FACTORS AFFECTING THE ADOPTION OF DRIP IRRIGATION AMONG SMALLHOLDER FARMERS IN ZAMBIA

(Case study of Kafue and kabwe districts)

A Research report submitted to the Department of Agricultural Economics and Extension Education of the University of Zambia

BY

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LIST OF ABBREVIATION

ADB/N	agriculture development bank Nepal
CSO	central statistics office
FAO	food agriculture organization
FNDP	fifth national development plan
IDE	international development enterprise
MIT	micro irrigation technology
NIP	national irrigation plan
TAM	technology acceptance model
VIF	variance inflation factor

ABSTRACT

Factors affecting the adoption of Drip irrigation technology among small holder farmers In Kabwe and Kafue Districts

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Irrigation has long been seen as an option to improve and sustain rural livelihoods by increasing crop production. It also enables farmers to switch from subsistence production to market-oriented production; with higher yielding and higher-value crops however most of the irrigation equipments available on the market are too expensive for an average small scale farmer to afford.

The low cost drip irrigation system was promoted as an alternative irrigation method to the traditional flooding method by International Development Enterprise in Kafue and Kabwe districts of Zambia. The aim was to ensure the efficient use of water and inputs as well as save on labour but despite the promotion the adoption rate was below the targeted. This paper used the Tobit model to analyze the socioeconomic and institutional factors that affect the adoption of the drip system among farmers in Kabwe and Kafue districts. Farm and household level data were obtained from 103 farmers consisting of 58 adopters and 45 non-adopters. Adoption in this study was considered as those farmers who were irrigating there field with at least a 200m2 drip systems on there fields

The study showed that the most important factors that affect farmers adoption decision is the household's level of assets, attending primary school, house hold size, age of house hold head, receiving training in irrigation farming and technology as these were found to be significant (at p-value> 0.01). The total land under irrigation and the ownership of treadle pump were found to be significant (at p-value>0.05) in explaining adoption of drip irrigation.

The age and household size were negatively related to adoption implying that the older the farmer is and the larger the house hold size is, the lower the proportion of irrigated land allocated under the drip system. The ownership of treadle pumps and the increase in the year of primary school attendance increased the farmer's proportion of irrigated land under drip system. The larger the area under irrigation and the more assets ownership was also associated with increased adoption. Farmers who received training in irrigation farming and technology also showed a higher proportion of there irrigated land being under drip system.

The study results emphasizes the importance of formal education as well as training in drip irrigation adoption hence, it is important to place adoption-enhancing interventions to promote education for (not only the household head but) the entire household. This can be inform of encouraging farmers to attend formal education inform of night school. There is also need to intensify the training and technical support that farmer receive on irrigation farming and technology. This may encourage farmers expand there irrigation farming and propel them into acquiring water saving technologies, as land under irrigation proved to be significant in the study.

CHAPTER ONE: INTRODUCTION

1.1 Introduction

Zambia is a country where 94% of the population lives on less than US$2 per day and 60% of the population is dependent on agriculture for their livelihoods. Around 51% of the population is female and 76% of the female population is involved in agriculture, this is according to International development enterprises gender differentiation impact of low cost irrigation technology (2009). Increasing agricultural productivity and creating rural prosperity is highly dependent on the ability of farmers to intensify land use. Without irrigation, farmers generally produce only rain-fed crops in the period between November and December and hence are faced with lower prices as a result of over supply.

Irrigation has long been seen as an option to improve and sustain rural livelihoods by increasing crop production. It can reduce dependency on rain fed agriculture in drought prone areas and increase cropping intensities in humid and tropical zones by `extending' the wet season and introducing effective means of water control. Irrigation farming further enables farmers to switch from subsistence production to market-oriented production, with higher yielding and higher-value crops. The commonly available irrigation technologies are expensive and out of reach of the poorest smallholders. For most smallholders bucket and furrow irrigation is a cheap way of growing irrigated crops, however these methods are very labor intensive and time consuming.

The Zambian government has development a National Irrigation Policy and Strategy. The National Irrigation Plan (NIP) is a follow up within context of Firth National Development Plan (FNDP 2006-2011) in which it wants to transform the irrigation potential into reality to achieve food security. NIP is a strategy for full, efficient and sustainable exploitation of both surface and underground water resources by promoting irrigation in its various forms and targeted at the different farmer types to ensure all round agricultural production of food, cash, export and industrial crops. NIP is aimed at expanding the production base, productivity and stability of irrigated farming systems through the use of improved and appropriate irrigation technologies and services.

Despite the increased government support of the irrigation sector there is need to realize that most modern irrigation techniques have been designed for relatively large and fairly sophisticated systems. With the introduction of alternative new technologies such as low-cost drip irrigation, improved treadle pumps and low-cost plastic water tanks to store runoff, smallholders can benefit from modern irrigation techniques that would otherwise be unaffordable, given the small size of their farms and the limited capital available to them. According to FAO (2008) Low-cost irrigation is a practical way to address poverty and hunger, has irrigation increases yields for most crops by 100 to 400%.

Zambia has over 1,740,380 million cubic meters of underground water resources and currently the total land under irrigation is 155912ha, with smallholder farmers accounting for 111525ha (approximately 72%). The medium scale farmers account for 7372ha (approximately 4.3%). The large scale farmers account for 37015ha (approximately 23.7%). 21% of the total irrigated land is under surface irrigation, 11.3% is under sprinkler irrigation, 3.6% is under localized drip and 64% is in the wetlands.(FAO-Aquastat-2007)

Drip-irrigation in the developing country context generally refers to the slow application of water through a set of emitters (holes) placed along water delivery lines precisely at the root zone of the plants. Water is supplied to the lines via drums, which can be filled by hand or other means. Drip irrigation is often associated with vegetable production for both home use and sale. (Upadhyay, B. 2005) figure 1, shows a typical small scale drip system with a 20litre bucket placed on a wooden stand.

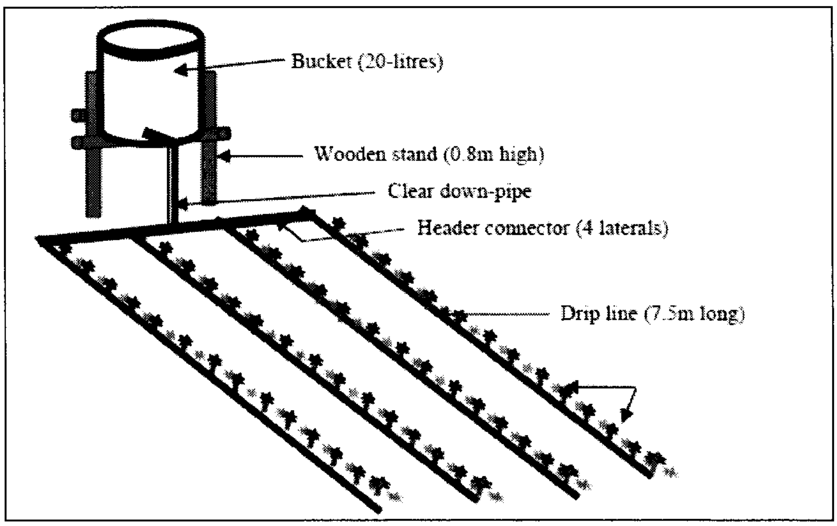

Figure 1 Typical drip kit 20-litre bucket irrigation system

Drip irrigation is particularly beneficial especially in areas were there is shortage of water and it also saves on time and energy, as time will not be wasted watering areas were there are no plants.

Casual observation of the kit suggests it can be particularly liked by women because of its time and energy saving characteristics thus it can be used to contribute to the alleviation of rural poverty .This study tried to understand what motivates and influence women farmers to choose and use the drip irrigation technology.

1.2 Background

International Development Enterprise (IDE) Zambia has been operating in Zambia since 1997 and since then it has been designing and marketing low-cost irrigation technologies (e.g. treadle pumps, low cost drip irrigation kits and micro sprinklers). The organization currently has 14000 smallholder farmer clients in the copperbelt, kabwe, Lusaka, Kafue, Pemba and Livingstone. Over 50% of these farmers are women farmers. The organization targets farmers earning less than US $2 a day.

IDE believes that additional benefits can accrue to existing and new smallholder farmer clients through differentiating its micro irrigation technology (MIT) design and extension approach between men and women farmers. If female farmers can achieve a 10% increase in annual net income as a result of implementing the results of the proposed research, this will add a considerable income on their lives.

1.3 Problem statement

According to IDE technology update (2009) 20% client farmers have accessed the drip kit and 75% of these are operating the equipment. The period between 2003 and 2008 in a MEDA sponsored project farmers were able to purchase the 20×10m drip kit for K30, 000 and yet despite this initiative only a few farmers accessed the drip kit and out of those who purchased the kits only a small percentage are using the kits.

When IDE initially started this project in Zambia it expected to have over 30% of there farmers to have adopted the drip kit by 2008. The projected adoption rate was over 50% and they have only achieved 20% according to the 2010 records compiled by the monitoring and evaluation department of IDE. The discrepancy between the expected adoption rate and the actual adoption rate leaves a lot of unanswered questions. If the yields of farmers are to increase resulting in an increase in incomes and standard of living, there is need to accelerate the rate at which they adopt efficient technologies. There has been no extensive study conducted in Zambia to investigate the factors that influence the adoption of micro irrigation technology system among smallholder farmers and most research has focused on the impact that using micro irrigation technologies have on the farmer's livelihoods.

1.4 Research objectives

1.4.1 General objectives

The general objective of this research was to determine the factors affecting the adoption of drip irrigation technology among smallholder farmers in Zambia.

1.4.2 Specific objectives

- To identify socioeconomic and institutional factors affecting the adoption of drip irrigation technology among smallholder farmers
- To determine the extent to which each factor affects the adoption of drip irrigation technology

1.5 Hypothesis

The study hypothesized that house hold size, age of house hold head and distance to the market and main road will have a negative effect on the decision of the farmer to adopt or not to adopt the drip system. The level of assets, total land under irrigation, training and technical assistance on irrigation farming and technology, availability of off farm income, access to credit and house hold members above the age of 16 were hypothesized to have a positive effect on the farmers adoption decisions.

The water source that is available for the household was also considered to be a factor and the water sources investigated were, river, borehole, well and dam. The source of water being well was hypothesized to affect adoption positively.

1.6 Justification of the study

Lack of information on the factors affecting the adoption of drip irrigation by smallholder women farmers has led to the assumption by researchers in Zambia that lack of income and technical know how are the only limiting factor to their adoption. Determination of the factors affecting the adoption of drip irrigation among women farmers will shed some light on the pattern of technology acceptability among women farmers. A quantitative approach to studying adoption is essential because it not only identifies the factors but also provides information on the significance of each factor that affects decisions to adopt and patterns followed. Awareness of these factors would facilitate the enhancement of development and transfer of appropriate technologies. This information can then be used to determine adoption rates and the effect of a change in a variable on adoption of drip irrigation. The findings of this study will be of help to researchers in their future studies pertaining to micro irrigation. Various stakeholders such as farmers, organizations promoting irrigation farming among smallholder farmers and extension agents will benefit too.

1.7 Organization of the report

This report is structured in such a way that the first chapter gives an introduction of the whole idea of irrigation and more particularly micro irrigation technology and it further goes on to give a brief background on drip irrigation as with regard to the work that IDE has done in the same area. It also highlights the reason why this study is important in understanding the reasons behind farmer's decision to adopt micro irrigation technologies. The chapter also brings out the general objective and the specific objectives of the study. The study hypothesis are also highlighted in this chapter

The second chapter reviews the available literature on adoption of irrigation technologies it focuses on past studies conducted in Zambia and elsewhere in the world. It also brings out the theories that are helping understand the adoption patterns. The third chapter looks at the methods that were used to analyze factors affecting the adoption of drip technology by looking at the sampling method, model used in the study the variables considered as well as the study areas.

Chapter four presents the study findings and there interpretation, it brings out the results of the characteristics of the sample in terms of demographics and other characteristics. This chapter also presents results of the regression and its interpretations. Conclusion and recommendations are in the last chapter. The conclusion sums up the study findings while the recommendation highlights suggestions toward the improvement of the identified problem according to the researcher.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The past decade has seen an increasing emphasis on irrigation farming in Zambia especially among smallholder farmers. Quantitative and qualitative studies have been carried out across the globe presenting valuable information on various aspects of adopting micro irrigation technology. This chapter reviews relevant literature on patterns of agricultural technology adoption, past studies on drip irrigation adoption, benefits of using the kit as irrigation equipment and theoretical framework.

2.1 Agricultural technology adoption patterns

The literature on agricultural technology adoption is vast and somewhat difficult to summarize compactly. Traditionally, economic analysis of agricultural technology adoption has focused on imperfect information, risk, uncertainty, institutional constraints, human capital, input availability, and infrastructure as potential explanations for adoption decisions (Feder et al. 1985; Foster and Rosenzweig 1996; and Kohli and Singh 1997). A more recent strand of literature focuses on social networks and learning. In the following, prominent analyses of agricultural adoption, from both traditional and social network perspectives, are presented. The literature is then synthesized into three paradigms of technology adoption. In studying agricultural technology adoption, analysis of the adoption of high yielding varieties (HYV) in India has been particularly influential. Kohli and Singh (1997) found that inputs played a large role in the rapid adoption of HYVs in the Punjab. They claimed that the effort made by the Punjab government to make the technological innovations and their complementary inputs more easily and cheaply available allowed the technology to diffuse faster than in the rest of India.

Butzer et al (2002) used a choice of technique framework to characterize the decision to adopt HYVs in India. They found that since HYVs require higher levels of fertilizer and irrigation to realize their yield potential, their introduction corresponded with a large jump in the demand for fertilizer and irrigated land. McGuirk and Mundlak (1991) also use a choice of technique framework in a study of the transformation of Punjab agriculture during the Green Revolution and find that the short period of transition from the use of traditional varieties to the adoption of HYVs was largely determined by the availability of irrigation facilities and fertilizer. This result partially stems from the fact that, as mentioned before, to fully utilize the yield potential of HYVs, it is necessary to apply considerably larger doses of fertilizer and water per unit of land. More recently, an influential body of literature on technology adoption has focused on the effect of social learning on adoption decisions. The basic motivation behind this literature is the idea that a farmer in a village observes the behavior of neighboring farmers, including their experimentation with new technology. Once a year's harvest is realized, the farmer then updates his priors concerning the technology which may increase his probability of adopting the new technology in the subsequent year. Bandiera and Rasul (2002) looked at social networks and technology adoption in Northern Mozambique and found that the probability of adoption is higher amongst farmers who reported discussing agriculture with others. Besley and Case (1993) use a model of learning where the profitability of adoption is uncertain and exogenous. Looking at a village in India, they found that once farmers discover the true profitability of adopting the new technology, they are more likely to adopt. Alternatively, Foster and Rosenzweig (1995) and Conley and Udry (2002) use a target-input model of new technology which assumes that the best use of inputs is what is unknown and stochastic. Applying this model to high yielding varieties (HYV) adoption in India, Foster and Rosenzweig (1995) found that initially farmers may not adopt a new technology because of imperfect knowledge about management of the new technology; however, adoption eventually occurs due to own experience and neighbors' experience. Similarly, Conley and Udry (2002), looking at pineapple cultivation in Ghana, analyze whether an individual farmer's fertilizer use responds to changes in information about the fertilizer productivity of his neighbor. They found that a farmer increases (decreases) his fertilizer use when a neighbor experienced higher than expected profits using more (less) fertilizer than he did, indicating the importance of social learning. Overall, to explain adoption behavior and determinants of technology adoption, three paradigms are commonly used. The paradigms are: the innovation-diffusion model, the adoption perception and the economic constraints models. The underlying assumption of the innovation-diffusion model is that the technology is technically and culturally appropriate but the problem of adoption is one of asymmetric information and very high search cost (Feder and Slade, 1984; Shampine, 1998; Smale et al., 1994). The second paradigm, the adopters' perception paradigm, on the other hand, suggests that the perceived attributes of the technology condition adoption behavior of farmers. This means that, even with full farm household information, farmers may subjectively evaluate the technology differently than scientists (Kivlin and Fliegel, 1967; Ashby et al., 1989;Ashby and Sperling, 1992). Thus, understanding farmers' perceptions of a given technology is crucial in the generation and diffusion of new technologies and farm household information dissemination.

Lionberger (1968) studied the process of adopting technologies and he concluded that the adoption process consisted of five distinct stages: awareness, interest, evaluation, trial, and adoption. According to Lionberger, the individual in the process goes through each stage within a definable time period. Later works by Lionberger and others have shown that these stages are not as distinct as he first proposed and that some of the stages may become condensed within the individual cognitive processes, thus making them unrecognizable as a behaviour which can be measured over time. He further goes on to say that Appropriateness of content is situation driven:

what is appropriate for one farm family may not be appropriate for another, even though both families operate within the same agro-ecological zone; or what is appropriate for one country may not be appropriate for another. Even at the national level, it has been shown that agricultural development can be facilitated by the development of appropriate technologies. Hayami and Ruttan (1985) pointed out that in Japan, where land is scarce; technology development was oriented towards biological technologies, for example to improve varieties. In the United States, however, where land is abundant, technology development was mainly in the form of mechanical innovations such as tractors. In the case of developing countries, their commercial relationship with the developed world predisposes them to accept or develop technologies that are not always appropriate for their farmers. For example, the research organization for banana production in the Windward Islands of the Eastern Caribbean because of market pressures and trade agreements have consistently produced technologies which require additional labour, although labour cost and availability are the biggest constraint to banana production in that sub region. In line with the above argument technology appropriateness can be defined as technically feasible, economically feasible, socially acceptable and environmentally safe and sustainable.

2.2 Socio-economic factors affecting adoption

Adetola I. Adeoti(2009) examined the factors influencing the adoption of treadle pump technology for irrigation in two regions with the highest adoption rates in Ghana. The socio economic analysis revealed that irrigated farming was practiced mostly by men irrespective of adoption status. There was no significant age differential between adopters and non-adopters of the technology. However, there were significant differences in the number of years of schooling, household size, dependency ratio and the number of extension visits per year between the adopters and non-adopters. The factors influencing the probability of adoption were the availability of labor and increase in the number of extension visits. The probability of adoption also differed between regions.

Masura .J. et al (2010) in the study on determinants of micro irrigation adoption for maize production among smallholder farmers concludes that the odds of adopting the micro irrigation technology decrease as the farmer gets older. This is supported by studies where findings were that as farmers get older, they tend to be more conservative and risk averse and are less likely to take up new ideas and innovations. This, however, may also be greatly influenced by the position of the farmer in the social cycle with those in high caste groups also having great chances of adopting. He further concluded that training has a bearing on adoption .Farmers that are trained have higher chances of adopting micro irrigation than the untrained farmers. This may be due to the ability of trained farmers to obtain and use information available on the relative advantages of the available technologies over the conservative technologies. Training also generates confidence among the farmers resulting in higher rates of adoption. Gender also has a strong bearing on the adoption decision and women who do much of the farming in the communal setup always tend to opt for low labour intensive farming methods. The study, results showed that young female farmers had higher chances of adopting micro irrigation as compared to older males. Kulecho (2006) conducted a similar study in Kenya were he was analyzing the adoption and experience of low cost drip irrigation The responses showed that generic factors such as access to developed irrigation water resources, efficient marketing facilities, efficient technical and institutional support services, a relevant cultural background, and good security for the kit were important in the adoption process.

2.3 Benefits of using a drip kit

Keller (1990) says that modern technology can result in less water wastage because water is conveyed in pipes and irrigators can control the amount of water applied and its timing more easily which can increase productivity per unit of water. He suggests that traditional methods have limited productivity and are dependent on a farmer's willingness to invest in land preparation and coaxing water to spread evenly over the land.

The following are some of the benefits of using a drip irrigation system as highlighted by IDE international (2007)

1. **Affordability:** The irrigation systems are available in affordable sizes at low price as compared to other costly irrigation systems.

2. **Improved Yield:** Slow, regular and uniform applications of water and nutrients to the plants increases productions and improved quality.

3. **Water Saving:** There are applied water savings of from 50 to 80 % compared to most traditional surface irrigation methods, thus a larger cropped area can be irrigated from a given supply of water. But of even greater importance the production per unit of water consumed by crop evapo-transpiration is typically increased by 10 to 50 %.

4. **Labor Saving:** Less labor is required for irrigation, weeding, and fertilizer application as compared to traditional irrigation methods.

5. **Fertilizer Saving:** By placing soluble fertilizer directly in the irrigation water, which is delivered to the root zone, fertilizer losses are minimized.

6. **Energy Saving:** Drip systems operated with gravity pressure or with low-pressure low horsepower pumps.

7. **Difficult Terrain:** Drip systems can be used on undulated terrain (hilly area) where irrigation using open channels is difficult.

8. **Tolerance to Salinity:** High yields can be obtained even with high salinity water because the slow and regular application of water decreases the concentration of salts in the active root zone.

9. **Uniform Application of Water:** Since water is applied uniformly to all the plants, there is uniformity in growth and the crop quality and yields are high.

10. **Improved Pest Control:** Regular irrigation ensures timely inter-culturing operations and spraying etc., which provides better pest control and prevents spread of diseases that would occur under traditional surface irrigation methods.

11. **Reduced Cultivation Costs:** Less land preparation and weeding is required.

Drip irrigation is the slow and regular application of water, directly to the root zone of plants, through network of economically designed plastic pipes with low-discharge emitters.

In a study conducted in Nepal by Upadhyay (2005) drip kits were seen to reduce women's workload and had a significant positive impact on family food and nutritional intake. Likewise, women's participation in vegetable farming under drip-irrigation tended to improve their rights to household resources, including food and cash. Since women are more involved in overall vegetable production, they have greater access to the cash generated from the sale of these vegetables. This improved their bargaining power and decision-making roles in the household. Moreover, women's participation in self-help groups, meetings and interactions among nongovernmental organization staff and groups had helped them build their capabilities.

Most of the literature available on drip-irrigation technology (Sarkar and Hanamashetti 2002; Narayanmoorthy 2004; Naik 2002; Phansalkar 2002; Foltz 2003) has so far been focused mainly on its hardware aspects and studies that have attempted to analyze adoption have overlooked the gender aspect of technology adoption in Zambia (Hiller ,S. 2007). Considering the way the African social set up factors that would motivate a rural male farmer and a rural female farmer to adopt a particular technology differ thus it is important to look at the two groups of farmers separately. Not much work related to women and drip-irrigation technology has been done in Zambia. This is unfortunate given the disadvantaged nature of women within marginalized societies and the fact that casual observation suggests that drip technologies can have a pro-women bias and, thus their contribution to alleviating rural poverty and gender inequity may be underestimated.

2.4 Theoretical framework

In order to understand the processes behind the factors affecting farmers' intention to use and adopt irrigation technology, it is necessary to get a thorough understanding of the theory behind it. The theory on this topic is based on several models that have been developed. In this chapter I will present two models that can be used to explain the adoption behaviour of small holder farmers. the technology acceptance model and Fishbein`s multiattribute model

2.4.1 Technology Acceptance Model

Several studies focusing on adoption of technologies have their roots in Technology Acceptance Model (Davis 1989), that was originally designed to predict user's acceptance of information technology and usage. TAM model has become the most widely applied model of user acceptance and usage (Ma & Liu 2004). Venkatesh & Davis (2000) claim that TAM has become well established as a robust, powerful and parsimonious model for predicting user acceptance.

TAM is grounded in the Theory of Reasoned Action (Fishbein & Ajzen 1975) and Theory of Planned Behaviour (Ajzen 1991). Numerous of research show that TAM consistently explains a substantial proportion of the variance (40%) in usage intentions and behaviour

The core of TAM lies in the hypothesis that intention to use a system is determined by two variables: perceived usefulness and perceived ease of use. Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her work" (Davis 1989: 320). Perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis 1989: 320).

TAM theorizes that perceived usefulness and ease of use mediate the relationship between external variables, such as system characteristics, development process, training, and intention to use a system (Venkatesh & Davis 2000). Perceived usefulness and ease of use are hence user's beliefs on information technology and therefore form user's attitude toward technology which will, in turn, predict acceptance (intention to use technology);

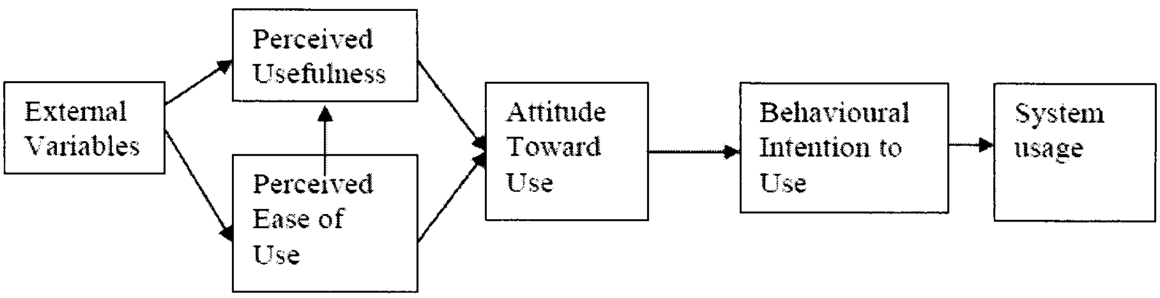

Figure 2 Technology acceptance model (Ma& Liu 2004)

The rationale behind these relationships is that technology that is easy to use, and is found to be particularly useful will have a positive influence on the intended user's attitude and intention towards using the technology. Consequently, the usage of the technology will increase (Taylor & Todd 1995).

2.4.2 Fishbein`s multiattribute model

This model suggests that a person's attitude to any object/behaviour is based on individual's belief about the object/behaviour and the evaluation of the object/behaviour.

Attitude towards object/behaviour = $\Sigma b_i \times e_i$, where:

- b_i is as belief component that expresses the probability that object/behaviour has a certain attribute i/consequence i. In other words, it is a belief that object possesses specific characteristics or that the behaviour has certain consequence.
- e_i is evaluation component associated with the attribute i/consequence i. This means the customer's evaluation, liking or disliking, of the attribute i, or evaluation of the consequence of the behaviour.

Fishbein's support for this statement comes from behavioural learning theory (Kassarjian & Robertson 1991: 325). The linkage was that "an attitude toward an object is more or less automatically learned as one learns about a new product, and that learning occurs in the form of beliefs about product attributes".

This will in general mean that if a person is performing a behaviour believing it will have a positive outcome, he will have a favourable attitude toward it. If the person expects negative outcome, he will maintain a negative attitude toward it (Harrison et al 1997).

Based on this model, attitude towards object/behaviour can change when either evaluative aspect associated with an attribute i or consequence i changes, when strength of belief associated with an attribute i or consequence i changes or when attributes are added or removed.

CHAPTER THREE: RESEARCH METHODS AND PROCEDURES

3.1 Introduction

This chapter outlines the methods and procedures that were used to achieve the stated goals. It gives information on the study sites, data collection and data analysis tools that were used in the study.

3.2 Study Sites

The sample survey was undertaken in Kafue and Kabwe district. The sampling frame will be taken from IDE in the two district. The two districts were particularly chosen due to the heavy presence of IDE micro irrigation projects in these areas

3.3 Data Collection Methods

A sample of 103 households was randomly selected from the IDE sampling frame from the two districts. 58 adopters of the kit were chosen and 45 non adopters. Focused group discussions were also used to gain deeper understanding of the study. Both primary and secondary data was collected in this study. Primary data was collected by means of structured questionnaires administered as interviews. Secondary data was collected from various institutions such as IDE, CSO, and from relevant publications.

3.4 Data analysis

In this study an adopter was defined as that particular farmer who was using at least the minimum sized drip kit on the market i.e.200 meter square drip. A non adopter is that farmer who is currently not using a drip system on there farm this includes all those farmers who have purchased the kits but have not installed it, as well as those farmers who have used the drip before but have not used it in the last two years.

Factors affecting the adoption of irrigation technology can be divided in to two internal and external factors. Internal factors include farmer's goal: income, food preference, risk, resource constraint, labour, land and capital. External factors include market, product input, institutions, land tenure, credit and extension (Musara et al 2010).

3.5 Model specification

In this study a Tobit model was used to test factors affecting the adoption of drip irrigation technology. The Tobit model accounts for a continuous dependent variable that has a zero limit that is characterized by a non-zero probability mass. This description fits well with factors affecting the adoption of micro irrigation technology if the latter is defined as the proportion of total irrigated land using micro irrigation equipment. This is so because there are typically a large proportion of the smallholder farmers that are not using any micro irrigation equipment at all, and those who use, use on small proportions relative to total land available

The Tobit model (Mc Donald and Moffat; Maddala 1983), which test factors affecting the incidence and intensity of adoption, can be specified as

$$y_i = \begin{cases} y_i^* & \text{if } y_i^* > 0 \\ 0 & \text{otherwise,} \end{cases} \qquad (1)$$

where y_i is the area that is irrigated using the drip irrigation equipment, and the latent variable $y_i^* = \beta x + \mu_i$, where x is a vector of explanatory variables postulated to explain the variation in the drip cultivated area, β is a vector of parameters to be estimated, and μ_i is the independent normally distributed random error term with zero mean and constant variance σ, that is $\mu_i \sim N\left(0, \hat{\sigma}^2\right)$.

The total change in y_i associated with a change in the explanatory variable can be decomposed into the change in the probability of being above zero and the changes in the values of y, if it is above zero.

The relationship between the expected value of all observations, E_y, and the expected conditional value above the limit E_{y^*} is given by

$$E_y = F(z)E_{y^*} \qquad (2)$$

Where $F(z)$ is the cumulative density normal distribution function and $Z = x\beta / \sigma$. Consideration of the effect of the K^{th} variable of x, for example age, can be decomposed as follows,

$$\frac{\delta E_y}{\delta X_k} = F(z)\left(\frac{\delta E_{y*}}{\delta X_k}\right) + E_{y*}\left(\frac{\delta F(z)}{\delta X_k}\right) \qquad (3)$$

Thus the total change in E_y is made up of two components; (1) the change in the expected value of Y for those observations above the limit of zero, weighted by the probability of being above the limit, and (2) the change in the probability of being above zero, weighted by the expected value of Y, if above zero.

Heteroscedasticity was significant at 5% and was corrected for using robust standard errors. The model was tested for specification errors using the linktest and ovtest. The variance inflation factor was used to test for multicollinearity which was absent. The proportion of total irrigated land under drip irrigation was regressed on independent variables and the regression was:

3.6 The Regression model

The regression model used was defined as:

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \alpha 1D1 + \alpha 2D2 + \alpha 3D3 + \alpha 4D4 + \alpha 5D5 + \alpha 6D6 + \alpha 7D7 + \alpha 8D8 + \alpha 9D8 + \varepsilon i. \qquad (4)$$

Where:

a) Y= proportion of irrigated land under drip irrigation

b) X1= household size;

c) X2= age of the farmer;

d) X3=total value of physical assets

e) X4=total land owned

f) X5=distance to nearest market

g) X6=water source

h) D1= marital status dummy, 1 if farmer is married, 0 otherwise;

i) D2= marital status dummy, 1 if farmer is single, 0 otherwise;

J) D3= availability of off farm income dummy, 1 if household has off farm income, 0 otherwise;

K) D4= education dummy, 1 if household head reached at least secondary school, 0 otherwise;

L) D5= access to credit dummy, 1 if household accesses credit, 0 otherwise

M) D6= access to training dummy, 1 if household accessed training, 0 otherwise;

N) D7= access to technical support dummy, 1 if household accessed technical support, 0 otherwise;

O) D8= access to marketing dummy, 1 if household accessed to marketing, 0 otherwise;

P) D9=treadle pump ownership,1 if household owns a treadle pump, 0 otherwise

p) εi = random error which is normally distributed with zero and variance.

CHAPTER FOUR: STUDY FINDINGS

4.1 introductions

This section presents the study findings, it brings out the descriptive characteristics of the data and it interpretation and it also presents the Tobit regression results and its interpretation.

4.2 Sample characteristics

Table 1 present's house hold and farm characteristics of small holder farmers in the study area. Comparin between adopters and non adopter of drip irrigation technology about 56.31% of the sampled households wer adopters and the remaining 43.69% were non adopters.

The study reveals that there were significant difference (at $p<0.1$) in the mean age of the household hea between the adopters and non adopters with older being older than non adopters. Table 1 also reveals that o average the adopters are older than non adopters. Adopters have smaller household sizes as compared to no adopters, were adopters have a mean household size of 6.91 members and non adopters 14.42 members, th house hold size is synonymous to poverty as most poor families tend to have more members than families tha are better off. Thus families who could be considered as being poor are the majority of non adopters. In bot groups male headed house holds are the majority, female headed house holds among adopter's accounts fo 8.4% and among non adopters this accounts for 17.7%.

It can also be seen that farmers who adopted the drip system have attended formal education to a greater exten than non adopter. The percentage of adopters who have not attended any formal school is less than the no adopters. it can also be seen that about 6 percent of the adopters have attended tertiary education.

On average those who adopt the drip system own more land and have larger gardens as compared to the no adopters. The size of land irrigated reflect the number of resources a particular household as in terms o operating inputs such as seeds, fertilizers and chemicals. Thus it can still be said that this technology i predominately found among households who are not resource poor.

Table 1Demographic and farm characteristics

	Adopters 58(56.31%)	**Non adopters 45 (43.69%)**	**Significance (t-test)**
Mean H/H age	39.8	38.6	0.7942
Mean H/H size	6.91	14.42	18.2851**
Male headed H/H	91.4%	82.2%	
Female Headed (widowed)	8.6%	15%	
Female headed (divorced)	0	2.2%	
Level of education of H/H			
none	7.6%	15.7%	
primary	62%	51%	
Junior secondary	3.4%	20	
Senior secondary	20.7%	13%	
Tertiary	6.3%	0	
Mean farm size (ha)	9	5	1.9528**
Mean area under irrigation (ha)	0.974	0.616	-1.1619**
Mean distance to the market (km)	32.86	33.38	1.4166
Mean distance to main road (km)	17	19	-0.3170**
Water source			
river	13.8%	20%	
Bore hole	20.7%	22.2%	
dam	3.45%	8.9%	
well	62%	48.9%	
Access to credit	38.7%	55.7%	

Source: own survey (2011)

The mean distance to the desired or nearest market is 17 kilometers among adopters and about 19 kilometers among non adopters and the two means are not statically different according to the results of the t-test. The average distance to the market is statistically different between the two groups at 10%.thus adopters leave closer to the main road as compared to non adopters.

The two groups access the same kinds of water sources however they access these water sources in different proportions. Water from wells seem to favor adoption most, unlike other sources were about 62% of those using drips have there water source from the well. The well is also the biggest source of water among non adopters.

In the last two years CETZAM has been offering loans to farmers in the target areas. These loans are mostly obtained for the purchase of operating inputs such as seeds, fertilizer and chemicals. Table 1 shows that a larger percentage of non adopters obtained these loans as compared to adopters. This emphasizes the point that non adopters are resource poor farmers and thus are the ones who see the need to obtained operating input loans.

The level of assets in terms of the number and how valuable these assts are have a bearing in indicating the directions or decision of a famer to take up an innovation. Table 2 indicates that 68.8% of the house holds that adopted the drip system owned at least one treadle pump as opposed to only about 45% of the non adopters owning it. However the percentage of the non adopters owning motorized pumps is statistically greater than that of the adopters.

The main form of transportation among rural people is a bicycle, it is used to transport farm inputs to the farm and farm products to the markets, and thus ownership of bicycles is critical for easy mobility. The data in table 2 shows that all the adopters owned bicycles and about 86% of the non adopter have bicycles; therefore about 14% of the non adopters' most likely walk to and from the market and this reduces the volume of products they can carry at any one time to and from the market.

Communication is critical for the dissemination of information and ownership of assets such as cell phones, television sets and radios have become important. Farmers need information on market prices of both inputs and products; they also need to obtain information on diseases and pest outbreaks.

It can be seen that both the adopters and non adopters have a 100% ownership of cell phones. Radio ownership among the two groups is not statically different from each other with 88.89% and 86.21% adopters and non adopter respectively owning the radio.

Table 2 Asset ownership

	Adopters	Non adopters	Significance (t-tests)
Treadle pump	68.8%	45.9%	
Motorized pump	18%	48.89%	
bicycle	100%	86.21%	
Cell phone	100%	100%	
radio	88.89%	86.21%	
Television set	92.3%	77.56%	
Ox drawn implements	80.29%	60.78%	
oxen	96.09%	66.37%	
Mean value of assets	12300000	4620000	-15.6925**

Source: own survey (2011)

Oxen and ox drawn implements are mostly owned by the adopters, this could be because they are more wealthy members of society and own more land thus require implement such as ox drawn ploughs to cultivate there field. The total value of physical assets owned by the household is a major indicator of there wealth levels. It can be seen that adopters have either more valuable assets or have more assets were the average is about K12000000 and non adopters have a mean of K4500000.this indicates that adopters are more wealthy than non adopters.

Table 3 Access to Institutional support

	Adopters	Non adopters
Technical support	84.48%	64.4%
Training on irrigation	96.55%	76.67%
marketing	70.69%	68.89%

Source: own survey (2011)

The amount of extension support a famer receives also affects there decision to adopt or not to adopt an innovation. Table 3 above reveals that a larger percentage of adopters had received technical support, training on irrigation and marketing assistance as compared to non adopters, though the difference between receiving marketing assistance is not statistically significant

4.3 The Tobit model

Table 4 presents regression parameter estimates for the combined model whose dependant variable was the proportion of irrigated land under the drip irrigation system. The survey Tobit results show that adoption of drip irrigation by small holder farmers who have attended primary school is significant (at p-value>0.01). This indicates that farmers who have at least a primary school education understand the value of employing an irrigation technology that is labour and water efficient. Therefore an additional year of primary schooling will result in an increase in the proportion of irrigated land under drip technology by approximately 0.05 and the additional year of schooling causes a less than one percent increase in the proportion of total irrigated land under drip irrigation.

Farmers who received training on irrigation technology have higher chances of adopting drip irrigation than untrained farmers. This is evident from the study result that shows a positive coefficient for the training variable and is significant (at p-value>0.01). The farmers who have had accesses to training on irrigation technologies are better placed to make decision on which technology to employ as the advantages of the technology have been properly communicated. Musara .J (2004) in his study on Determinants of micro irrigation adoption for maize production in smallholder irrigation also highlights the importance of training in technology adoption and he qualifies it by further adding that, this may be due to the ability of trained farmers to obtain and use information available on the relative advantages of the available technologies over the conservative technologies. Training also generates confidence among the farmers resulting in higher rates of adoption.

The total value of farm asset has proved to be a highly significant variable (at p-value>0.01) and has a positive coefficient. Farmers who have more assets or have valuable assets adopt the drip technology more than those with fewer assets. This may also be greatly influenced by the position of the farmer in the social cycle with those in high social status having great chances of adopting.

Table 4 Tobit regression parameter estimates for the adoption of drip technology

Variable description	Marginal effects	P- value	dy/ex (Elasticities)
intercept	0.1820453**	0.047	
	-0.904878		
Age of the H/H	-0.0059918***	0.005	-0.2845612
	(0.039392)		
H/H members above 16 years	-0.0015765	0.786	-0.029543
	(0.0057852)		
Household size	-0.00171523 ***	0	-0.452981
	(0.0039392)		
Access to credit	0.0227733	0.41	0.0301877
	(0.274766)		
Treadle pump ownership	0.0089457*	0.084	0.097453
	(0.043876)		
Dummy for primary school attendance	0.0503297***	0	0.2370459
	(0.02215779)		
Dummy for river water source	0.112249	0.77	0.007863
	(0.0383303)		
Dummy for borehole water source	0.0155086	0.584	0.0248954
	(0.0282188)		
Dummy for field manager being male	0.065009	0.321	0.0032678
training	0.1153518***	0	0.3763393
	(0.0274484)		
0ff farm income	0.0272032	0.136	0.0077133
	(0.0178074)		
Technical assistance	0.1476551	0.629	0.0459751
	(0.026732)		
Distance to market	-0.0012978	0.41	-0.09221745
	(0.0004911)		
Total land under irrigation	0.0146335*	0.062	0.02453312
	(0.0026316)		
Total value of assets	0.1114000***	0	0.54820013
	(0.0065476)		

Log pseudo likelihood = -100.7415
Number of observation= 103
Censored observation =45
Uncensored observation= 58
*,** and ***=10%,5% and 1%
Figures in parenthesis are standard errors

.

Larger family's rate of adoption is lower than smaller families according to the study finding which shows the variable household size a negative coefficient and it's significant (at p-value 0.01). This implies that the larger families have enough labour to irrigate using flooding and have very little need to employ labour saving technologies. Therefore an additional member to the household will result in a reduction of the proportion of total land under drip irrigation by 0.0017 and this is a less than one percent decrease in proportion.

The variable for age was significant (at p-value>0.01) and the coefficient was negative. This means that the odds of adoption of the micro irrigation technology decrease as the farmer gets older. This is supported by study findings which showed that as farmers get older, they tend to be more conservative and risk averse and are less likely to take up new ideas and innovations. (Musara.J et al, 2004).

The decision to own a drip kit is also affected by the farmers ownership of a treadle pump, the study has shown that owning a treadle pump increases the proportion of irrigated land under drip technology by 0.0089 and has a less than one percent effect on increase in proportion. This could be explained by the fact that for a drip system to fully function there is need for a water tank placed at an elevated level and for the farmer to fill this water tank they need a pump to pump water from there water source (mostly wells and rivers) and into the tank thus a treadle pump comes in handy.

This study investigated four forms of water sources a borehole, wells, dam and a river, from the analysis it is evident that the source of water doesn't not affect the adoption rate of the drip technology as all the water sources were insignificant (at p-value>0. 10).therefore the type of water source will not affect a farmers choice to use drip technology or expand there area under drip technology. In most rural households the house hold head makes the major decisions regarding agriculture such as what crops to plant and what technology to use.

The access to credit variable despite having the correct sign is insignificant (at p-value> 0.05) this is inconsistent with the findings of other researchers on irrigation technology adoption such as the study conducted in Nepal by Upadhyay, B (2004) which revealed that farmers who accessed loan from agriculture development bank, Nepal (ADB/N), were using micro irrigation technologies in there gardens and had expanded there field. In the same vein a study conducted in Zimbabwe by Musara. J, et al (2001) on Determinants of micro irrigation adoption for maize production in smallholder irrigation schemes had level of credit being significant (at p-value>0.05). Credit ensures that farmers have increased access to inputs and availability of requisite capital for farm operations as well as the ability to invest in innovations leading to enhanced production and yields

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Ultimately the rate of adoption of new technologies will be determine by its suitability to farmers, the profitability and risk associated with the new technology and the institutional capabilities to communicate to farmers about the new technology, thus the findings in this study showed that the most important factor affecting the decision of a farmer to adopt the drip kits, is the total value of assets owned by the household the more assets a household owns the higher the chances of them adopting the kit, thus wealthier farmers have higher chances of adopting the system. Wealthier farmers also tend to have smaller families and according to this papers analysis smaller families are more likely to adopt the system, wealthier farmers also have a higher risk bearing ability. Older farmers are usually reluctant to take up new ideas or they are risk averse and thus were observed to have a negative attitude towards drip technology has compared to younger farmers.

The ownership of treadle pump is important in the farmer's decision to adopt the drip system. Having a larger irrigated field attracts more farmers to adopting a labour, water and input saving technology such as the drip. Training on irrigation technology also plays an important role in the farmer's decision to adopt a particular technology as there are more informed about each technologies relative advantage and are in a better position to make informed decision.

Primary school attendance proved to be significant in the analysis and thus having primary education is important in influencing the decision of the farmers to adopt drip irrigation system.

5.2 Recommendation

There is need for extensive training on irrigation farming and technologies, this will avail farmers with information on the relative advantages of using MIT. Technical advice should also be offered to farmers with regard installing and how to operate the equipment as well as maintenance. This information will allow farmers to expand there irrigated land and consequently increasing the adoption rate, has it was seen that farmers with larger proportions of there land under irrigation has increased adoption rate.

The technology is predominantly found with wealthier or progressive farmers, there is need to encourage the rest of the farmers (relatively resource poor farmers) on the relative advantages of using the drip in terms of input saving. This can be done by extensive extension visits to farmers. Wealthier farmers have more productive assets such as treadle pumps and ox drawn implements, thus there is need to encourage farmers to own such assets to increase on their risk bearing ability when it comes to taking up new technologies

Considering that farmers who had attended primary school had higher chances of adoption. There is need to encourage farmers to attend formal primary school education through night school.

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Appendix: Questionnaire

Questionnaire serial number: | | |

QUESTIONNAIRE

Factors affecting the adoption of drip irrigation kit among women farmers in Zambia. A case of Lusaka, kabwe and Kafue districts

AGE 500: Research Project (Mulenga Chishimba)
Department of Agricultural Economics and Extension Education
University of Zambia

1. Household Identification

1.1 **Province Code** | | | — **Province Name:** ....

1.2 **District Code** dist | | | — **District Name:** ....

1.3 **Block Code** block | | | — **Block Name:** ....

1.4 **Camp Code** camp | | | — **Camp Name:** ....

1.5 **Village Name:** ________________________________
Chiefdom: ________________________________

1.6 Name of **farmer** ________________________________

1.7 (a) Year farmer was born was born | |

1.10 Response status ____________________ **Status** (1= Complete, 2 Refusal, 3 = Non-contact)

Date of enumeration | | | |

Demographics

Enumerator: Fill in the information asked for in the following table for each member of the household. Household members are defined as those that eat from the same pot.

I now would like to ask you a few questions about each of the members of your household/farm family.

Can you please give me the names of the members of the household? *Start with the farmer*		What is ...'s sex?	When was ... born?		What is ...'s marital status?	What is the highest level of education attained by ...	What is ...'s relationship to the farmer?	Did ... provide farm labour the past 12 months?	Did ... earn any income during the past 12 months (farm or off-farm)?	Did ... have his/her own irrigated field(s) last year (July 2009 – June 2010)?
Member code	Member name	0=Female 1=Male	Month ***Codes below***	Year (e.g. 1967)	1=Single or under-age 2=Married 3=Divorced or separated 4=Widowed	***See code below***	***See code below***	0=No 1=Yes	0=No 1=Yes	0=No 1=Yes
MID	**NAME**	**DM01**	**DM02**	**DM03**	**DM04**	**DM05**	**DM06**	**DM07**	**DM08**	**DM09**
1.										
2.										
3.										
4.										
5.										
6.										
7.										
8.										
9.										
10.										
11.										
12.										
13.										
14.										
15.										
16.										
17.										
18.										
19.										
20.										

Month codes (DM02)

1=Jan
2=Feb
3=Mar
4=April
5=May
6=June
7=July
8=August
9=September
10=October
11=November
12=December

Level of education codes (DM05):

0=None
1=Sub A; Grade 1
1=Sub B; Grade 1
2=Std 1; Grade 2
3=Std 2; Grade 3
4=Std 3; Grade 4
5=Std 4; Grade 5
6=Std 5; Grade 6
7=Std 6; Grade 7
8=Form 1; Grade 8
9=Form 2; Grade 9
10=Form 3; Grade
11=Form 4; Grade 11
12=Form 5; Grade 12
13=Form 6
14=College Student
15=Tertiary Certificate
16=Bachelors degree

Relationship to head codes (DM06):

1=Head
2=Spouse
3=Own child
4=Step child
5= Parent
6= Brother/Sister
7= Nephew/Niece
8= Son/daughter-in-law
9= Grandchild
10=Other relation (Specify)
11=Unrelated
55=Farm manager

Nature of the farm

Basics

Which year was the farm started (e.g. 1947) **hh01** [| | |]

How far is the farm from the nearest market town? **hh02** [| |] km

How far is the farm from the main (surfaced) road? **hh03** [| |] km

How long does it take to get to the main road by motorized vehicle in the
- a) Dry season (minutes)? **hh04** [| |] minutes
- b) Rainy season (minutes)? **hh05** [| |] minutes

For how many months in a year is the nearest main road accessible? **hh06** [|] months

What is the main economic activity for this farm? **hh07** [ ] months
- 1 = Fruits and vegetables
- 2 = Livestock/dairy
- 3 = Grains
- 4 = Other, specify:_______________

How many farm labourers did the farm hire during the past 12 months
- a) Males? **hh08** [| |]
- b) Females? **hh09** [| |]

Who manages this farm? **hh10** [ ] .
- 1 = Farmer/owner
- 2 = Owner's spouse
- 3 = Owner's child
- 4 = Farm manager
- 5 = Co-owner of the farm
- 6 = Other, specify:_______________

What is the sex of the one who manages this farm? (0=Female; 1=Male) **hh11** [ ] .

What is the roofing material for the main farm house made of? **hh12** [ ] .
- 1 = Iron/metal
- 2 = asbestos
- 3 = Tiles
- 4 = Corrugated iron sheets
- 5 = Grass/straw
- 6 = Other, specify:_______________

What is the wall material for the main farm house made of? **hh13** [ ] .
- 1 = Burnt bricks
- 2 = Concrete blocks
- 3 = Mud bricks
- 4 = Pole/bamboo
- 5 = Pole and dagga
- 6 = Mud (mudhindo)
- 7 = Grass/straw
- 8 = Iron sheets
- 9 = Hard board

What is the door material for the main farm house made of? **hh14** [ ] .
- 1 = Std door frame & door
- 2 = Traditional

What is the floor material for the main farm house made of? **hh15** [ ] .
- 1 = Cement
- 2 = Concrete
- 3 = mud
- 4 = Bear earth
- 5 = Other (specify)

Does the farm have running water/potable water in the house? **hh16** [ ] .
- 0=No
- 1=Yes

off farm income

Fill in the following table on income earned by household members in the past 5 years. Be sure to include both activities involving casual/salaried employment and those involving businesses.

List all off-farm income-earning members of the household (i.e. those with ***DM08=1*** *in Table 2.1 above)*		List four most important off-farm income generating activities (IGA) used by ... during the past 2 years ***(employment AND businesses)*** ***See codes below***	How much income did ... earn from this IGA during the past 12 months (ZMK)? *Enter '0' if none*	How much income did ... earn from this IGA the year before (2003/04) (ZMK)? *Enter '0' if none*	When did ... start this activity?	
					Month 1=Jan . . 12=Dec embe r	Year (e.g. 1998)
M	**Name**	**IN01**	**IN02**	**IN03**	**IN04**	**IN05**

Off-farm income sources (IN01)

CASUAL/SALARIED EMPLOYMENT
1=on smallholder farm
2=on commercial farm
3=in factory
4=in a mine
5=other industrial work
6=teacher
7=other civil servant
8=clerk
9=shop attendant
10=non agricultural piece work

BUSINESSES
21=agricultural trading
22=livestock trading
23=retailer/shop owner
24=hawker/vendor/marketer
25=firewood/charcoal production
26=carpentry
27=builder
28=local brewing
29=butchery(all meats including game, cooked or uncooked)
30=Agric services (e.g. ploughing, planting, spraying)
31=milling
32=oil processing
33=agro-processing
34=tailor
35=bicycle repair
36=weaving
37=blacksmithing
38=traditional doctor
39=Fishing and selling fish
40=Mining of precious stones
41=Other (specify)

51=Sale of household goods

61=Remittances

Organizational capital

Does your farm collaborate with other farms in the following activities (0=No; 1=Yes).

a) Buying inputs **hh17** [ ]

b) Production (land preparation; weeding; harvesting) **hh18** [ ]

c) Marketing of produce **hh19** [ ]

Fill in the following table about the services received by the farm and their providers.

Service and its description		Has this farm ever received assistance with or info on ...? 0=No→ Go to next service 1=Yes	Which year did you first receive help/info on...? *Enter year (e.g. 2001)*	Who is/was the most important supplier or organizer of this service? ***See codes below***	***Ask only if SR03=2*** Is the farmer org. still active? 0=No 1=Yes	How did you receive (info on) this service? ***See codes below***	Did you use or receive this service during the past year (July 2004 – June 2005)? 0=No 1=Yes
service	**Name/description**	**SR01**	**SR02**	**SR03**	**SR04**	**SR05**	**SR06**
1	Technical assistance						
2	Training						
3	Inputs						
4	Credit						
5	Farm machinery services						
6	Irrigation technology						
7	marketing						
8	Price information						
9	Others specify						
10	Others specify						
11	Others specify						

Codes for service provider (SR03)

1=Fellow farmer(s)
2=Farmer organization
3=Private firm(s) or intermediaries
4=Government department
5=NGO or project
6=Bank

Codes for mode of service delivery (SR05)

1=Informal conversation
2=Radio program
3=Pamphlet/newspaper
4=Workshop
5=Field Day
6 =Demonstration plot
7 =Other (specify)

Five years ago, did you belong to more, less of the same number of farmer organization? **Hh20** [ ] .

1=More 2=Less 3=Same 4=Not applicable

Some status indicators

Physical capital/assets

Fill in the following table about the household's ownership of livestock and non-livestock assets.

Asset type		Does the household have ...? 0=No→ *Go to next asset* 1=Yes	Which year did the household start to have ...? (*e.g. 1982*)	How many ...s does the household own?	Approx. what is the current value of all the ...s? (ZMK)	How many ... did this household have in 2000 *Enter '0' if none*	How much money did the household earn from sale of ... in the past 12 months (ZMK)? *Enter '0' if none*
Asset	**Name/description**	**AS01**	**AS02**	**AS03**	**AS04**	**AS05**	**AS06**
1	Tractor						
2	Truck/pick up						
3	Tractor trailer						
4	Other tractor-drawn implements						
5	Ox cart						
6	Other ox-drawn implements						
7	Yenga Press						
8	Television set						
9	Radio						
10	Sewing machine						
11	Mobile phone						
12	Bicycle						
13	Treadle pumps						
14	Motorized pump						
15	Car/van						
16	Other assets (specify)						
17	Oxen						
18	Other types of cattle						
19	Donkeys						
20	Sheep						
21	Goats						
22	Poultry						
23	Pigs						
24	Other livestock						

Land holding and use

If the farm wanted to, could it find additional land to buy? **hh21** [ ] .
0=No → Go to question 3.6.3
1=Yes

If yes, what is the purchase price of land (ZMK)? **hh22**__________ per unit **hh23** [ ]
(1=acre; 2=hectare; 3=lima)

If the farm wanted to, could it find additional land to rent? **hh24** [ ] .
0=No → Go to question 3.6.5
1=Yes

If yes, what is the rental value of land (ZMK)? **hh25** __________ per unit **hh26** [ ]
(1=acre; 2=hectare; 3=lima)

Has this farm had any irrigation system between 1999 and now? **hh27** [ ] .
0=No → Go to question 3.6.9
1=Yes

Does the farm have enough irrigation water all year round? **hh28** [ ] .
0=No
1=Yes → Go to question 3.6.8

How many months in a year is there enough irrigation water? **hh29** [ ] .

Fill in the following table about (each of) the irrigation system(s) at your farm.

Irrigation system		Did farm have this irrigation system in place in 2005 0=No 1=Yes	Does farm have this irrigation system in place now 0=No→ Go to next system 1=Yes	How much did this irrigation system cost (machinery, furrows, etc) (ZMK)	What type of power do you use? 1=Hand→ go to IR07 2=Treadle pump 3=Motorized	What are the machine-related costs (ZMK)? Purchase and installation cost	Operating costs per month (wages, fuel, electricity, etc)	What is the major sourc[e] of irrigation water? 1=River 2=Well 3=Dam/lak[e] 4=Borehole
Code	**Name**	**IR01**	**IR02**	**IR03**	**IR04**	**IR05**	**IR06**	**IR07**
1	Furrow/gravity							
2	Sprinkler							
3	Drip							
4	Bucket/watering can							
5	Centre pivot							
6	Other (specify)							
7	Other (specify)							
8	Other (specify)							

2.9 I WOULD LIKE TO ASK YOU INFORMATION ON EACH FIELD YOU OWN

Field or plot identification *As identified in the sketch above*	Area of the plot		Which year did the household acquire this plot? *Indicate year, e.g. 1996*	*July 2009 – June 2010*						*Five years ago (around 2005)*		
	Quantity	Unit 1=Ha 2=Acre 3=Lima		What was the use of this plot last year (July 2009-June 2010) ***Codes below***	***Ask only if FD03<41*** Was this plot under irrigation in the just ended year? 0=No→ Go to FD07 1=Yes	Indicate type of irrigation system used last year ***Codes below***	What is the tenure status for this field? 1=Own 2=Rented in 3=Borrowed in 4=Other (specify)	***Ask only if FD04=42 or FD07=2.*** If FD04=42 indicate amount received. If FD07=2 indicate amount paid (ZMK)	For what rental duration (number of months)?	What was the use of the plot 5 years ago or when it was acquired, if acquired after 2005 **(FD03>2000)** ***Codes below***	Was this plot under irrigation 5 years ago? 0=No→ Go to next field 1=Yes	Indicate type of irrigation system used 5 years ago ***Codes below***
FIELD	**FD01**	**FD02**	**FD03**	**FD04**	**FD05**	**FD06**	**FD07**	**FD08**	**FD09**	**FD10**	**FD11**	**FD12**
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												

Use of field (FD04; FD10)
1=Tomato
2=Onions
3=Cabbages
4=Rape
5=Carrots
6=Irish potato
7=Other vegetables
8=Orchard
21=Maize
22=Sorghum
23=Rice
24=Millet
25= Groundnuts
26= Soybeans
27= Seed cotton
28= Other field crops
41=Fallow
42=Rented out
43=Virgin land

Irrigation system (FD06; FD12)
1=Furrow/gravity
2=Sprinkler
3=Drip
4=bucket/watering can

Only for drip owners (FD06; FD12=03)

2.9.1 What size of drip kit do you own..

2.9.2 What period of the year do you use the kit (*indicate months)*... ... ...
2.9.3 Do you experience any physical problems using the kit.
1=yes 2=no→5.6
2.9.4 What type of problem?
1= blockages
2=lack of spare parts
3=others specify

2.9.5 indicate the ease of using the kit
1=very easy
2=easy with a minor problems
3=difficult

2.9.6 what are the benefits of using the kit as opposed to other irrigation technologies
....
....
....
....
....
....