000), irrigated land area increased rapidly until 1980 with the expansion rates of more than 20%, where in Asia it led to a steady increase of staple food production and in Sub- Saharan Africa it remained low and 18% of the irrigated land. Reasons behind these are need special attention therefore to realise significant growth in irrigation food production. Crop production is the main food source where it can contribute 38% of every poor household and 82% of the better households (Stinger, 2000). Because of

that, irrigation had gained global attention and about 279 million hectares of land (19%) are irrigated throughout the world, (Hanjra and Qureshi, 2009). As argued by FAO (2010), although past experiences resemble some disappointing experiences with irrigation, about 75% of all sub-Saharan African irrigation achieved or exceeded the expected rate of return, therefore enhances food security for most vulnerable households.

2.8. Successes of Irrigation Development

FAO (1997) in a brief general overview of the smallholder irrigation sub-sector in Zimbabwe concluded that smallholder irrigation has brought success stories to farmers. In Zimbabwe, it had been noted that, when Manunure irrigation rolled into life in 2012, irrigators started to grow a variety of crops such as carrots, cucumbers and cabbages of which most of the households where used to sadza and vegetables especially the poorest households, (W.F.P 2013). Moreover, Hama Mavhaire irrigation scheme was constructed in 1992, after the drought and it allowed growth of a cereal (maize), beans and vegetables (Mutasa, 2011). The observations made include that smallholder farmers were now able to grow high value crops both for the local and export markets, thus effectively participating in the mainstream economy, in areas of very low rainfall, as in Natural Regions IV and V, farmers enjoy the human dignity of producing their own food instead of depending on food handouts. Irrigation development has made it possible for other rural infrastructure to be developed. Moreover, in Zimbabwe, the same scenario was witnessed at Biri irrigation scheme (Mberengwa district) when 58 hectares of sugar beans were written off due to power cut-offs and farming families suffered (Mhandu, 2014), thus a clear indication of how irrigation is effective.

Similar inferences were also highlighted in a study of an irrigation scheme in the village of Chakunda in the Gambia, (Lankford, 2003) realised a number of benefits from irrigation that included increased income that was translated into increased expenditure, investment, construction and trade. Traders were reportedly coming to purchase irrigation produce and in turn sell jewellary. At household level, increased wealth could be seen in 55 houses built in the village, fourteen with corrugated metal roofing. In Malawi, it had been noted that, 9% was considered to be food insecure after the installation of the treadle pumps as they increased crop production, (Mangisoni, 2008). Moreover, changes in cropping patterns were witnessed in India after the installations of micro irrigation adaptors, (Domenech and Ringler, 2013).

2.9. Challenges and constraints

Rukuni *et al* (2006) state that a number of problems have befallen irrigation schemes such as poor marketing arrangements, limited access to water, inability to meet operational costs due to poor fee structures and the lack of a sense of ownership, financial viability and poor governance. Some of these problems have necessitated government transferring responsibility to farmers, who have continued to mismanage these systems, hence their dilapidation. Poor maintenance and lack of effective control over irrigation practices have resulted in the collapse of many irrigation systems. The FAO (1997) report identified a number of constraints, which hampered smallholder irrigation development in Zimbabwe. Some these include high cost of capital investment in irrigation works considering that communal farmers are resource poor, lack of reasonably priced appropriate irrigation technology for the smallholders, shortage of human resources at both technician and farmer levels, lack of decentralized irrigation service companies to give back-up service in rural areas, poor resource base of farmers, fragmented and small size of land holdings, unsecured or lack of land titles and high interest rates.

Further to the above constraints, Saliu and Jimoh (2008) stated that in many countries, institutional weaknesses and performance inefficiencies of public irrigation agencies have led to high costs of development and operation of irrigation schemes. Poor maintenance and lack of effective control over irrigation practices have resulted in the collapse of many irrigation systems. The study concluded that collective action for the maintenance of community irrigation schemes is more likely to be problematic when the user group size is large and ethnically heterogeneous, and where the scheme is shared by several communities (Saliu and Jimoh, 2008). Use of labour intensive techniques in the rehabilitation of irrigation schemes promotes a sense of ownership and moral responsibility that help ensure sustainability. A high quality of rehabilitation works and regular training activities also contribute to successful irrigation management by communities. The identified constraints have a great implication on the effectiveness of irrigation schemes thus for any scheme to be a success there is need to consider these constraints. In this regard these constraints identified by other researchers constitute part of this research.

2.10. Summary

Irrigation has been employed as a strategy to address the effects of drought by providing a controlled system for moisture distribution in many countries. Empirical literature acknowledges that irrigation adaptation enables a secure environment for crop production

leading to enhanced productivity. This is however different from the Mberengwa community situation which seems to be facing difficulties in realising a positive outcome in improving food security in the entire community though with a considerable number of irrigation schemes. This further creates the need to assess whether irrigation schemes are failing otherwise there are some causes to the problem than failure of irrigation schemes. The next chapter present, analysis and discuss the findings of the research in one of the irrigation schemes in Mberengwa district.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction

The chapter describes the study area, material and the research design which is qualitative in nature, data collection procedures and research instruments. The varied instruments helped for triangulation. It also discusses the methodological approaches and specific data gathering techniques that were used. Moreover, it looked on the sample was selected and the sample size as well.

3.2. Study Area

The Mundi-Mataga irrigation scheme was derived from the name of the river (Mundi River) as shown in figure 3.1 which is a tributary of Mwenezi River. The government of Zimbabwe constructed the large dam Mundi-Mataga to develop an irrigation scheme as an extension of Biri Irrigation Scheme which was inadequate to feed the local community. The scheme is located in Mberengwa district approximately 115km from Zvishavane town. It is located in agro-ecological region VI which is characterised by low rainfall averaging to 400mm per year, low run off and higher rates of evaporation (Feresu, 2010) rendering rain fed crop production at risk of crop failure due to these existing climatic conditions.

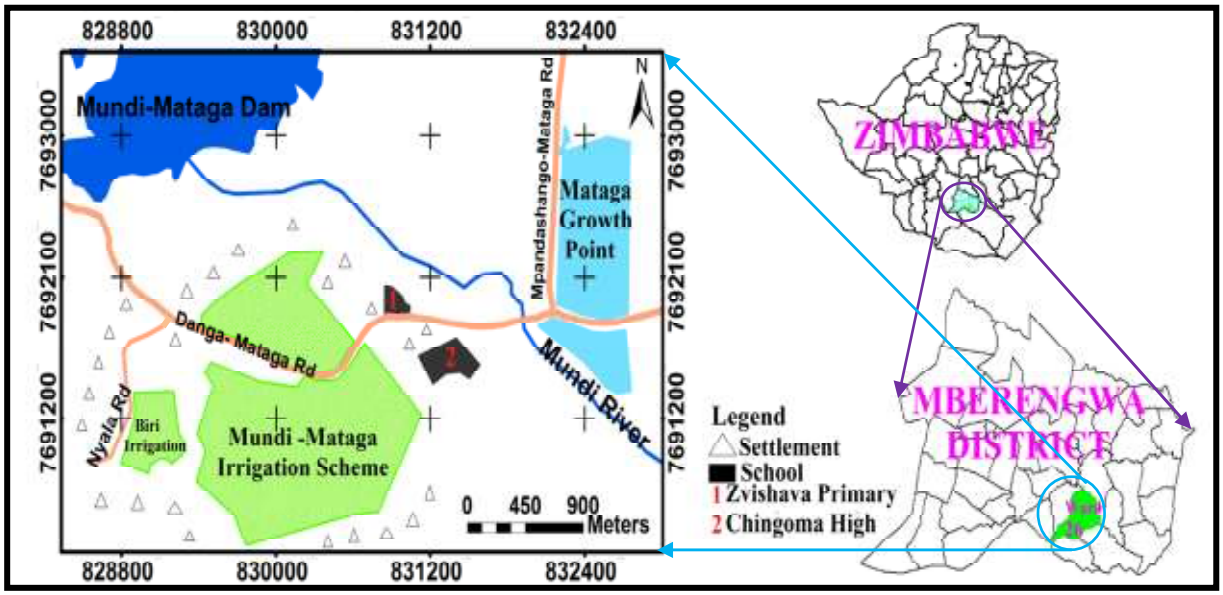


Figure 3.1. **Map of Mundi-Mataga Irrigation Scheme, Mberengwa District**: AGRITEX (2010)

The irrigation scheme is located in the agro-ecological region IV which is a drought prone area. The soil type is a mixture of loam and clay. The slope is slightly gentle on the larger area of the irrigation land and steep on the borders of Biri irrigation which is also shown on the map. It is bordered by Biri irrigation scheme and the Mundi River besides the settlements which surrounds the irrigation scheme.

Although the scheme is also surrounded by a settlement in ward 26, it serves farmers from three wards which include 19, 26 and 27. The scheme is able to serve all the three wards due to its geographical location. It lies at the borders of the three wards which include itself, ward 19 and 27. It is also located at the fringes of two schools which offer a prospective market for some produce like tomatoes and sugar beans which are some crops grown in the scheme.

The scheme is also served by a good gravel road that links it to the Mataga Growth Point its main market for the surplus produce. It is linked by a gravel road that links Mataga growth point to shopping centres that include Danga, Chegato, Inyala and many other small townships that are also prospective markets. Some economic activities done in the local community include vending, market gardening, fishing and livestock rearing other than crop production. Some does cross border activities as their livelihoods sources. The wake of Mundi-Mataga brought some economic activities that are basically on horticultural sales either in the households or at shopping centres to earn income.

3.3. Research Design

The study employed case study design with both qualitative and quantitative data. A purposeful sampling method was employed in selecting Mundi-Mataga irrigation scheme as the study area. Besides being located in the most dry and highly impoverished side of the country it is the most recent scheme with a considerable number of farmers which would have an impact on alleviation of hunger in the community. With it adding to already existing ones the assumption was that food security status of that community should improve so the continued effect of hunger might be attached to some issues to do with the scheme, as the study seeks to assess the effectiveness of small scale irrigation schemes in enhancing household food security in Mberengwa district it is one of the latest and bigger irrigation projects in the area. Mundi-Mataga irrigation has been in operation since 2005 and crops grown include maize, sugar beans, wheat, vegetables and tomatoes. Both quantitative and qualitative data will be assessed to determine whether the issues of hunger are related to the irrigation scheme.

3.4. Population

There are a total of 200 plot holders practising irrigation in the Mundi-Mataga irrigation scheme hence 200 farmers is the population. From these a sample of 60 households was selected to represent 200 farmers. There are also other key informants who include AGRITEX officials from the department of irrigation and local Mataga G.M.B management. Since irrigators are the main target primary participants thus from these the sample was be taken.

3.5. Sampling

Primary data was used as a main source of inference, while secondary data was used as a backup to the primary data. Systematic random sampling was used. The study randomly picked the first plot holder and then followed a regular interval of three households through plot numbers for the rest of the 59 participants from the scheme. Data collection was done through structured surveys using self-administered questionnaire. The questionnaire captured data on household characteristics, asset endowment, livestock endowment, agronomic practices, off-farm income and yield of grain crop. Purposive sampling was used to select key informants into the study who included Mataga G.M.B management and AGRITEX personnel for secondary data. Thus for these two purposive sampling was very relevant because these have much stake to the Mundi-Mataga irrigation. The data was entered into the Statistical Package for Social Scientists (SPSS) version 21 and Microsoft office excel 2013 for further analysis.

The study purposefully targeted only households for members of the irrigation scheme for conducting households' interviews. According to Rodgerson (2010), sample size relies from larger populations therefore 25% of the total population of the farmers in the Mundi-Mataga irrigation scheme was selected. In this study the systematic random sampling was used. For the 25% sample the first respondent was chosen at random then followed by a regular interval to offer equal chances for members to be interviewed.

3.6. Research Instruments

Research instruments that were used include questionnaires, interviews and observations.

3.6.1. Questionnaires

A questionnaire is a set of questions designed to gather data. Structured questionnaires with some open ended provisions were administered to a selected sample from the farming community. This is the relevant type since the research is an assessment where some evaluation was made so the most required information is concerned with an evaluative

decision hence to limit the time a closed questionnaire is administered. To make objective evaluations controlled information was useful to determine which information is required thus employing the method of structured questionnaires. Each chosen respondent was issued with the questionnaire to fill in. Structured questionnaires are simple to analyse and to improve the quality of information other sources for the same required data were considered which include AGRITEX and G.M.B.

3.6.2. Interview Schedules

An interview guide was designed to guide the interviewer in the type of data required. It guides on the information that would be required. The interviews were mainly on farmers, AGRITEX officers assisting in the scheme and the mostly the local Mataga G.M.B management for statistical records of farmers' supplies to the G.M.B. The inclusion of both farmers and AGRITEX officers including GMB records gives optimum view in the assessment since it compliment the questionnaires in gathering same data but from different sources. For AGRITEX and G.M.B sources respondents are few enabling direct interaction possible thus interviews were the most suitable as that enabled more information to be sought. Besides the likelihood of mutual relationships through interaction interviews helped in bringing in some indirect but relevant data to the study through development of some undrafted questions which arose in the conversation for, issues the welfare of other neighbouring schemes which helped in drawing conclusions.

3.6.3. Secondary Data

The researcher observed through time series analysis, the records of the AGRITEX officials and Mataga G.M.B as well to see the trends in the farmer output and grain supply changes respectively. Secondary data was part of the instruments that were used to do time series analysis to verify changes as backup to primary data obtained. The use of secondary data from AGRITEX department was useful to compare the trends in output changes for the farmers.

3.6.4. Field Observations

Field observation was part of the research process through a transect walk across the irrigation scheme and it preceded all other activities in the research process. This was done to in order to observe the current activity in the irrigation scheme. During the research period

farmers were busy on land preparation there were no crops planted yet. This helped in the designing interview guide hence it become very instrumental in conducting the research.

3.7. Data Analysis, Presentation and Interpretation

The analysis of data commenced from the field observation which preceded the whole data collection process. To facilitate the data analysis from the survey research instruments Microsoft Excel and SPSS were used for data analysis and presentation. The researcher used graphs, figures and tables to present the data so as to show the relationship of data and objectives for easy interpretation of the findings in order to disclose the research findings of the study. The data was also analysed using specific themes like demographic characteristics, productivity trend analysis, impacts of irrigation interventions to food production and the extent to which irrigation promote food availability.

3.8. Conclusion

The complexity of individual household understanding on their food security position makes measurement and interpretation difficult hence the need to determine thresholds for the better understanding of given data. This research applied the model, "Months of Adequate Household Food Provisioning (MAHFP" also used by Africare (2002) in Food Security Interventions (FSI) as a monitoring tool using a calendar of 12 months for food in/secure households. The same was used to assess the changes in food secure and insecure months before and after engaging in irrigation scheme. The next chapter will present data in graphs and tables for analysis and interpretation.

CHAPTER 4

DATA PRESENTATION, ANALYSIS AN DDISCUSION

4.1. Introduction

The findings of this study are presented in this chapter. It deals with gender imbalance, comparison of production between respondent characteristics, effectiveness of the scheme and the relationship between access to irrigation and change in total output for farmers.

4.2. Demographic Characteristics of Respondents- Gender and Education.

This section interprets the demographic characteristics of the farmers in the irrigation scheme. Demographic characteristics, both sex and education of the respondents determines how farmers use the scheme for food security.

4.2.1. Gender and Household Food Security

The majority of respondents were males which reflected that males were key players in Mundi-Mataga irrigation scheme. Mundi-Mataga irrigation scheme has more male farmers as shown in Figure 4.1.

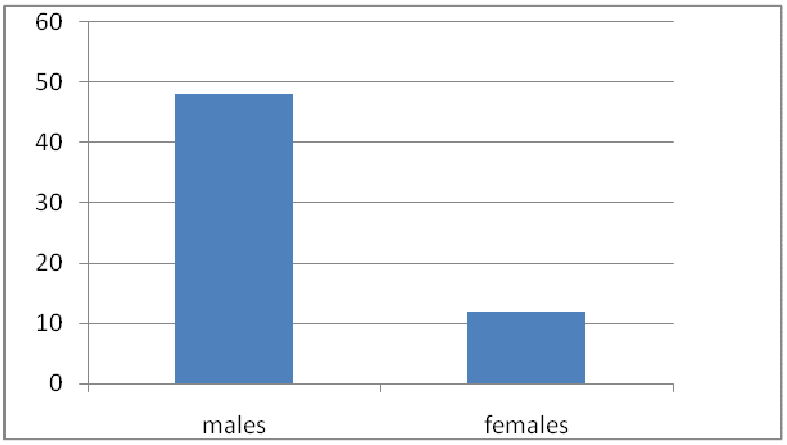


Figure 4.1.**Sex Composition for Farmers: -** Primary Source.

Figure 4.1 shows that females are fewer, 20% of the total farmers in the irrigation scheme this have an impact on the general evaluation of the food security situation in the area because present data (Table 4.1) shows that female headed families have higher family composition than male headed families conversely access to irrigation facilities is dominated by men than women. Because of gender inequity, (World Bank, 2013) the most vulnerable group in most rural poor societies are women so their lower participation from accessing

irrigation facilities in the community exposes them to shocks hence food insecure though the scheme is effective.

Table 4.1 shows that women headed families have high household composition than male headed families. Of which by comparing gender balance female headed families produce lower output than male headed even though they have similar sizes of land which is 0.5 hectors.

Table 4.1: Farmers' Marital Status and Household Composition

Participants	Characteristics		Household composition	Total average Output/season *50kgs (maize)
	Gender	Marital status		
27	Males	Married	>5	35
12	Males	Married	<5	29
4	Males	Widowed	>8	23
5	Males	Single	<5	18
9	Females	Married	>8	27
3	Females	Widowed	>8	27

Source: Primary Data

Table 4.1 shows that female headed families have higher household composition yet land allocation is skewed in favour of males. Thus, the more are female headed families in the entire community food insecurity at community level remains high though the irrigation scheme is effective in enhancing food security at household level. The results show that males have a greater contribution towards food security in the scheme. In this regard males are key players in Mberengwa's Mundi-Mataga scheme as opposed to Chazovachii (2012), who confirmed that women are key players in irrigation farming in rural areas.

4.2.2. Level of Education and Irrigation Agriculture

Smallholder irrigated agriculture is highly recognised to rural life where most farmers rely on agriculture as the source of their livelihood. Data on figure 4.2 shows that there is a relationship between educational level and irrigation farming. Mostly those with lower educational levels are engaged in irrigation activities than those with higher levels.

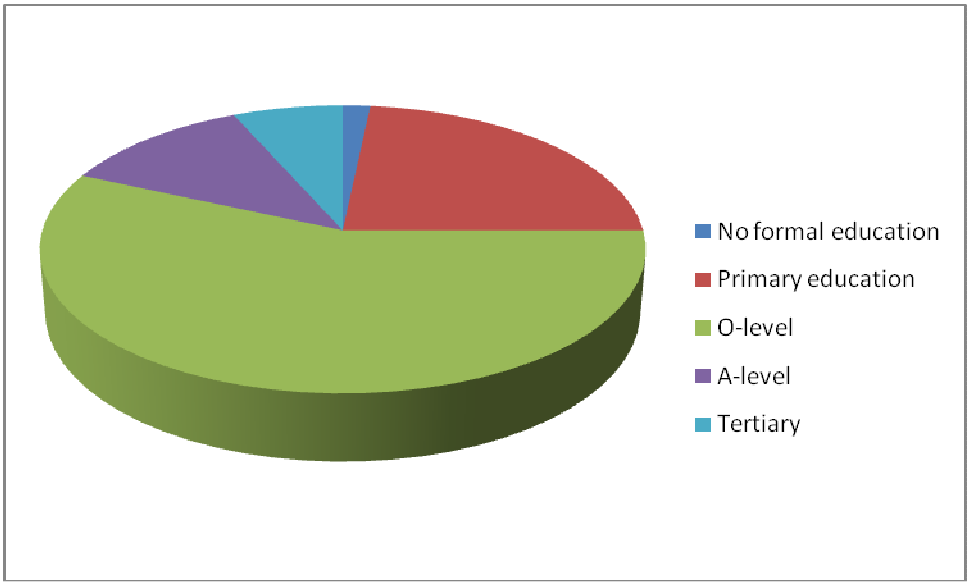


Figure 4.2 **Level of Education and Irrigation Farming**: Primary Source

Data on Figure 4.2 shows that the largest proportion of those in Mundi-Mataga irrigation scheme is concentrated in the lower levels of education and as the level gets higher the proportion of people lowers. Irrigation agriculture is considered a form of self-employment and income generating project in Mundi-Mataga irrigation scheme thus those with formal employment are not much concentrated in the irrigation activities. This is in line with Chazovachii (2012) who asserted that small scale irrigation farming is a government policy to reduce rural to urban migration hence those without professional skills will focus on self-help activities. More importantly those with low levels of education duly rely on informal activities for survival this is the reason why they are mostly concentrated in smallholder irrigation because they have the largest population in rural livelihood activities. In addition they are the most concentrated in rural areas. ZIMVAC (2011) acknowledges that highest levels of poverty in Zimbabwe are in rural areas, this is so because of their poverty. They are highly susceptible to shocks which trap them into hunger and for Mberengwa the area is vulnerable to drought hence those with little education may have less skills for adaptation to shocks so irrigation may be the best option since they will be assisted by AGRITEX in farming.

4.3. Trend Assessment of Individual Crops

The research results show that the trends of average total output for major irrigated food crops (maize, sugar beans and wheat) increased after adoption of Mundi-Mataga irrigation scheme. Coefficient of determination (R^2) shows that there is a relationship (Somekh and Lewin, 2011), between irrigation and increased output and the orientation of the trend line on irrigated crops shows that there is significant change. The Chi-Square results show that irrigation schemes are very effective in enhancing household food security although there are issues of sustainability which was however a different scenario.

4.3.1. Maize Trend Analysis

The trends (figure 4.3.) for maize output shows that more yields were obtained after irrigation than in dry land farming. The period from 2002 to 2009 gives enough evidence that irrigation at Mundi-Mataga scheme had a great impact on increased quantity of output as opposed to dry land agriculture. The data was used to test the hypothesis that access to irrigation promotes increased productivity at Mundi-Mataga irrigation scheme.

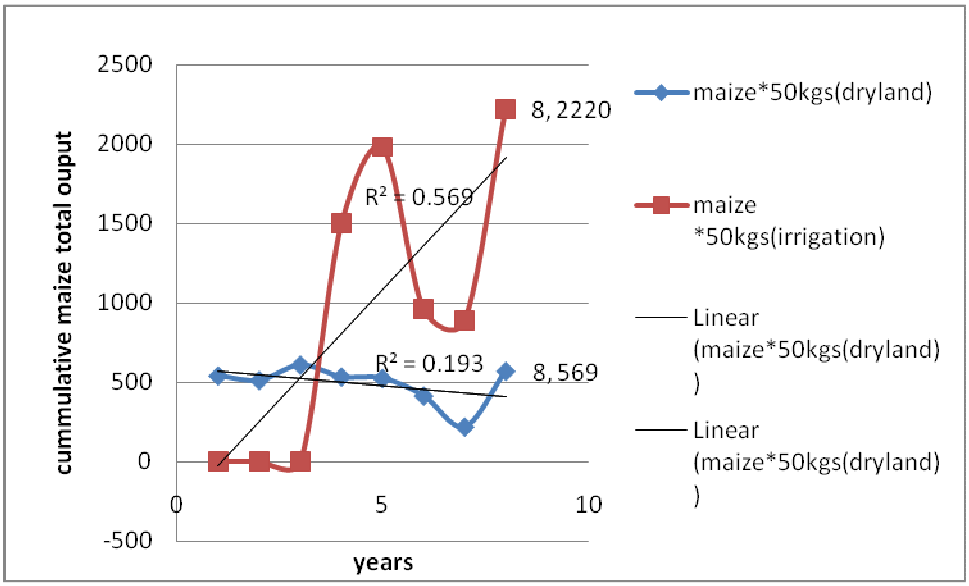


Figure 4.3: **Maize output trend before and after Irrigation Adoption**: Primary Source

The trend of maize between 2002 and 2009 shows that dry land agriculture almost maintained a lower output level for the whole period. In irrigation; that is 2005 and beyond there was a sharp increase in the maize output as reflected by trend line for irrigation which has a steeper gradient, however there are also larger fluctuations although output is increased. These fluctuations entail the experiences of 2007/8 and 2008/9 which negatively affected the performance of the scheme. The community was affected by the effects of the economic

recession which affected all economies to a global level, farmers realised low yields but the productivity still was more than in dry land as shown by the trends on figure 4.3. The orientation of the two trend lines shows that irrigated maize output increased significantly therefore there is evidence that irrigation had a greater contribution to farmer productivity for the main staple crop which is maize.

4.3.2. Sugar Beans Trend Analysis

The two trend lines on Figure 4.4 reflect that in dry land agriculture less can be produced than in irrigation thus irrigation is effective in enhancing household food security. R^2 for both gives positive results however R^2 for irrigated sugar beans has a greater value therefore there is a more significant relationship between irrigated sugar beans and increased yields.

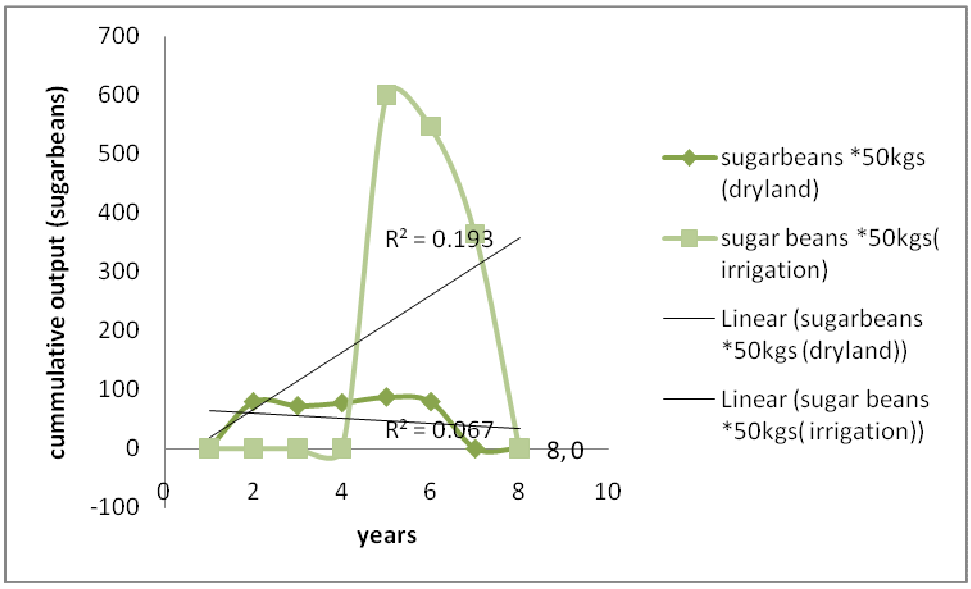


Figure 4.4: **Sugar Beans Trend before and After Irrigation Adoption**: Primary Source

With reference to Figure 4.4 trend line for irrigation on sugar beans productivity shows an improvement in yields after irrigation adoption. There was a reduction for dry land agriculture for the same crop. Sharp increase in the output was realised after irrigation due to an increase in the number of farmers who practiced sugar beans farming than in dry land therefore irrigation at Mundi-Mataga scheme enhanced household food security. Although a sharp increase in irrigated sugar beans was affected by some technical challenges household food security improved after adoption of Mundi-Mataga scheme.

4.3.3. Wheat Trend Analysis

Figure 4.5 shows that in dry land agriculture no wheat was produced. This is because wheat is a winter crop of which in Mberengwa community during winter the soils are mostly dry rendering it difficult to produce any crop in dry land agriculture. In irrigation, it shows that wheat was produced only for a two seasons and stopped.

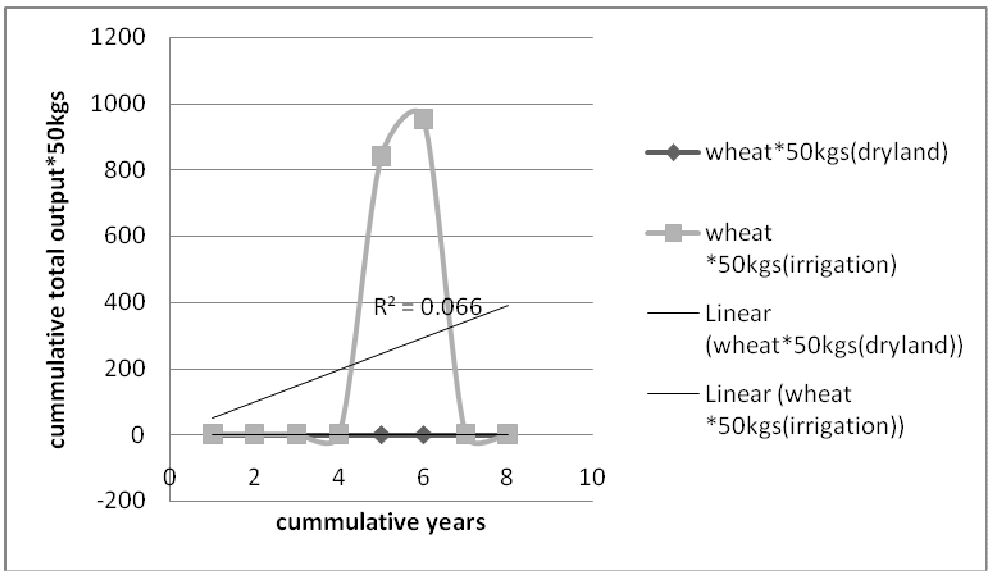


Figure 4.5.**Wheat before and after Irrigation Adoption**: Primary Data

The trend line in irrigation shown by R^2 =0.066 shows that practicing irrigation increases output produced. Therefore irrigation facilitated the growth of wheat so it is effective in enhancing household food security. From this data it is noted that irrigation at Mundi-Mataga has a great impact on crop production as there was a sharp increase in wheat production after irrigation was adopted. Evidence from data presented on figure 4.5 shows that with irrigation farmers can realise a positive outcome in output. Therefore it can be concluded that irrigation enhances household crop productivity therefore irrigation agriculture plays a crucial role as a livelihood intervention.

4.4. Relationship between Irrigation and Household Food Security

Access to irrigation significantly improved the food security status for Mundi-Mataga irrigation farmers. Output for maize, wheat and sugar beans as shown in section 4.3 shows greater improvements in productivity, for example the growth of wheat was realised after irrigation by households. Data for the main staple crop (maize) gave enough evidence that productivity increased significantly after irrigation. This data was used to test the hypothesis that there is a significant relationship between access to irrigation and increased output.

Table 4.2. Relationships between Maize Output before and after Adoption of Irrigation farming: Primary Source

	Average maize output was above 1 tonne/year: [N=60]	
Number of households	Before irrigation	After irrigation
	16	52

Average total productivity for the main staple crop (maize) for farmers increased sharply after adoption of irrigation. The trend shows that irrigation has a greater effect on crop productivity.The hypothesis was computed in order to establish the relationship between output in dry land (before irrigation) and change in output produced after irrigation using chi-square. Table 4.3 are the results of the hypothesis test. Access in this instance as illustrated in Table 4.2 explains the nature and effect of adoption of irrigation to small holder farmers in Mberengwa community. This depicted that most of these farmers benefited in adoption of irrigation

Table 4.3. Irrigation Increases Household Food Security: Chi-Square Test

(Primary Source)

	Value	Degrees of freedom	Significance (2-sided) (p=<0.05)
Pearson Chi-Square	3.357	1	0.067
Continuity Correlation	1.968	1	0.061
Likelihood Ratio	5.397	1	0.020
Number of Valid Cases	60		

The results of the Chi-Square test for independence between irrigation and output suggest a significant relationship between change in output and irrigation. At 95% significance level, the value for Pearson Chi-Square is 0.067 and is greater than 0.05 therefore change in output for farmers have a strong relationship to adoption of irrigation. Also the likelihood ratio is any test with a critical or rejection region (Park et al,. 2005), and it rejects the null hypothesis

if the ratio is too small and that ranges from 0 to 1. From Table 4.3 the probability/likelihood ratio (P) =0.020 and therefore the assumption that output increases with access to irrigation as resembled by the test accepted, there is a strong association between access to irrigation and increased crop output. Although households in Mundi-Mataga irrigation scheme realised increased productivity however, there are no statistical thresholds that can be used to determine a perfect prediction on the effect of irrigation on household output, however a good guess can be made although because in most cases based on the results one would be right to say irrigation increases farmer crop productivity.

The results from this study indicate that the Mundi-Mataga irrigation scheme is effective in enhancing household food security through the realisation of increased crop output by farmers after adoption of the irrigation scheme. Though the scheme faces some difficulties for meaningful food availability among the farmers irrigation is effective. Jama and Pizarro (2008) argued that the promotion of improved agriculture performance through smallholder irrigation development should avert hunger by the direct effects of increased agricultural productivity and income to the beneficiaries as is noted in this study. The findings of this study are almost similar to studies conducted by Yves le-gal et al. (2003), Manyatsi (2005), Fanadzo et al. (2010), Malaza and Myeni (2009) and Tapela (2008) who asserts that irrigation schemes are effective in improving livelihoods through increased productivity. The studies stated that, public small scale irrigation schemes are effective although in some developing countries the schemes are faced with sustainability challenges ranging from technical level that is maintaining and replacing infrastructure, poor agronomic practices leading to low yields and economic level covering the long term water costs, high debt, low farm income, market constraints and high inputs, to social level conflicts, exclusions and continued poverty and ecological level preserving water and soils under irrigation.

4.5. Negative Constraints for the Sustainability of the Scheme.

The research revealed that Mundi-Mataga irrigation scheme is effective but there are some challenges constraining the sustainability of the irrigation scheme to realise its full potential. These include technical, economic and social constraints which all contribute to inconsistence of production in the Mundi-Mataga irrigation scheme.

4.5.1. Technical and Production Issues for the Sustainability of the Irrigation Scheme

Through the irrigation farmers have been able to diversify into high value crops and enterprises that is commercial maize (dry and green sales), vegetable, sugar beans, wheat and

tomato production instead of specialisation to only dry-land crops and low value subsistence diversification, this was also observed in the study by Smith (2004) who indicated that the contribution of irrigation especially in smallholder schemes can either be positive or negative depending on the management practices applied. However the findings of this research study also showed that the irrigation scheme is faced with low and continued fluctuating crop productivity. The reasons behind the decrease in yields and low levels of production included the challenges faced by farmers which emanate from other critical stakeholders like, ZINWA and ZESA who sometimes fail to provide their essential services for the sustainability of the irrigation scheme. All these are very directly linked to the functionality of the irrigation scheme, however, there are always problems in the operational relationships (as revealed by irrigation authorities) rendering it difficult for the irrigation scheme to operate sustainably.

4.5.2. Economic Constraints Affecting the Sustainability of the Scheme

The study discovered that the availability of financial resources for the effective operation and rehabilitation of the irrigation scheme is a major constraint. Though the farmers were able to source start-up capital from local financiers but due to the below average returns from surplus sales, high operation costs and high rates charged by other service providers like ZINWA and ZESA, it is difficult for the farmers to pay back the loans as highlighted in other regional studies (Tafesse, 2003).This has been exacerbated by the continuous increase of farming inputs prices and electricity charges leading to the scheme to be highly indebted and members dissatisfied with irrigation project. As a result the scheme is not consistent. Challenges in marketing were also among the major causes of poor returns to the farmers in the irrigation scheme. G.M.B is failing to pay farmers for what they would have delivered, the authorities admitted that they failed to do so and according to farmer representatives in this case AGRITEX farmers end up operating an informal market where no records are captured for output sold. The most commonly grown crop is maize, vegetables and tomatoes. Wheat and sugar beans faced some challenges rendering them not being grown on regular rotational basis. This compromises diversity on food crops exaggerating nutrition which is another important component of food security that can be directly influenced by irrigation.

4.5.3. Social Constraints for the Sustainability of the Irrigation Scheme

The findings of the study indicated that social constraints were among the major contributors to the extent of the performance of the irrigation scheme. The scheme is characterised by inactive and poorly supported population. Female headed households have got higher household composition as compared to male headed households yet land allocation is skewed

in favor of males. The scheme did not adequately target vulnerable groups in the area. So the project is not realising its full potential in addressing food security concerns in the area. Male plot holders produced higher yields than their female counterparts. Also most male farmers hold Master Farmer Certificates than females even though female farmers are most vulnerable.

4.6. Conclusion

A call for increased food insecurity in Mberengwa district can be attributed to some institutional failures which compromise the sustainability of the irrigation schemes in the area, otherwise families who practice irrigation are food secure even though the whole community is often affected by hunger. Also, food security is measured at community level where the determinants would differ from those at household level. Mundi-Mataga irrigation scheme had a greater impact on enhanced food security status of the faming households hence the period the scheme went without any activities there are reports of increased level of food insecurity in the area. Sustainability constraints of the irrigation scheme had a great implication on increased food insecurity situation in the agro-based community, however, the problem can be resolved as it requires good relations between parties hence the food security situation can be improved through irrigation. The major thrust of this research was to evaluate the irrigation schemes in enhancing household food security thus it tried to check whether irrigation schemes are able to contribute to increased productivity and results shows that irrigation schemes can enhance productivity.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

The paper assessed the effectiveness of Mundi-Mataga irrigation scheme in enhancing household food security in Mberengwa district. The research revealed that irrigation schemes enhance household food security basing on the study results. There were improvements in the levels of output after irrigation in maize, sugar beans and wheat especially.

5.2. Summary of Findings

The purpose of the study was to evaluate the effectiveness of Mundi-Mataga irrigation scheme in enhancing household food security in Mberengwa district. Data collection methods included interview schedules, field observations and questionnaire administration which helped for triangulation. SPSS and Microsoft excel were applied in data presentation for analysis. At household level the farmers benefited a lot from production of crops for example, wheat which they had not produced before irrigation. There were fluctuations in output produced and for wheat and sugar beans there was no consistence which has an implication on the sustainability of the scheme. Mundi-Mataga irrigation scheme has benefited households through increased output which improved their food security status. The irrigation contributed significantly to household food security for farmers and this was one of the objectives of this study to determine the contribution of irrigation schemes. Also it was noted that there is a positive relationship between irrigation agriculture and improved household food productivity, thus access to irrigation agriculture enhanced the food security status for farming households. Although there can exist some challenges for the sustainability of the scheme, it was noted that irrigation schemes are effective in enhancing household food security and evidence from this study shows that in the area of study some crops like wheat were only practiced after irrigation adoption thus they have enhanced production and also productivity.

5.3. Conclusions

The findings of this research show that increased productivity was realised by small holder farmers after adoption of Mundi-Mataga irrigation scheme. Thus farmers who were involved in irrigation farming in Mundi-Mataga scheme were food secure as long the irrigation functions even though the whole community would be realising hunger. Irrigation agriculture increases food production hence availability of food for households practising irrigation.

The use of irrigated agriculture enabled crop production during dry seasons which increases the number of harvests per year and therefore enhanced productivity and production. With the huge investments in the irrigation infrastructure, the irrigation scheme have contributed to improvement in the quality of lives on smallholder farmers as well as increasing agricultural productivity for economic growth in the community. In addition, the scheme causes nutritional improvements by enabling the growing of such crops as sugar beans and other types of vegetables like spinach and cabbages which were not grown on dry land agriculture.

The socio-economic status of the smallholder farmers had improved as a result of the irrigation project. Factors contributing to that include compatible technology especially on the irrigation system which is flooding therefore cheaper to adapt to, however farmers face challenges in the growing of wheat and sugar beans, lack of markets for vegetable crops and lack of training on business and financial management. Institutional arrangement of the irrigation scheme is well accepted by the smallholder farmers but it is faced with a number of conflicts arising from lack of cooperation by ZINWA and ZESA leading to unsustainability of the scheme.

The research concludes that irrigation schemes enhance household food security through increased productivity. Moreover, irrigation schemes are, if necessary conditions are put in place, effective in enhancing household food security through increased productivity. This makes the need for further researches in Mberengwa district to be carried out to find out why food insecurity continues on the rise while available adopted drought coping mechanisms that include irrigation are effective.

5.4. Recommendations

To ensure the sustainability of the irrigation scheme the study recommends that:

- AGRITEX may approach DDF for technical support in rehabilitation of the irrigation scheme. Also the whole production processes be started all over again.
- The Ministry of Agriculture, Mechanisation and Irrigation Development can establish agricultural financing targeting the most vulnerable households which will be used to source inputs to boost production and improve income.
- Farmers can negotiate a sustainable payment plan for ZIMWA and ZESA services to improve the sustainability of Mundi-Mataga irrigation scheme to realise its full potential in increasing farmer productivity.

- G.M.B authorities need to make payments for delivered crops in time for farmers who would have supplied their produce.
- There may be the need to increase the size of the irrigation scheme by government through responsible ministries as the dam capacity is far much above the irrigated area so as to accommodate more farmers.
- It could be helpful if there be new policy reforms on complimentary institutions like ZESA, ZINWA, and DDF to the irrigation on service provision rate payments.
- The government can subsidise the major resources like power and water for irrigation sustainability.
- AGRITEX and other authorities can consider gender issues when conducting policy interventions if they are to minimise the level of hunger in the area.
- There may be a need for farmer education through field days, master farmer training courses and outreach field trips to be coordinated by AGRITEX.

5.5. Overall Conclusion

Sustaining improved food security status in Mberengwa district communities require an appreciation of the causes of the situation and their interlinkages with others which could indirectly have an implication on the resultant condition which can be done through impact analysis. To better find out the possible causes of the continued existence of food insecurity in Mberengwa district requires a further research. Evidence shows that irrigation practise enhances the food security status of the farming households therefore the intervention is very reliable however, the continued incidences of hunger may be attributed to other reasons which need to be explored hence the need for more research to better improve the food security situation in the district.

REFERENCES

Bagson E. and Kuunder C.J. W (2013). "Assessment of small scale irrigation schemes on household food security and leisure in Kokolign, Ghana". Journal of the research on humanities and Social Sciences. Volume 3 No 1

Beldier P. et al.(2007). Can drip irrigation improve food security for families in Zimbabwe?www.stanford.edu/group/solarbenin/references/can_Drip_Irrigation.pdf - Retrieved 16/12/14

Chazovachii B. (2012). "The impact of small scale irrigation schemes on rural livelihoods. The case of Panganai irrigation scheme in Bikita District of Zimbabwe".The Journal of Sustainable Development in Africa.Volume 14, No 12 (2012).Clarion University of Pennsylvania. Pennsylvania.

Chivizhe J, Mugabe F.T and Hungwe C. (2008) Quantitative assessment of the effectiveness of Drip Irrigation Kits in Alleviating Food Shortages and its Success in Zimabwe. A Case Study of Gweru and Bikita Districts. FANRPAN. Harare

Department of AGRITEX (1999).Learning Together through Participatory Extension. A trainer's guide. Harare. Zimbabwe.

Domenech, L. and Ringler, C. (2013)."The Impact of Irrigation on Nutrition, Health and Gender. A review paper with insights for Africa South of Sahara." International Research Institute. Washington D.C.

Ewumbu, J.S. (2011). Out-migration and its effects on the food security of households in the Lambussie-Karni District of the Upper West Region. University for Development Studies, Tamale

FAO (1997).Poor irrigation management. A threat to soil, water and food security .www.fao.org/focus/e/spec/pr/spro13_e.htm Retrieved 19/01/15

FAO (2003). Small-Scale irrigations for Arid Zones. Principles and Options. www.fao.org/docrep/w3094e/w3094e02.htm Retrieved 03/02/15

FAO (2007). Crop and food supply assessment mission to Zimbabwe, June 2007. http//www.fao.org/giews. Retrieved20/02/15

FAO (2010) The State of Food Insecurity in the World: Addressing Food Insecurity in A Protracted Crises.FAO. Rome

Feresu, S. B. (2010). Zimbabwe Environmental Outlook. Our Environment, Everybody's Responsibility:Government of Zimbabwe.The Ministry of Environment and Natural Resource Management. Harare.

Field, W. P and Collier F. W (2009).Guidelines for planning irrigation and drainage investment project.International commission on drainage.

Food and Environment (2013).Basic Concepts of Food Security.Definition and dimension.www.foodandenvironment.com/2013/01/... Retrieved 16/03/15

CGIFR.(2013). Typology of Farm Households and Irrigation System.www.egfar.org/news/imported/typology... Retrieved 16/03/15

Hanjra, M. A and Quresh, M. E (2009).Global Water Crisis and Future Food Security in ever Climate Change.www.elsenier.com/locate/foodpol. …Retrieved 11/01/15

Hart C.E, Hayes D.J and Babcock B.A (2003) Insuring Eggs In Baskets. Center for Agricultural and Rural Development (CARD).Lowa State University.Lowa

Hoddinott J. (1999),"Choosing Outcome Indicators of Household Food Security", International Food Policy Research Institute. Technical Guide 7

Hunger J. D and Wheelen T. L. (2007). Essentials of Strategic Management. Prentice Hall, New Delhi.

IFAD(2005). Ethiopia, Enhancing Food Security through Irrigation Schemes. www.ifad.org/evaluation/public.html/e/syst/doc/profit/ethiopia.htm-Retrieved 17/01/15.

IFDC (2013). Drip irrigation and FDP Double Tomato Yields and Increases Incomes.www.ifdc.org.gov/oecaagt/agli/croirrigation.html....Retrieved -12/01/15.

Jama B and Pizarro G (2008)."Agriculture in Africa: Strategies to Improve and Sustain Smallholder Production Systems". Ann. N. Y. Academy. Sci. 1136:218-232.

Kari A. (2010).Policy Responses to Food Crisis in Kenya.Kenya Agricultural Research Institute. Nairobi

Lankford B. (2003)"Irrigation Based Livelihood Trends in River Basins: Theory and Policy Implications for Irrigation Development". Physics and Chemistry of the Earth.28 ; 817-825

Malaza S and Myeni D.M (2009)."Integrating Smallholder Growers into Competitive Sugar Production".Irrigation and Drainage Systems.19. 1-36

Makombe T. et al (2010). "The Determinants of Food Security in Rural Malawi: Implications for Agricultural Policy." International Food Policy Research Institute. Washington D. C.

Manyatsi A. M. (2005). Smallholder irrigated and agriculture and food security in Swaziland. University of Swaziland.Lunging.

Manzungu and van de Zaag (2006). Water for Agriculture in Zimbabwe.Policy and Management Option for Smallholder Sector.University of Zimbabwe. Harare.

Mangisoni B. (2008). "Impact of Treadle Pump Irrigation Technology on Smallholder Poverty and Food Security in Malawi: A Case Study of Blantyre and Mchinji Districts." International Journal of Agricultural Sustainability 6 (4): 248–266.

Mhandu F. (2014)."Irrigation, ARDA Farms answer to Food Security Threat". The Zimbabwean, 26 January 2014. Harare.

Ministry of Agriculture, Mechanization and Irrigation Development (2013).Cereal Production estimates for 2012/13 season. Government of Zimbabwe. Harare

Mutasa M. (2011). Taming the Beast, Vulnerability to Coping and Adaptation with Drought Impacts in Rural Zimbabwe.ICARUS. Michigan.

Musa I.K. (2010). Irrigation Development: Challenges for the Least Developed Countries in Africa. Report on the ICID Task force on priority issues of Least Developed Countries in Africa. Vol 10 (2).

Musara J.P. et al (2010)"Determinants of Micro Irrigation Adoption for Maize Production in Small holder Irrigation.Case of Hama Mavhaire irrigation scheme". African Journal for food, agriculture, nutrition and development. 4. 134-155.

Nanama S and Souli K (2002) Methods of Measuring Household Food Security and Vulnerability: Evidence from the Zondoma Food Security Initiative. AFRICARE. Washington.

Peret, S. (2006).Water Governance for Sustainable Development.: Approaches from developing and transnational countries.EARTHSCAN. London.

Peter, G. (2011).“The Impact of Small Scale Irrigation Schemes on Household Food Security in Zimbabwe”.The Journal of Sustainable Development in Africa.Volume 13 No 6(2011).Clarion University of Pennsylvania. Pennsylvania.

Rodgerson P.A. (2010).Statistical Methods for Geography.A Student Guide. SAGE Publications. London.

Rukuni M. and Eicher C.K. (1994).Zimbabwe's Agricultural Revolution. University of

Zimbabwe Publications. Harare.

Rukuni M, Tawonezvi P and Eicher C (2006) Zimbabwe Agriculture Revolution Revised. University of Zimbabwe Publications. Harare

Saliu H. A. and Jimoh H.I(2008) Irrigation and Food Security: Perspectives of Nation - Building and Development y in Nigeria, Environmental and EconomicIssues. Concept Publications Ltd. Lagos

Sasson A. (2012). “Food security for Africa: An Urgent Global Challenge”. Agriculture and Food Security 2012 (1) : Volume 2.

Scoones I.(2013) irrigating Zimbabwe. Time for some new thinking. Zimbabwe land zimbabweland.wordopress.com/2013/09/30/irrigating-zimbabwe-time-for newthinking/Smallholder irrigation in Zimbabwe….Retrieved 30/12/14

Smith L.E (2004). “Assessment of the Contribution of Irrigation to Poverty Reduction and Sustainable Livelihoods”.Water Resources Development. 20(2):243-257

Somekh B and Lewin R. (2011).Theory and Methods in Social ResearchSAGE Publications. London

Stinger R.(2000).Food Security in Developing Countries. Policy discussion paper No 001. University of Adelaide. Adelaide. Australia.

Tafesse M (2003). Small-Scale Irrigation for Food Security in Sub-Sahara Africa. Report and recommendations of a CTA study. CTA Working Document Number 8031. Ethiopia.

Tapela B.N (2008).Livelihoods in the Wake of Agricultural Commercialization in South Africa’s Poverty Notes: Insights from Small-scale Irrigation Schemes in LimpompoProvince. Development Southern Africa 25(2):181-198.

World Food Programme (2009).Comprehensive Food Security and Vulnerability Analysis (CFSVA) Ghana. World Food Programme, VAM Food Security Analysis. Rome.

WFP (2013).Community Irrigation Scheme in Zimbabwe Makes Crops Flourish and Food Plentiful.University of Nebrska. Lincoln.

Word Bank, (2013). Gender and Development. worldbank.org>countries>Africa>Gender Retrieved -04/03/15

Yves le-gal P, Rieu T and Fall C (2003).Water Pricing and Sustainability of Self-governing Irrigation Schemes.Irrigation Drainage.Systems. 17:213-238.

ZIMVAC (2011).Zimbabwe livelihood Profile. August – September 2011. SIRDC. Harare. Zimbabwe.

ZIMVAC (2013).Rural livelihoods Assessment.SIRDC. Harare.

ZIMVAC (2014).Rural poverty on the rise in Zimbabwe.September 12, 2014SIRDC.Harare

Appendix 1: questionnnaire.

HOUSEHOLDQUESTIONNAIRE Date……/……/…….

My name is Edson Macheza. I am studying Development Studies at Bindura University of Science Education. I am carrying out a research on: The Effectiveness of Irrigation Schemes in enhancing household food security in Mberengwa District. "A Case study of Mundi-Mataga Irrigation Scheme". The purpose of the questionnaire is to solicit information on the above topic. Be assured that responses will be strictly confidential and will be used for the sole reason of pursuing academic interests. No individual names are required on the questionnaire. You are kindly requested to answer the questionnaire honestly.

-Please do not write your NAME on the questionnaire.

-Tick where applicable in the space provided.

Questionnaire Number ☐☐☐

SECTION A: DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS.

a) Sex of respondent 1 = male ☐ 2 = female ☐

b) Age of respondent 1)<18 ☐ 2)20-39 ☐ 3)40-59 ☐ 4) 60+ ☐

c) Position of respondent in the household

1 = Head ☐ 2 = Spouse ☐ 3 = child ☐ 4 = other specify……

d) Age of household head in years

1 = 18-30 ☐ 2 = 31-40 ☐ 3 = 41-50 ☐ 4 = 50^{+} ☐

e) Education of Household head

1 = no formal education at all ☐ 2= Primary ☐ 3 = 'O' Level ☐ 4 = 'A' Level 5=Tertiary ☐

f) Main Source (s) of H/H food

1 = dryland farming ☐ 2 = irrigation ☐ 3 = market ☐ 4=food aid ☐

g) Experience of household head in irrigation agriculture

1) 1-5years ☐ 2) 6-10 years ☐ 3) 10+ years ☐

h) What is the size of your plot? 1) 0-0.5 ha ☐ .5-1.0ha3)1.0 h ☐ ☐

i) Crops grown by the household in the irrigation scheme.

1) Maize ☐ 2) sugar beans ☐ 3) wheat ☐ 4) vegetables ☐ 5) tomatoes

6)rapoko ☐ 7)sorghum ☐ 8)groundnuts ☐ 9) other,.....

j) Main source of income for the household (economic activities done to raise income)

1) Sale of cash crops ☐ 2) remittances ☐ 3) on and off farm labour ☐ 4) sale of livestock ☐ 5)other.(specify)……

SECTION B: CHANGE PERCEPTIONS AND ADAPTATION

1.What was your total output for the following years?

Cop	2002	2003	2004	2005	2005	2006	2007	2008	2009
1.maize (kgs)									
2.Sugar beans (kgs)									
3.wheat (kgs)									
4.vegetables (bundles)									
5.tomatoes (crates)									

2) Were you having at least three meals a day for the family before engaging into irrigation?

1)Yes ☐ 2) No ☐

3) Crops grown through irrigation.

1)Maize ☐ 2)sugar beans ☐ 3)wheat ☐ 4)vegetables ☐ 5) tomatoes ☐

Have you managed to make any surpluses from irrigated crops, please tick a box below.

1)Maize ☐ 2)sugar beans ☐ 3) wheat ☐ 4)vegetables ☐ 5) tomatoes. ☐

4) Where do you get inputs ?specify.....

5) What constraints have you encountered in an effort to adapt in irrigation? Shortage of:

1) finance to purchase inputs ☐ 2) proper technology ☐ 3) enough labour ☐

6) Suggest measures that can be put in place to counteract the constraints

……

……

C: FOOD CONSUMPTION PATTERNS

1) How many meals were you having per day as a household before you engaged in the scheme?

1 meal ☐ 2 meals ☐ 3 meals ☐ more than 3 ☐

2) How many meals do you have after engaging in the scheme?

1meal ☐ 2meal ☐ 3meals ☐ more than 3 ☐

3) Can you please describe your typical food basket for each day for the household?

Morning..... Afternoon……Evening……

4) Ever since you started irrigation have you acquired any assets1)Yes ☐ 2)No ☐

5) Do you always have an average of three meals throughout the year?

Yes ☐ No ☐

If not, which periods (months) do you experience hunger in your household?

6) If the government is to establish more irrigation schemes what will be your advice?

.....

Justify your reason.....

THANK YOU FOR YOUR EFFORT

Appendix II: Interview guide

The effectiveness of irrigation schemes in enhancing household food security in Mberengwa district. Acase study of Mundi- Mataga Irrigation Scheme.

INTERVIEW GUIDE-1 (G.M.BMataga)

I am Edson Macheza a student at Bindura University of Science Education and I am doing my research on"The effectiveness of irrigation schemes in enhancing household food security in Mberengwa District: A case study of Mundi-Mataga irrigation scheme".

1. Since the inception of Mundi-Mataga irrigation scheme are any changes in grain stocks?
2. Do the farmers constantly supply the G.M.B?
3. On average what quantities do they supply? Can you say that is their full potential?
4. How do assist farmers if you do assist them?
5. How do you pay them for what they supply and on average how much a tonne of:

-maize

-sugar beans

-wheat

6. Can you say the coming in of Mundi-Mataga irrigation scheme had a positive change towards your stock levels?
7. Any opinion on the G.M.B relationships with the farmers.

THANK YOU

The effectiveness of irrigation schemes in enhancing household food security in Mberengwa district. Acase study of Mundi- Mataga Irrigation Scheme.

INTERVIEW GUIDE-2 (AGRITEX)

I am Edson Macheza a student at Bindura University of Science Education and I am doing my research on"The effectiveness of irrigation schemes in enhancing household food security in Mberengwa District: A case study of Mundi-Mataga irrigation scheme".

1. Was there any criterion which was used to allocate the land?

2. How big is each plot?

3. How many households are in the scheme?

4. How far is the furthest plot from the dam? What about the closest plot?

5. Is there consistence in the farming activities?

6. What do you do in the event that the plot holder had died?

7. Is there any irrigation management committee? Can you say it's effective?

8. Who decides the cropping program for the scheme?

9. In your opinion does this scheme have impact on food security?

10. Suggestions for improvements

THANK YOU

Appendix II1: Chi-Square testing

CROSSTABS

/TABLES=Quantity BY Output

/FORMAT=AVALUE TABLES

/STATISTICS=CHISQ

/CELLS=COUNT

/COUNT ROUND CELL.

Crosstabs

[DataSet0]

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Average output was above 1 tonne after irrigation * Output average was above 1 tonne before irrigation	60	100.0%	0	0.0%	60	100.0%

Average output was above 1 tonne after irrigation * Output average was above 1 tonne before irrigation Crosstabulation

Count

		Output average was above 1 tonne before irrigation		Total
		Yes	No	
Average output was above 1 tonne after irrigation	Yes	16	36	52
	No	0	8	8
Total		16	44	60

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.357[a]	1	.067		
Continuity Correction[b]	1.968	1	.161		
Likelihood Ratio	5.397	1	.020		
Fisher's Exact Test				.095	.069
N of Valid Cases	60				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.13.

b. Computed only for a 2x2 table

SET DIGITGROUPING=No Small=0.0001

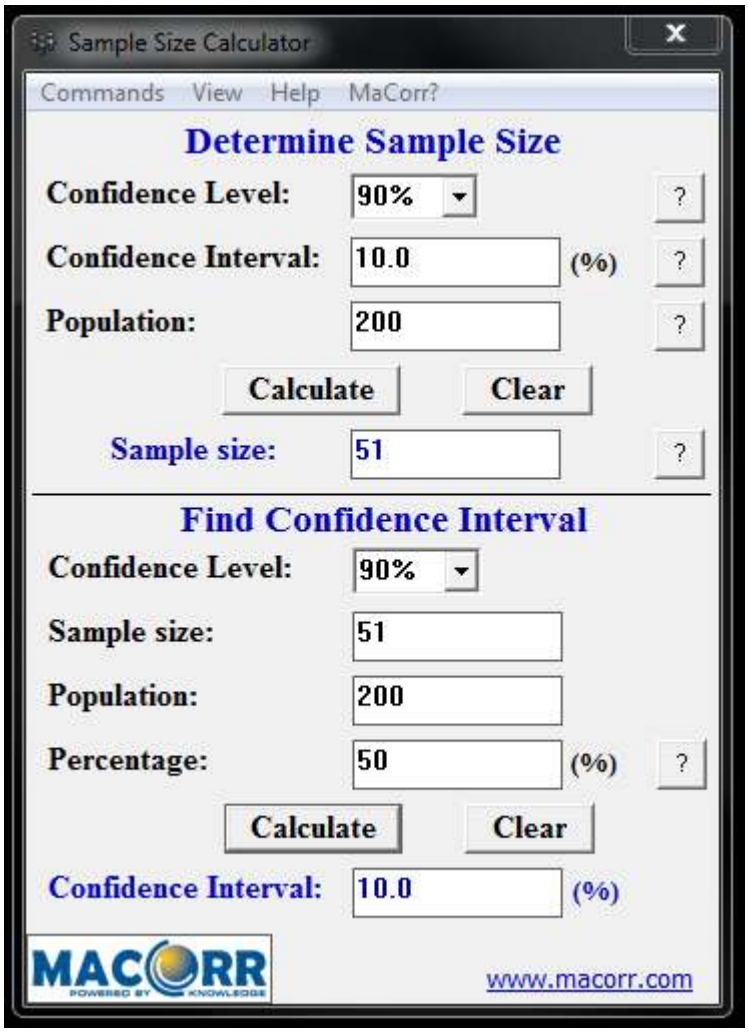
Unicode=No OLang=English.

SET Printback=On.

SET Printback=On.

SET Printback=On.

Appendix 4: Sample Size Calculator



51 is the minimum recommended size of your survey. And in the study 60 was the sample size.

The confidence level is the amount of uncertainty you can tolerate.

The margin of error is the amount of error that you can tolerate