An Analysis of Adoption of Low Cost Drip Irrigation Kits in Zambia

A case study of IDE's Irrigation Technology Dissemination in Kafue and Kabwe areas

MSc. Thesis by Kudzai Magwenzi

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Master thesis submitted in partial fulfilment of the M.Sc. Degree in International Land and Water Management with Wageningen University, Netherlands.

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ABSTRACT

In a bid to reduce poverty in some rural areas of Zambia, IDE Zambia had embarked on the Rural Prosperity Initiative (RPI) programme. The programme comprises of five segments, among which one of them is the supply of micro irrigation technologies. In this segment, the low cost drip irrigation kit was the technology which IDE Zambia promoted from the onset of the programme. The low cost drip kits were introduced to small scale farmers in the areas of Kafue and Kabwe but it was not certain whether the farmers had adopted the technology. So the research wanted to identify the adopters and non adopters of the technology and also determine the reasoning behind the adoption and non adoption. It also wanted to determine the influence of the technology on gender relations within households. A rapid rural appraisal technique which involved the Interviews and a focus group discussion was used to get the information from farmers. Also interviews with individuals from different organizations were an input together with observations in the field. One of the major findings of this research was that only a few farmers are consistently using the low cost drip kits. The major reason was that they had a complete set of the drip kit. The majority of the farmers are not using the drip kits and these include farmers with complete and incomplete drip kits. One of the reasons for non use is because they encountered a lot of technical problems when they used the drip kits. This can give an implication that farmers did not have enough knowledge on the operation and maintenance of the drip kits. Moreover they did not receive technical assistance in the initiation stage of drip kit use. The other main problem is that the farmers do not have enough money to fully invest in the technology which explains why most of them have incomplete drip kits. This leads to a conclusion that the farmers in general did not adopt the technology which made it difficult to determine its influence on gender relations within the households. Further research on the access and priority of use of finances within households is advisable. With this, one can get a good picture of the farmer's values and interests which might influence the adoption of low cost drip kits or other technologies.

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1. INTRODUCTION

IDE Zambia is one of the organisations in Zambia which is involved in disseminating micro irrigation technologies. IDE introduced this type of technology from the 2001 to 2002 era and it was up scaled through the Rural Prosperity Initiative (RPI) programme which started in 2006 (van Wijk, 2009). This is an ongoing programme whose aim is to alleviate poverty of the rural poor farmers of Zambia and irrigation is one of its segments. The low cost drip irrigation kit is the micro irrigation technology which was introduced to the rural farmers of Zambia in order to fulfil their aim. They come in different sizes of areas they cover that is, from 200m^2 to 1000m^2. The complete drip kit comprises of a tank, main line, laterals, micro tubes and a filter. The drip kits were introduced with the hope of reducing the labour requirements. By providing water direct to the plant, adequate amounts will be applied and weed growth will be reduced. This will eventually lead to producing high quality crops which attract the market. There is also a possibility of growing a variety of crops with the drip which in turn improves the smallholder farmer's nutrition.

IDE has reached many farmers in the rural areas of Zambia through its RPI programme. A 'reached farmers 'according to IDE is a farmers who is registered under IDE and belongs to a certain farm group which it recognises (IDE, 2009). Even though IDE Zambia has got quite a number of farmers who are registered under it, it's still not certain if the farmers who purchased the drip kits are using them. If the farmers are not using them, the main question will be why they are not using the drip kits to irrigate in their gardens? Also the introduction of a new technology might influence the gender relations within a household and is it the case for Kafue and Kabwe in Zambia?

Adoption of technology is depended on a number of factors for a specific area or region. Roger's theory of Diffusion of Innovations shows that diffusion of an *innovation* is *communicated* through certain channels over *time* among certain members of a *society* (Rogers 2003). It will be of interest to find out how this process of technology diffusion was initiated and implemented in Kafue and Kabwe areas of Zambia. This research is part of a Wageningen University and IDE project with a title 'Gender Differentiated Impact of Low Cost Irrigation Technologies' financed by IDRC. This research seeks to address the first segment of the major research which is looking at the adoption of the technology and its accompanying gender differentiated impacts.

The first chapter gives a brief description of the research including the description of the methodology used gather information. This is followed by the background of the research areas including Zambia as a whole in chapter 2. Chapter 3 gives a description of IDE Zambia and its programme RPI which is the basis for this study. The theories of Adoption (which explain the process of adoption) and Gender (which explains the gender relations within households) are presented in the fourth chapter. These theories were also used to analyse the results which are presented in chapter 5. Chapter 6 gives the conclusions and recommendations and it is the last chapter of this research.

1.1 Objectives and Research Questions

The specific objectives of this research include

- To identify the adopters and non-adopters of the technology
- To determine the reasons for adoption and non-adoption of low cost drip irrigation kits.
- To determine how this innovation(low cost drip irrigation kits) was diffused in Kafue and Kabwe
- To determine if the gender relations are influenced by the adoption of the technology

With the objectives in mind, the main question of the research reads;

What are the outcomes of the adoption process of low cost drip kit innovations in Kafue and Kabwe and how does it influence the gender relations within households? The following sub questions were used to answer the main question

1. Who are the adopters and non-adopters of the technology?
2. What factors led adoption or non adoption of low cost drip kits?
3. Who are the major actors in this process?
4. How are gender relations shaped or constructed within the household of Kafue and Kabwe?
5. Does the adoption of low cost drip kits influence gender relations within households?

1.2 Methodology

A rapid rural appraisal (RRA) technique was used in this research for data collection. The explanation of the technique was obtained from a FAO Corporate Document Repository (Crawford, 1997). RRA is a technique which include interview and questionnaire designs. It also includes methods of cross-checking information from different sources. It is also a sampling technique that can be adapted to a particular objective (in this case purposive sampling), and group interview techniques (in this case focus group discussions). It also uses methods of direct observation at site level and secondary data (Crawford, 1997). This technique also involves a team of researchers from different disciplines and so, the research was conducted together with a person from an agricultural economics background in order to benefit from each other's information.

The RRA technique proved to be a useful tool to use in this research because it takes a short time to complete, and is relatively cheap to carry out. It also makes use of more 'informal' data collection procedures such as informal interviews and observation techniques. This technique also relies primarily on expert observation coupled with semi-structured interviewing of farmers, local leaders and officials (Crawford, 1997). Since the research was analysing the adoption of low cost drip kits, the technique would be used to determine the local agricultural conditions, problems and characteristics of Kafue and Kabwe which influenced the adoption process.

I did my research in two areas which are Kafue and Kabwe of Zambia. The reason for choosing these areas was because the low cost drip kits were promoted by IDE in these areas and thus the adoption impacts will most probably be visible in these areas. Twenty farmers were interviewed with ten coming from Kafue and ten from Kabwe. All the farmers interviewed had purchased the low cost drip kits at one point in time. The farmers who were interviewed in Kafue came from Shimabala and Chinyana regions. In Chinyana region, 9 farmers were interviewed whereby 5 farmers came from Kabweza area, 3 farmers came from Chikupi area and 1 farmer came from Mungu area. One farmer came from Chilembela area of Shimabala region. The farmers interviewed in Kabwe came from Chisamba and Muswishi regions. 7 farmers in Chisamba region came from Chikongomene area. In Muswishi region, three farmers were interviewed whereby 2 of them came from Chowa and one farmer came from Kaputula areas. Figure 1 below shows the locations where the interviewed farmers came from.

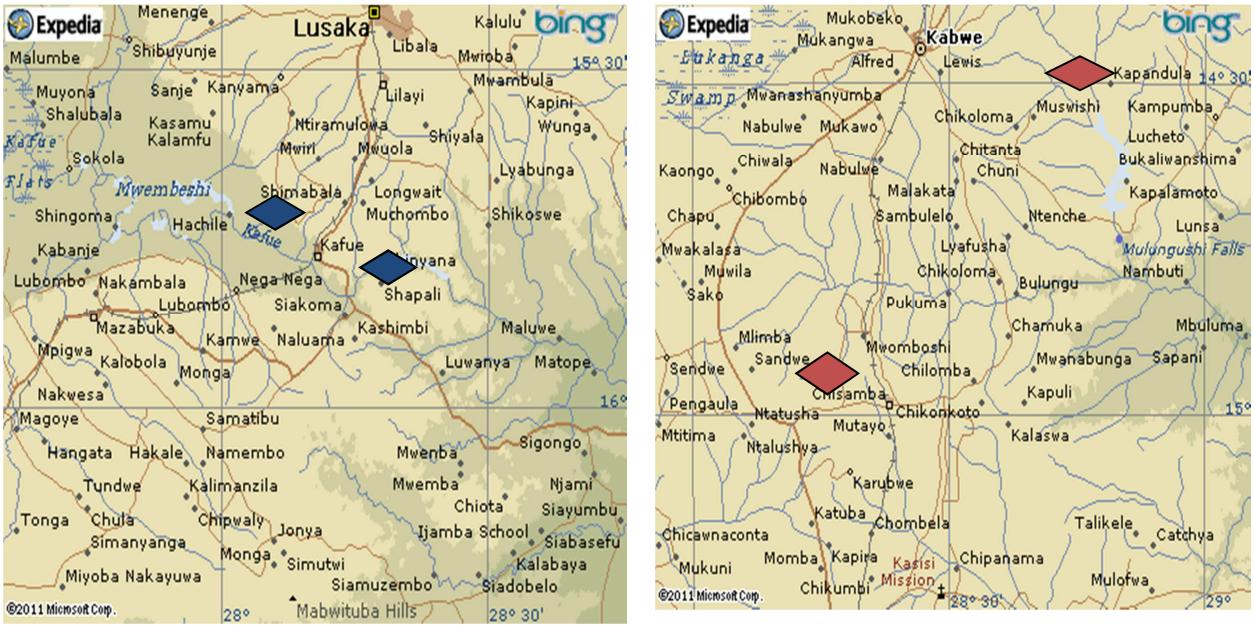

Figure 1.Locations of interviewed farmers Source: (Embassy World, 2011)

Region in Kabwe

Region in Kafue

At first, I did a literature review of the IDE documents during the first week of my field work in order to get an understanding of the programmes of IDE. With this literature I also wanted to find out how the technology was introduced to the farmers and the criteria they used in doing so. Initially I was planning to use gender analysis framework in the formulation of questions and analysis of the results obtained from my field work. I had the hope that most of the farmers adopted the technology but this was not the case when I went into the field. So the focus shifted to looking more into the adoption process to find out why the farmers didn't adopt the technology.

1.2.1 Characteristics of interviewed farmers from Kafue and Kabwe

The social and farming characteristics of the farmers from Kafue and Kabwe are different. The average household number of farmers interviewed in Kafue and Kabwe is 7 and 11 respectively. The reason for the high average number of people in a household in Kabwe is because seven out of ten farmers interviewed are in a polygamous relationship where one man has two or more wives.

The common types of irrigation used by the farmers interviewed in each area also differ. In Kafue, bucket, flooding and basin irrigation are the most common types used to irrigate a portion of their gardens which range from 1\4 to 1\2 a hectare usually in the dry season. The reason for irrigating a portion of their garden has to do with the water source they use to abstract water, which is the well. Kabwe farmers interviewed have furrow and basin irrigation as their most common types.

Farmers from Chikongomene area in Kabwe mainly abstract water from the river with the use of motorised pumps thus they can irrigate larger areas compared to Kafue farmers. The other three farmers from Kabwe do not live close to the river so they rely on the well as their water source and basin irrigation is popular among these three farmers. The characteristics mentioned above are presented in the table below.

Table 1. General characteristics of interviewed farmers in Kafue and Kabwe

Area	***N***	***H***	***Common types of irrigation***	***Market***	***Water source***
Kafue	10	7	Bucket, flooding, basin,	Kafue, Chilanga, Lusaka,Farmgate	Well, Borehole
Kabwe	10	11	Furrow ,basin	Kabwe, Lusaka, Chibombo,Farmgate	River, Well

N-number of farmers interviewed in an area

H-average number of people in a household

1.2.2. Selection criteria and Interview techniques used

The farmers were selected with the help of IDE field officers from both areas using purposive sampling since they knew the farmers who bought the drips. According to IDE, the farmers who bought the drip kits should belong to a particular IDE group. It would occur that farmers belonging to the same group can be sparsely located and farmers choose themselves the group they want to belong to. So it becomes a difficulty to use other sampling techniques. Also, it's not all the farmers belonging to a certain group who managed to purchase the low cost drip kits.

The first interviews were with only women in households which owned the drip kits in Kafue. This was done with the intention of checking whether they were involved in the farming activities within their households. After conducting several interviews, I decided to balance the numbers because I wanted to hear the views of male farmers pertaining to the use of the drip kits. So I ended up with interviewing 7 women and 3 men in Kafue and 7 men and 3

women in Kabwe. This made an impact on the types of answers I obtained from the interviews with both men and women. The impact is explained in the results chapter. Semi structured questionnaires were used to conduct the interviews. Some of the individuals interviewed are shown in figures 2 below.

Figure 2. Interviews in Kafue and Kabwe Source. (Kudzai Magwenzi)

Formal and informal Interviews were also done with the IDE staff and other people who would provide information on the use of the drip kits. Observations and field visits also assisted in gathering information. A focus group discussion with women was held in Kabweza area of Kafue. A total of nine women attended the discussion and among those nine, five of them owned drip kits and four did not buy the drip kits. The reason for holding the focus group discussion in Kabweza was because most farmers live close to each other in this area and it will be easier for them to gather around. My choice for female farmers was because women were not mobile as men so it wouldn't be difficult to find them at their homesteads. Also women work in the gardens most of the time growing their vegetables for home consumption so it was interesting to hear their views on the use of the drip kits. Two out of five women with drips had an experience with the use of drip kit the other three were using it for the first time. A semi structured questionnaire was also used to get the information from the focus group discussion.

2. BACKGROUND INFORMATION OF ZAMBIA

In this chapter a general description of the background information about the country's geography, population, political status, agriculture, water resources and irrigation will be presented. This will show the status of the country at present. Most of the information about Zambia is taken from the CIA world facts book and the US department of State website

2.1 Geography

Zambia is located in Southern Africa and covers a total area of 752 618 km^2, the land area being 743 398km^2 and the water covering only 9 220km^2. It is surrounded by seven countries which are namely Zimbabwe, Namibia, Angola, Democratic Republic of the Congo, Mozambique, Malawi and Tanzania (CIA, 2011). Lusaka is the capital city of Zambia with a population of approximately 1.7 million. Zambia's weather is generally dry and temperate and its rainy season stretches from October to April (US Department of State, 2010). Zambia is currently using 7% of its total arable land area and 10% of the total irrigable land. Basing on the last measurements taken in 2001, Zambia has got total renewable water resources of 105.2 cu km. Zambia experiences periodic droughts and tropical storms mostly from the months of November to April. The rest of the country is generally level to gently undulating slopes of a range of 3 to 5 %(CIA, 2011). Black clays and sandy clays are the major soils found in Zambia mainly in Kafue basin. The dambo areas are of moderate fertility and have no problems of salinity. Rainfall is mainly influenced by the Inter Tropical Convergence Zone (ITCZ) with variations due to altitude, latitude, relative humidity and temperature. Mean annual rainfall of Zambia is 1020mm but it is lower in the south with a recording of 750mm (Matlock, 2007)

2.2 Population Characteristics

Zambia has got a population of approximately 12.9 million with an annual population growth rate of 3% (CIA, 2011). It has got a vast number of ethnic groups approximately 70 which originated from the migrants of the Luba and Lunda tribes from Democratic Republic of the Congo and Angola and the Ngoni speaking people from the South. It is constituted with different religions which are traditional, Christianity, Muslim and Hindu of which Christianity and traditional beliefs are the two dominant ones. Education is not compulsory in Zambia and government institutes offer 7 years of free education to pupils (US Department of State, 2010). The percentage literacy levels of males and females in Zambia are 81% and 60 % respectively (CIA, 2011).

15% of the total population is living with HIV and AIDS and over 56 000 people have died of it. Life expectancy of the total population stands at 52 years. Most of the population (65%) stays in the rural areas and most of them are subsistence farmers, the remaining constitutes the urban population. The urbanisation rate is approximately 2% (CIA, 2011).

2.3 Economic situation

The economy of Zambia has experienced a significant growth rate of 4% in 2009 and the inflation levels have dropped from 30 % in year 2000 to a single digit of 9% in 2007. This was due to the monetary discipline and increase in domestic food supplies. Zambia has also received a significant debt relief from the International Monetary Fund (IMF) and the World Bank's International Development Association (IDA) in 2005.Even though there is a significant growth in the economy it cannot support the rapid population growth or the strains which have been posed by the HIV/AIDS pandemic which is the major challenge of the country. Almost two thirds of the Zambian population live in poverty or are below the poverty datum line (US Department of State, 2010). Agriculture constitutes the highest number of work force which is approximately 85% followed by services which contains about 9% of the work force and lastly industry which contains 6% of the workforce. In the year 2000 the unemployment rate was at 50% (CIA, 2011).

Zambia had been a middle income country before the 1970s and it began to slide down into poverty afterwards due to the declining copper prices on the world market. This triggered the Government under the president Fredrick Chiluba, to commit itself to an economic reform programme which was a success in other areas but accompanied by a lot of corruption. There was a steady decline in Copper production due to poor management of state owned mines and the declining number of investors in this sector. This was reversed after 2000 when the mines were privatised and investments were made in the plant rehabilitation and expansion of the exploration. At present Zambia is embarking on an economic diversification programme to reduce the country's reliance on copper production by promoting agriculture, tourism, gemstone mining and hydropower (US Department of State, 2010).

2.4 Agriculture

Zambia has got plenty of land and only one sixth of the arable land is being used. Its farms range in size from household farms to commercial farms. Smallholder farmers produce food crops such as maize, sorghum, millet, groundnuts and cassava and usually use hand hoes and external inputs for production. The commercial farmers are mostly the European settlers and their farms are located along the rail way line where fertile land is found. Maize is the staple food of the country and it takes the largest proportion of planted area in Zambian farms. For many years maize production has been promoted through the use hybrid seeds and subsidised fertilisers but because of poor infrastructure and low levels of commercialisation, some of the grain would rot in the rural areas.

Before the year 1991 the agricultural policies were centred on government controls through parastatals and other government authorities to drive the production of commodities (Hantuba, 2004). In 1992 the policies were reformed into liberalization of the agricultural sector and the promotion of private investors to participate in the production and distribution of agricultural goods and services. The policy objectives were to ensure national and household food security, to maintain and improve the existing agricultural base, to generate income and employment opportunities, to increase agricultural exports and to

sustain the industrial development by providing them with locally based agricultural raw materials. The driver of implementation of these policy objectives from the period of 1995 to 2001 was the agricultural sector investment programme (ASIP) which was under the (MAFF) Ministry of Agriculture, Food and Fisheries (Hantuba, 2004).

In order to achieve its policy objectives, it developed a free market and reduced the government's role in the commercial services. Instead, its interventions were organised around the programmes such as extension, irrigation, research, agricultural training, and marketing to mention but a few (Hantuba, 2004).

2.5 Water Resources, Policies and Irrigation

Zambia lies between the Congo River basin and the Zambezi River basin and has got approximately 1700 dams with a total capacity of 106km^3 including the contribution of the Lake Kariba on the Zambezi River which is shared with Zimbabwe. The government with the help of the farmers had built about 2000 to 3000 low cost earth dams and water impounded earth bunds in areas of the Eastern, Lusaka, Central and Southern Provinces to provide water for livestock, agriculture and domestic use. However most of these structures are in a state of despair due to insufficient maintenance and poor design. Zambia has got wetlands which include dambos which covers around 4% of the total land area and are a source of livelihood for many small scale farmers. Dambos are used mainly for animal grazing and vegetable production in the dry season and also seepage zones and shallow wells are used as sources of water (Matlock, 2007).

Zambia has got irrigation potential of 2.75 million hectares based on water availability and 523,000ha can be economically developed. There are different categories of irrigated farming in Zambia which include the informal irrigation by small scale farmers, smallholder irrigation schemes, formers quasi-government schemes and commercial irrigation schemes. Small scale farmers have been practicing informal irrigation in their gardens from way back through application of water using buckets, watering cans, hose pipes to grow their vegetables and fruits. They used this form of irrigation because it is not capital intensive, is farmer operated and it helped to meet their needs. Areas which are irrigated in this manner are small in size ranging from 100m^2 to 200m^2 and the introduction of the treadle pumps had significantly increased the area to 1000m^2 (Matlock, 2007). The government managed smallholder irrigation schemes existed in the 1960-1970 era and the primary objectives of their construction were to produce crops for local people, for hunger relief during drought and to introduce and promote irrigated agriculture. However, these schemes did not perform well due to the top down approach which less empowered the farmers to operate and maintain the schemes by themselves. The parastatal schemes followed which were constructed with the sole purpose of producing crops for their industries such as coffee, tea and bananas and among these schemes were Kateshi and Ngoli irrigation schemes. The private and commercially owned irrigation schemes were constructed solely for the production of high value crops for both export and local consumption (Matlock, 2007).

2.6 Research areas

Figure 3 shows the research areas Kafue and Kabwe and their brief description follows

Figure 3. Research areas Source: (Bized, 2001)

◇ Research areas

2.6.1 Kafue

Kafue is situated in Lusaka province on the north of Kafue River bank and according to the 2000 census, it has a population of around 162 262. The majority of the people in Kafue engage in agriculture and fishing. Commercial farming is also evident in an area extending along the edge of the Kafue flats. It has got manufacturing industries like Nitrogen chemicals of Zambia, Bata tannery and textile industry. It consists of 400m wide strip of small farms and gardens which separate the town from a bend of the river (World Bank, 2003). Kafue is located in the low rainfall area which receives less than 800mm/year. It lies in one of the major wetlands in the country which is important for conservation of fisheries, wildlife, grazing and agriculture, however underground water resources have not been fully studied in this region (Chabwela and Mumba, 1996).

2.6.2 Kabwe

Kabwe is the capital of Zambia Central Province with a population estimated at 210 000. It's situated on the main Lusaka- Copperbelt railway line and the Great North road. Kabwe has quite a number of manufacturing industries which include Zambia- China Mulungushi textile,

pharmaceuticals, milling, cotton ginning and leather tanning. It has some commercial farming areas which surround the city about 10km from the centre and the road and rail links provide easy access to markets of Copperbelt and Lusaka (Zamnet, 2007). Kabwe has a mean annual rainfall of 937mm (Houston, 1982). This is low compared to other areas in Zambia. The interviewed farmers in Kabwe mentioned that they did not have a problem with water scarcity and this contradicts with the amount of rainfall received in that area. Basing on my observations, the reason for the contradiction might be that farmers are not utilising the resource to its fullest potential.

3. INTERNATIONAL DEVELOPMENT ENTERPRISE-IDE

3.1 Introduction

IDE Zambia is part of social enterprise organization International Development Enterprises(IDE), which was founded in 1981 (IDE Zambia, 2010).IDE has been operating in Zambia for the past twelve years engaging in design and marketing of low cost appropriate water technologies which include treadle pumps, low cost drip irrigation kits and micro sprinklers. Under its Rural Prosperity Initiative (RPI) programme, it claims to have around 14000 small holder farmer clients in the Copperbelt, Kabwe, Lusaka, Kafue, Pemba, and Livingstone areas (IDE, 2009). It uses market based business principles to facilitate smallholder farmers to participate effectively as micro-entrepreneurs in order to progress them from subsistence agriculture to commercial farming through adoption of appropriate water control techniques and access to the markets (IDE Zambia, 2010).

'IDE targets farmers with small plots to whom they introduce and promote inexpensive and environmentally friendly irrigation technologies that are simple, of low cost and suitable for house hold level small plot irrigation' (IDE Zambia, 2010). It provides agricultural support services like training, innovative practice of technologies and farm business management which are included in the Rural Prosperity Initiative (RPI) programme (IDE Zambia, 2010).

3.2 Rural Prosperity Initiative

The Rural Prosperity Initiative (RPI) is one of IDE's programmes which up scaled the promotion and distribution of micro irrigation technologies among the rural poor in Zambia. This makes it an important section to look into in order to have the knowledge of what was involved in the programme and how it was executed by IDE so that they could meet their intended goals.

The RPI was launched in 2006 funded by Bill and Melinda Gates Foundation and the Dutch Ministry of foreign affairs. It was implemented in 6 countries which are Ethiopia, Bangladesh, Nepal, Vietnam, Myanmar not forgetting Zambia (IDE, 2009). The RPI was intended to increase the net income of poor farm families in the above mentioned countries and maintain the supply of low cost water control technologies so that the farmers will be able to purchase them. It also wanted to create sustainable increases in the income of 40 000 rural smallholder farmers by at least $200 every year through a combination of technology sales and value chain development (IDE, 2009).

The RPI programme constituted of five segments which are namely Capacity Development and Gender, Input Supply, Irrigation, Market Linkages and lastly Credit Linkage. In its capacity building segment, IDE Zambia arranges training programs on production enhancing capacities which included physical layout, nursery management, conservation farming, and integrated pest management. In addition to agronomy skills it provides training in business principles, leadership skills and marketing (IDE Zambia, 2010). The technical capacity is also built to augment effectiveness of smallholder irrigation principles and practices including application, maintenance and management of low cost irrigation systems (IDE Zambia, 2010). 'In order to achieve equitable prosperity among men and women, IDE ensures that

opinions, constraints, knowledge and decision making roles are addressed during the project design and implementation. This is done by treating male or female small holder farmers as customers rather than charity recipients' (IDE, 2010). IDE also designs micro irrigation technologies that are intended to meet women farmer needs and uses rural marketing strategies that appeal to women, and promote products and services in places that are easily accessible to women (IDE, 2010).

In input supply segment, IDE Zambia links smallholder with input markets for them to access agricultural supplies of quality such as seed, pesticides, fertilizer, and irrigation equipments to increase productivity (IDE Zambia, 2010). Moreover, IDE Zambia is developing value chains to establish enabling environments for poor rural households to be economically active (IDE Zambia, 2010).

IDE Zambia is also facilitating linkages between smallholder farmers and micro finance institutions (credit linkages) as this enables them to truly compete in a market driven agricultural sector which requires efficient production supply which would otherwise not be possible without the financial support(IDE Zambia,2010). It also works together with farmers to identify the prevailing market opportunities in the tourism, retail, and food processing sectors in order to create long term sustainable linkages (IDE Zambia, 2010).

Irrigation which was explained early in the chapter is one of the RPI segments. Irrigation in this sense is a broad word which encompasses all the low cost water control technologies which were introduced to the rural poor farmers. This research concentrated only on the low cost drip irrigation kit. Drip kits were up scaled together with other water control technologies in the RPI programme. They usually came in packages which covered 200m2, 400m2, 500m2 and 1000m2. The 200m2 drip kit was popular among the farmers because it became affordable when purchased with a voucher.

The five segments of RPI are not stand alone segments but are linked and are dependent on each other. IDE facilitates in linking the farmers with credit facilities which in turn enables them to purchase the water control technologies. Apart from providing them with training to enhance their production capacities, IDE also links the farmers. These inputs markets provide them with good quality seed and chemicals which enhance their productivity and also enable them to practice what they would have learnt in trainings. They can also use the credit they receive to buy inputs. In order to complete the circle of RPI the farmers should have a ready market where they can sell their produce in order to realise their profits. IDE comes in again and links them to reliable markets where they can sell their produce. Thus in order to achieve the goal of RPI there should be a linkage among the segments.

4. THEORIES OF ADOPTION AND GENDER

The theories of adoption and gender were used in this research in order to analyse the results obtained from the two research areas of Kafue and Kabwe. The chapter will first start by giving a description of theory of Adoption as has been described by Rogers (2003) in Diffusion of Innovations. This will be followed by the factors which affect or influence the adoption process which will enable the analysis of the outcomes of the adoption of the low cost drip irrigation kits in the research areas mentioned earlier. A description of the theory of gender will follow together with its concepts and this will assist in analysing how gender relations within a household influence the adoption of the drip kits. The gender analysis which was used in collecting information of the households will be explained later in the chapter.

4.1 Adoption (Diffusion of innovations)

According to de Graaf and Kessler (2009) a practice is considered adopted only when its execution or use is sustained and integrated in a household's farming system. They argue that the adoption of a certain measure or practice does not automatically guarantee long-term use by most farmers since the conditions of accepting a certain practice or measure may have changed (de Graaf and Kessler, 2009).

It is important to understand the rationale behind what motivates people to take action if one wants to understand the reasons behind human behaviour in relation to adoption process (de Graaff and Kessler, 2009). These motivations can be put into two categories which are intrinsic (doing something because it is inherently interesting) and extrinsic (doing something because reward is expected (de Graaff and Kessler, 2009).

Adoption can be best understood by exploring Rogers's theory of diffusion of innovations. This theory starts by describing diffusion as the process in which an innovation is communicated through certain channels over time among the members of a social system. Thus diffusion consists of four major elements which are namely innovation, communication, time and lastly social system. These are identifiable in every diffusion research study. Each element will be described as Rogers put it across.

4.1.1 Innovation

Rogers (2003) describes an innovation as an idea, practice or object that is perceived as new by an individual or other units of adoption and is not always desirable for every individual. He goes on to say that most of the new ideas whose diffusion had been analyzed are technical innovations. He defines technology as a design for instrumental activity that reduces the uncertainty in the cause- effect relationship involved in achieving a desired outcome. It consists of the hardware aspects which are the tools that embody the technology as a physical object and software aspect which is the information base for the tool. In this case the hardware is the components of the drip kit which are the tank, mainline, laterals, micro tubes, filter and the software is the knowledge gained from IDE trainings on the operation and maintenance of the drip kits. A technology innovation has a degree of

some benefits to its intended adopters but its advantage is not certain to them. When potential adopters know of a technological innovation a degree of uncertainty is created in their minds and its potential advantage will impel them to exert effort to learn more about the innovation (Rogers, 2003).

Rogers (2003) says that it is how the individuals perceive the different characteristics of innovations which help explain their rates of adoption. These characteristics are relative advantage, compatibility, complexity, triability and observability. ***Relative advantage*** can be regarded as the added value to an innovation compared to the ones already in use. It doesn't matter if the innovation has got an objective advantage but it is the opinion of the individual which matters. The technology or innovation should be consistent with the existing values, past experiences and needs of potential adopters for it to be regarded as ***compatible***. Rogers (2003) also goes on to say that if innovations are difficult to understand and use they are complex and the ease of ***complexity*** of an innovation increases its rate of adoption. Innovations which can be experimented on a limited basis can generally be adopted quicker and if an innovation is ***triable*** its uncertainty is reduced to the individual who would want to adopt it. ***Observability*** is when the results of an innovation are visible to others. The visibility will stimulate peer discussion of a new idea which in turn might make their adoption rate to increase, thus innovations which are regarded by individuals as having greater relative advantage, compatibility, triability, observability and are less complex will be adopted faster than others.

4.1.2 Communication

Rogers explains communication as the means by which messages get from one individual to another and mass media channels are the most rapid and efficient means of informing an audience of potential adopters about the existence of an innovation. Apart from this, interpersonal channels are also used. According to Rogers, they are more effective in persuading individuals to accept a new idea and they involve a face to face exchange between two or more individuals. He also goes on to say that effective communication exists when two or more individuals are homophilous (the degree to which two or more individuals that interact are similar in certain attributes such as beliefs, education, socioeconomic status). Homophily occurs when similar individuals belong to the same groups, live or work near each other and share similar interests. Problems arise in the diffusion of innovations when the participants are usually quite heterophilous (opposite of homophily). For example a change agent or professional will be more technically competent than his/her clients and this difference may lead to ineffective communication as the two individuals will not speak the same language. On the other hand, for diffusion to occur there should be some heterophily between the individuals so that there is exchange of new information (Rogers, 2003

4.1.3 Time

Rogers (2003) says that the time dimension is involved in **a**) the innovation-decision process by which an individual passes from knowledge of an innovation through to its adoption or rejection **b**) the innovativeness of an individual (i.e. the relative earliness/lateness with

which an innovation is adopted) **c**) an innovation rate of adoption in a system usually measured as the number of members of the system who adopt the innovation in a given time period. These three are further described below to show the involvement of time in them.

a)Innovation- decision process

The innovation decision process is the process through which an individual passes from 1) knowledge of an innovation 2) the formation of an attitude towards the innovation, 3) a decision to implement and use of the new idea, and 4) confirmation of the decision. It can be illustrated by figure 4 below

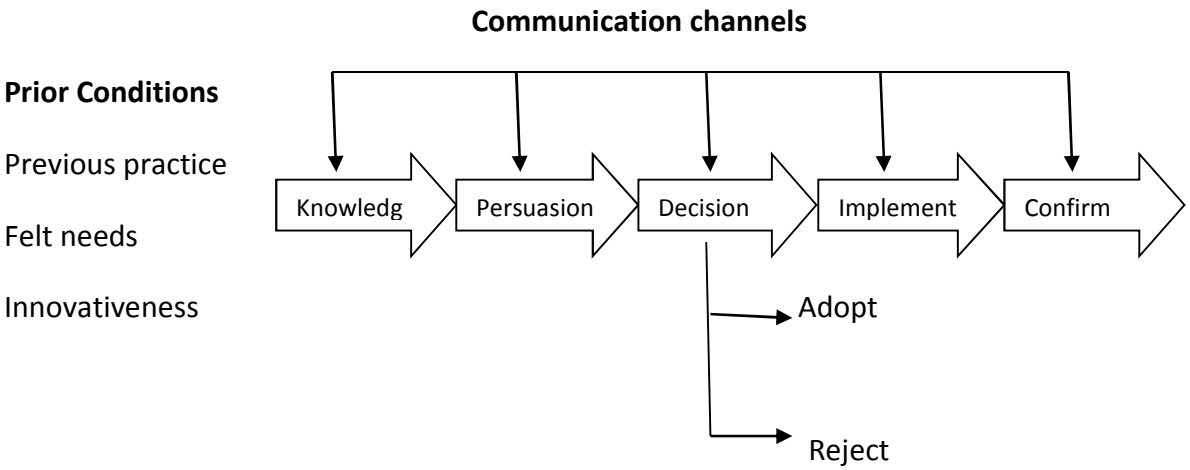

Figure 4. Innovation decision process Source (Rogers 2003)

Knowledge is the first stage in the innovation decision process which commences when an individual is exposed to an innovation's existence and gains an understanding of how it functions. Knowledge of an existence of an innovation can create a motivation to learn more about it and eventually adopt it. The knowledge of an innovation process is divided into three types; *awareness knowledge* which is the information that an innovation exists. This can motivate individuals to seek a second and third type of knowledge, the '*how to' knowledge* and the '*principles knowledge'*. The *how to* knowledge is information to use an innovation properly and inadequate levels of this type of knowledge prior to trial and adoption may lead to rejection or discontinuance of an innovation. *Principle knowledge* is information on the functioning principles underlying how an innovation works. It is usually possible to adopt an innovation without it but this might lead to the misuse of an innovation and not to continue using it (Rogers, 2003).

Persuasion is when the individual forms a favourable /unfavourable attitude towards the innovation. The person becomes more psychologically involved with the innovation and actively seeks more information about the new idea. The person decides the information he/she regards as credible, thus selective perception determines the individual's behaviour at the persuasion stage about the innovation. The perceived attributes of an innovation

which are relative advantage, compatibility, complexity, triability and observability are important at this stage. Individuals may seek some social reinforcements from others pertaining to his/her attitudes toward the innovation since all innovations carry some degree of uncertainty with them. By so doing the individuals will want to see if their thinking is in line with the others.

The ***decision*** stage in the innovation decision process occurs when an individual engages in activities that lead to a choice to adopt or reject an innovation. Most individuals do not adopt an innovation without first trying it on a probation basis to see its usefulness in their own situation. Some innovations cannot be divided for trial and these tend to have a low rate of adoption. Trials can also be done by peers in the same area and they can be influential in the adoption of an innovation (Rogers, 2003).

In the ***implementation*** stage, the individual puts an innovation to full use. A certain degree of uncertainty will still exist and active information seeking takes place in this stage in order to answer several questions which have to do with the use of the innovation. Thus change agents/professionals have to fulfil their role of providing technical assistance to the clients as they begin to use the innovation. The implementation stage may continue for a period of time depending on the nature of the innovation. Eventually, a point is reached at which the new idea becomes institutionalized as a regularized part of an adopter's ongoing operations.

At ***confirmation*** stage the individual seeks reinforcement for the innovation- decision already made and may reverse this decision if expose to conflicting messages about the innovation. In this stage an individual may decide to discontinue (a decision to reject an innovation after having previously adopted it). Two types of discontinuances exist which are replacement discontinuance and disenchantment discontinuance. the former meaning to reject an idea in order to adopt a better one that supersedes it whilst the latter means a decision to reject an idea as a result of dissatisfaction with its performance. Discontinuance may also occur if the individuals misuse an innovation that might have functioned advantageously for them. This is more common among the late adopters who have fewer resources which may either prevent adoption or cause discontinuance because the innovation does not fit their limited financial position. Rogers (2003) also states that high discontinuers are characterized by less formal education, lower socioeconomic status, and less change agent contacts which are the opposite characteristics of innovators.

Thus the innovation decision process involves time in the sense that the five steps usually occur in a time ordered sequence. The innovation decision period which is the length of time required to pass through the innovation decision process differs with individuals. Some require many years to adopt an innovation whilst some need less time.

b) Innovativeness

Innovativeness is the degree to which individual or other units of adoption are relatively earlier in adoption new ideas than other members of a system. Basing on their

innovativeness they are put into adopter categories which are innovator, early adopters, early majority, late majority and the laggards.

Innovators are a small group which consists of imaginative, visionary people who spend most of their time, energy and creativity developing new ideas and technology and love to talk about it (Robinson, 2009). Rogers (2003) goes on to say that innovators must be able to cope with a high degree of uncertainty about the innovation and they play a gate keeping role in the flow of new ideas in the system. Early adopters start to leap in once the benefits start to become apparent and they love to be ahead of their peers. They also have time and money to invest and also love to be seen as leaders. Social prestige is one of their biggest drivers and they gain respect through their economic success and are well connected and informed (Robinson, 2009). This adopter category has the highest number of opinion leaders and potential adopters look up to them for advice and information about the innovation (Rogers 2003).

Early majority group is comfortable with moderately progressive ideas, but will act after having solid proof of benefits and this group is cost sensitive looking for simple and better ways of doing what they already do and requires minimum disruptions, minimum commitment of time, minimum learning and rapid pay back periods(Robinson,2010). Late majorities are conservatives, hate risks and are uncomfortable with new ideas and are usually driven by the fear of not fitting in (Robinson, 2010). Laggards are the last ones to adopt an innovation and they tend to be advanced in years and individuals in this group are more focused on traditions. They have the lowest social status and lowest financial fluidity and are usually in contact with family and close friends only and are isolated from the social networks of their system (Rogers, 2003).

These categories explained above and their percentages are illustrated by figure 5 below.

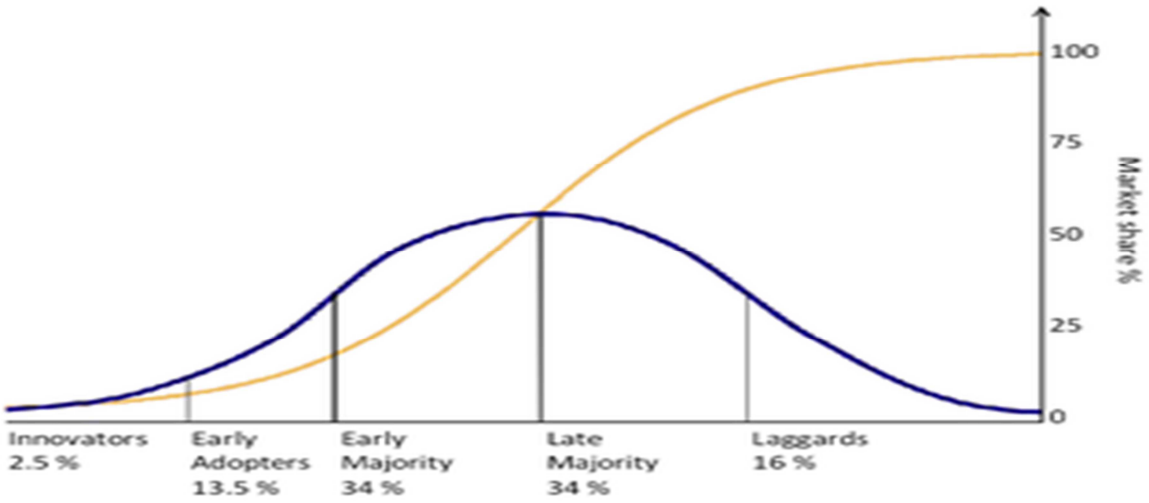

Figure 5. Adopter Categories Source: (Rogers, 1962)

c) Rate of adoption

Rate of adoption is a third way in which an innovation is adopted by members of a social system. When plotted on a cumulative frequency basis over time, the resulting distribution is an S-shaped curve because a few individuals adopt the innovation in a time period of innovators, the diffusion curve begins to climb, as more and more individuals adopt in each succeeding time period. Finally, the S-shape curve reaches its asymptote and the diffusion process is finished. Innovations with a lower adoption have gradual S-shape and those with a rapid adoption process have a step S-shape curve.

4.1.4 Social system

Social system is the fourth component which is defined as a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. The members of a social system may be individuals, informal groups, organizations etc. The structure of a social system can facilitate or impede the diffusion of innovations. It's a complicated matter to untangle the effects of a system's structure on diffusion independent from the effects of the characteristics of the individuals that make up the system (Rogers, 2003). Individual's innovativeness is affected by both an individual's characteristics and by the nature of the social system in which the individual is a member. Social norms of a community can be a barrier to change and these can be defined as the established behaviour patterns for the members of a society. They can operate at the level of a nation, a religious community, an organization or a village (Rogers, 2003).

In a social system there are certain members who are influential in the activities of a community and according to Rogers these are called '*Opinion leaders'*. There are also professionals who are external to the system who influence a client's innovation –decisions in a direction deemed desirable and these are called '*change agents*'. Opinion leadership may be earned and maintained by the individual's technical competence, social accessibility and conformity to the system's norms. Through this conformity they can be regarded as models for the innovation behaviour of their followers. When compared to their followers, they are more exposed to all forms of external information, have a higher socio economic status and are more innovative (Rogers, 2003).

Change agents seek to obtain the adoption of new ideas but may also attempt to slow down diffusion and prevent the adoption of undesirable innovations. They often use opinion leaders in a social system as their lieutenants in diffusion activities. Since change agents are professionals and have a higher status than their clients, they become heterophilous from their typical clients. This may pose some problems on the effective communication about the innovations they are promoting. In this respect they use opinion leaders who might have almost the same social status with the clients (Rogers, 2003).

4.1.5 Critiques of diffusion of innovation theory

There are several authors who complement Roger's diffusion of innovation process. Padmaja et al, (2006) says that adoption of new technology depends on the necessity of the technology and accessibility in terms of price and distance. This is the innovativeness of the

technology as perceived by the farmer. Most rural farmers lack money to purchase the technology and do not even have money to purchase the inputs to use with the technology (Karlsson et al, 2001). Farmer's attitudes and old habits might be one of the obstacles of technology adoption. They may be resistant to change due to the marginal situation they live in where they mainly focus on farming in one season at a time to get enough food for family and necessary expenditure (Karlsson et al, p48). The farmer's attitudes are created within the social system they reside in.

Although there are authors who complement Rogers's theory of diffusion, it is also faced with a number of critiques. Lievrouw and Livingstone, (2002) say that the diffusion theory is 'technologically deterministic' implying that it treats innovations as given and focuses more on the impacts or effects of the innovation in a social system. They continue to argue that the diffusion theory makes an assumption that technologies or innovations do not change throughout the diffusion process whilst sociologists, communication researchers and economists say that it is rare to have singular inventions of technological innovations (Lievrouw and Livingstone, 2002).

In his definition of diffusion of innovations, Rogers describes the social system in which the innovation is diffused as a set of interrelated units that are engaged in joint problem solving. According to Larsen (2005) this is not necessarily true or not always the case because members of a social system may have an interest in the technology but they do not necessarily have to be interrelated or working together to achieve a common goal.

The theory of Social Shaping of technology (SST) contradicts with the diffusion theory. It argues that technological determinism is inadequate to describe or explain technological innovations and developments (Lievrouw, 2006). SST emphasises the importance of human choices and actions in technological changes with the aim to formulate policies to guide technology developments. Thus it emphasises the influence of society on technology rather than technology on society (Lievrouw, 2006). However, diffusion theory is usually associated with institutions that sponsor innovations and promote technological development therefore it becomes a theory that fits to do an analysis on IDE's technology dissemination impact on society.

4.2 Gender

Gender can be defined as the relations between men and women which are revealed in a range of practices ideas and representations including division of labour, roles and resources between men and women. These are then ascribed to different abilities, attitude, personality, traits, behavioural pattern, etc (Agarwal, 1994). In planning for and implementation of agricultural development projects, the household is generally taken as the unit of analysis and male heads of the household as the principal decision makers and sources of information. Other members are frequently ignored and to ignore them is to ignore half or more of the system in which decisions about farming are made (Feldstein et al, 1989).

In order to incorporate ideas and information in relation to farming of the other members of the family, it is important to know the gender relations within the households. The definitions of gender relations and households are described below.

Gender relations refers to the relations of power between women and men which are revealed in a variety of practices, ideas and representation including the division of labour, roles and resources between men and women. These relations are largely socially constructed and are variable over time and place (Agarwal, 1994).

According to Agarwal (1994), a household might be a residential unit and or a unit of joint property ownership, production, consumption or investment or constitute some intersection of these dimensions. She goes on to say that they can vary in membership composition from units of single persons, to those of parents and children and those with additional relatives like grandchildren.

Households can be conceptualised as a complex of matrix of relationships in which there is an ongoing negotiation subject to the constraints set by gender, age and type of relationship (Agarwal, 1994). This intra-household interaction contains simultaneously elements of cooperation and conflict and many different outcomes are possible in relation to who does what, who gets what goods and services and how each household member is treated. Among the set of efficient cooperative outcomes some are more favourable to one party than to others and the emergence of these outcomes depend on the relative bargaining power of the household members (Agarwal, 1994).

An individual's **bargaining power** is defined by the strength of the person's fallback position which are the outside options which determine how well off he/she would be if cooperation ceased (Agarwal,1994). The person with a stronger fall-back position would emerge with a more favourable outcome, even though both parties would be better off than if they did not cooperate (Agarwal, 1994). Relative bargaining power within the household could be retrieved in who participates in decision making and about what (Agarwal, 1994). It has been observed that women who participate in decision making concerning issues like agricultural production or cash expenditure in the home may have greater bargaining strength than those who are excluded from such decision making altogether. Bargaining power is revealed in whose interests prevail in the decision made in terms of the distribution of resources, goods, services, and tasks (Agarwal, 1994).

4.2.1 Gender and Technology adoption

New technology adoption is believed to raise the agricultural output and productivity on a sustainable basis in developing countries (Padmaja et al, 2006). Major international agencies like the United Nations (UN) have the notion that these technologies should address to the needs of both males and female farmers in terms requirements and adaptability (Padmaja et al, 2006).

Women in rural areas do a major proportion of farm work and are responsible for family food security. They are often involved in post-harvest processing and marketing but they

have a lower social status and economic security in the family. Social capital is an important factor which influences the adoption impact of agricultural technology, which is in this case the low cost drip irrigation kit. Social networks and social relationships both facilitate and constrains technology dissemination in that different social networks corresponds differently and as a result, men and women experience different economic consequences due to different levels to access of information (Padmaja et al, 2006).

There are times when women were thought of as not responsible for farming, thus certain technologies were introduced to male farmers even though particular crops or tasks were the responsibility of women (Padmaja et al, 2006). Lynch (1993) also said that usually programs and services are directed to the male households by irrigation agencies with the assumptions that what is good for the head benefits the whole family. This in turn reinforces women's subordination and makes it harder for them to reap the benefits of irrigation development (Lynch, 1993).

On the other hand, some authors like O'laughlin (2007) regard it as a myth that allocation of resources to women in rural African households would increase their efficiency and hence their produce. The author goes on to say that providing women with resources in order to make it on their own might redresses inequality with co-operative gender relations through reconstruction of the division of labour which might be a disruptive and broad political process that cuts across households and communities.

The gender analysis framework was used to formulate or design semi structured questionnaires which were going to be used to collect information from farmers. However there was not enough data to make a good analysis with this theory because many farmers were not using the low cost drip kits which was the perception in the process of designing the questionnaire.

4.2.2 The conceptual framework for Gender Analysis

The conceptual frameworks for gender analysis provides guidelines by which information on gender roles and the intra- and inter household aspects of farming systems may be gathered, analysed. It is then applied to the design of improved technologies for agricultural systems (Feldstein et al, 1989). The basic argument underlying this framework is that some of the differences between men's and women's roles and patterns of intra and inter-household relations are embedded in farming systems and will have an effect on and be affected by changes in these systems (Feldstein et al, 1989).

Gender analysis recognises that men's and women's lives, experiences, needs, issues and priorities are different. It also recognises that to achieve equitable outcome for women and men, strategies should be differentiated among men and women (ADB, 2002). Gender analysis provides a robust analysis of the differences between women's and men's lives, which in turn removes the possibility of analysis based on incorrect assumptions and stereotypes (ADB, 2002).

Although gender analysis framework might seem to be a good analytical tool, it has some of its draw backs as well. One of them is that it can give the impression that giving any additional resources to women is a good thing which might not necessarily be true because it might lead to increasing the workload of women (March et al, 1999). It doesn't draw out power dynamics or show relationships between different people or how people bargain, negotiate interests, and make decisions, thus leading to gender specific interventions rather than to reveal the ones which transform gender relations (March et al, 1999). Gender analysis concentrates on the activities and resources of different categories of people, rather than on the relationships between different groups. This leads to an emphasis on men and women, old and young as separate groups with different and separate activities but the inter relationships between them and the forms of house hold and community cooperation and exchange are not examined (March et al, 1999).

According to IDE (2009) men and women living in the same household in Zambia often have different roles, responsibilities, and access to resources, as well as separate incomes and expenditures. Moreover, Zambia is a male-dominated society and women can be marginalized in accessing information. IDE (2009) also found that the literacy and knowledge levels also vary and lead to a differentiation in the capacity of men and women to adopt new technologies and agronomic practices. An understanding of the different roles and requirements of both men and women need to be more clearly understood to make sure that the introduction of technology is positive for all members of a household(O'Laughlin,2007).

The gender analysis framework has got four areas of analysis which include activities analysis, resource analysis, benefits and incentives analysis and lastly inclusion analysis.

Activities analysis

This analysis is concerned with who does what and also helps to understand what tasks are undertaken by men, women and children which contribute to farm production, house-hold production(for self-provision or sale), child bearing and rearing, and other off farm activities(Feldstein et al, 1980). It considers all categories of activities which are productive and reproductive and it also identifies how much time is spending on each activity and how often it is done (ADB, 2002). It also identifies where the activities take place (the village, marketplace, fields and urban centres) an how far these places are from the household and thus giving insights into female and male mobility, and allows assessment of the impact of the program on mobility and potential ways on saving time(ADB, 2002).

Resource analysis

Provides an outline for disaggregating by gender and age who has access (freedom or permission to use the resource) to and control (power to decide whether and how the resource is to be used) of critical resources (Feldstein et al, 1980). It considers the productive resources such as land, equipment, labour, capital, credit, education and training (ADB, 2002). Access and control analysis of resources creates another screen or map for

looking at production constrains and proposed solutions by looking at the available resources, the resources required for proposed changes, the one in control of resources and to whom and how the new resource will be made available(Feldstein et al, 1980).

Benefits and incentives analysis

Benefits analysis looks at who has access to or control of the outputs of production which includes all the end uses of a product for example a crop, home consumption, income from sale etc. benefits might also occur through the changes in the farming system such as reduced labour demands or reduced risk(Feldstein et al, 1980). Incentive analysis goes on to analyse what motivates the farmers to continue with what they do and they may be associated with the production characteristics of an enterprise such as increase in yield or income, stabilisation of yields, reduction of risks. It may also be associated with the uses of the outputs such as prestige, obligation to family and improved nutrition (Feldstein et al, 1980).

Inclusion analysis

Inclusion analysis looks at the technique or the methodology an organization uses to include its participants and it also asks who is included at each stage of in each activity of farming (Feldstein et al, 1980). It shows how men and women are included in the categories or kinds of information gathered, as sources of information, and as actors (implementers), decision makers, and beneficiaries. It also asks questions like “whose interests or preferences are represented at each stage”? Inclusion analysis also looks at the criteria used to include particular individuals and if the selection is random or purposeful and the steps taken to encourage inclusion e.g time and frequency of visits or meetings, location, rules and means of access. Inclusion analysis is useful for planning and monitoring research and other activities and helps to see whether there are any groups of people which are not included due to lack of necessary resources(Feldstein et al, 1980).

The theory of diffusion of innovations shows how an innovation is communicated through certain channels in a social system. It was also mention earlier in the chapter that diffusion is usually associated with institutions that sponsor innovations and promote technological development. So in the case of IDE this theory of diffusion of innovations can be used as a framework for the analysis of how it promoted technology development. An introduction of technology can influence the gender relations within households in a society by having differential benefits and constraints among men and women. The different areas of analysis of the conceptual framework of gender can assist in showing how different gender was influenced by the introduction of the technology. Thus using both theories as frameworks for analysis will give a better picture of the adoption and use of the low cost drip kits in Kafue and Kabwe. In order to have an analysis which produces representative results, a large sample size is required. However this doesn’t mean that a small sample cannot give good results. A descriptive analysis is used in this research because the sample size is not big enough to make a statistical analysis so the theories become a framework on which the analysis is based.

5. RESULTS

The results of the technology adoption were obtained through literature review of some IDE documents and through interviews with the farmers from both Kafue and Kabwe areas. they were also obtained from interviews with IDE employees and other individuals who had an influence on the adoption of the drip kits.

5. 1 Adopters and Non adopters of Low cost Drip Kits

The graph below shows the number of farmers interviewed who consistently used the drip kits, those who used and abandoned the drip kits and those that never used the drip kits in both areas of Kafue and Kabwe.

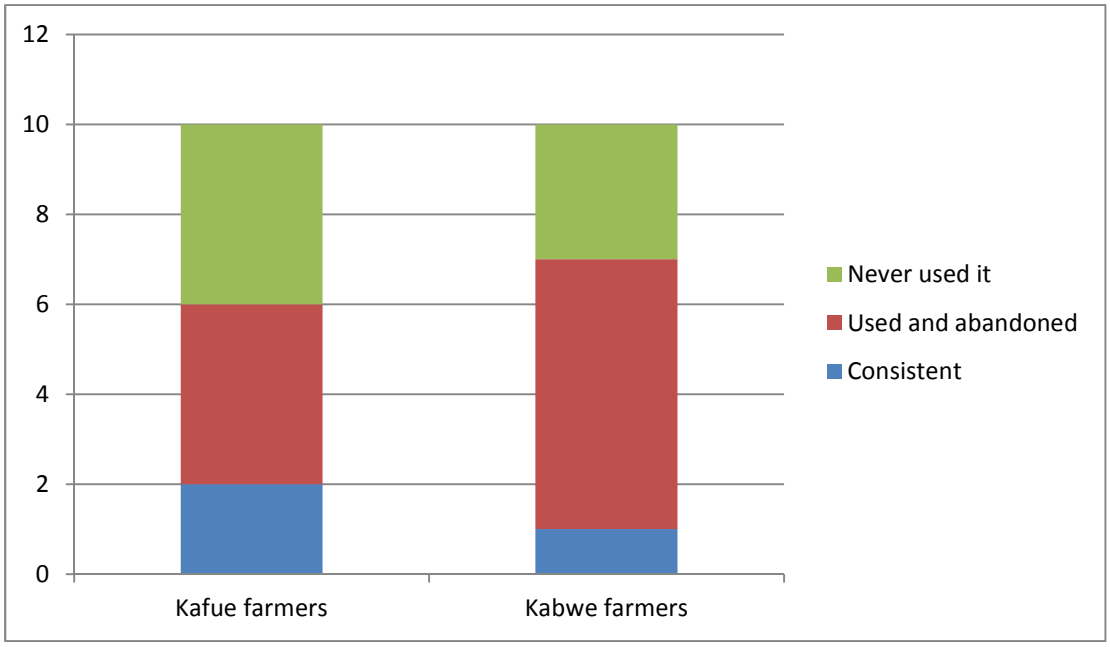

Figure 6. Drip kit use among the interviewed farmers in Kafue and Kabwe

The graph shows that the number of farmers who maintained their consistency in using the drips is low in both areas. In Kafue only 2 out of 10 farmers interviewed are consistently using the drip kits and 1 out of 10 farmers interviewed in Kabwe is consistently using the drip kit. The proportion of interviewed farmers who used the drip kits and later abandoned them is quite large in both areas of Kafue and Kabwe. Kafue has 4 out of 10 farmers interviewed who used the drip kits once and then later abandoned them whilst Kabwe had 6 out of 10 farmers who used and abandoned the drip kits. The number of interviewed farmers who never used the drip kits in Kafue and Kabwe is 4 and 3 respectively.

The farmers who consistently used the drip kits are the adopters of the technology for they have gone through the innovation decision process that is from the knowledge stage to the confirmation stage where they made a decision to continue using the drip kits. Those who did not continue using the drip kits are the non adopters and they also went through the innovation decision process but at the confirmation stage they made a decision to

discontinue using the drip kits. The reasons behind their adoption and non adoption are explained below.

5.1.1 Adopters

There are different reasons why the three farmers in Kafue and Kabwe were consistently using the drip kits. All the three farmers had complete drip kits and they also have motorized pumps to abstract water from the well or river into the tank so it became easier for them to use the drip kits. Two farmers from Kafue have got treadle pumps whilst the farmer in Kabwe doesn't own one. The farmers who own both the treadle pump and motorised pumps said that they usually use the motorised pump to fill the tank. The treadle pump is a stand by technology which will be used when the farmers do not have fuel to run the engine of the motorised pump.

The two farmers who use drip kits in Kafue have more than one drip kit set. One of them has two tanks (200 and 1000 litre) and they are both used on different drip sets in their garden. The other one has a 1000 litre tank which he uses when irrigating with the drip kit. The farmer from Kabwe uses a 200 litre tank when irrigating with the drip kit. One of the farmers in Kafue was given a complete drip kit with IDE Zambia so that other surrounding farmers can observe from her and eventually buy the drip kits if they are interested in it. She fits into the adopter category of innovators of the technology. The other farmer from Kafue bought the incomplete drip kit with a voucher from IDE Zambia and then separately bought the tank from the local retailers. The voucher discount will be explained later in the chapter. The farmer in Kabwe bought the complete drip kit from IDE Zambia. He bought the tank at a cost of 180 000 kwacha[1] He had a discount of 40% on the other part of the drip kit which had an original price of 50 000 kwacha thus in total, he paid 210 000 kwacha for the complete kit.

These three farmers were asked in which period of the year they usually use the drips and their answers were different. Both farmers from Kafue use the drip kits for growing tomatoes from the months of July to December to avoid the attack of tomatoes by winter frost. One of these farmers usually plants green maize in the winter season which is usually between May to July. The third farmer in Kabwe uses the drip kit between the months of September to December. He usually grows watermelons with the drip kit because it is a high value crop and doesn't need to be flooded with water which makes the drip kit a suitable technology to use for this crop.

The farmers who adopted the drip kits also face a number of problems when they irrigate their crops. The common problems these three farmers encountered are that they had blockages and leakages in the drip system. Despite the existence of the filter on the drip, blockages still occurred mainly in the micro tubes. The drip lines usually leaked at the water distribution points i.e. where water is diverted from the tank to the main line and at the lateral main line intersection. The other problem they encountered was the breakages along the drip lines. According to the farmers this was due to the material of the drip kits which is

[1] 1USD is approximately 5 000 kwacha

of low quality and long periods of exposure to the sun of drip kits. They would overcome this problem by replacing the broken drip kit lines with those from the other drip kit components they already had. One of the farmers pointed out that she had a difficulty in fitting the micro tubes as it requires some expertise. Technical experts are not always available to help when the farmers are laying out the drip kit. Farmers experience problems and difficulties when they are in full use of the technology. This occurs in the confirmation stage of the innovation decision process. Change agents (field officers) have to take their role of providing technical expertise when the farmers start to use the innovation (Rogers 2003).

5.1.2 Non adopters

Non adopters can be put into two groups which are 1) those that used and abandoned it and 2) those that never used the drip kits. Regarding the innovation decision process these two groups have gone through the knowledge stage to the decision stage. The group that used and abandoned the drip kits went through all the stages of the innovation decision process but in the confirmation stage they made a decision to discontinue using the technology. The other group which never used the drip kits only reached the decision stage of the innovation decision process. At this stage they decided to buy the drip kits but because they were incomplete, they wouldn't be able to use them and so they couldn't reach the implementation stage. These groups have different reasons why they could not adopt the technology.

The graph presented earlier shows that ten of the interviewed farmers in both areas of Kafue and Kabwe tried to use the drip kits and later abandoned them. There are several reasons which led to these farmers abandoning the use of drip kits. This group consists of a mixture of farmers who had complete drip kits and incomplete drip kits. The proportions of farmers interviewed who had complete drip kits and incomplete drip kits in Kafue and Kabwe are shown by figure 5 below.

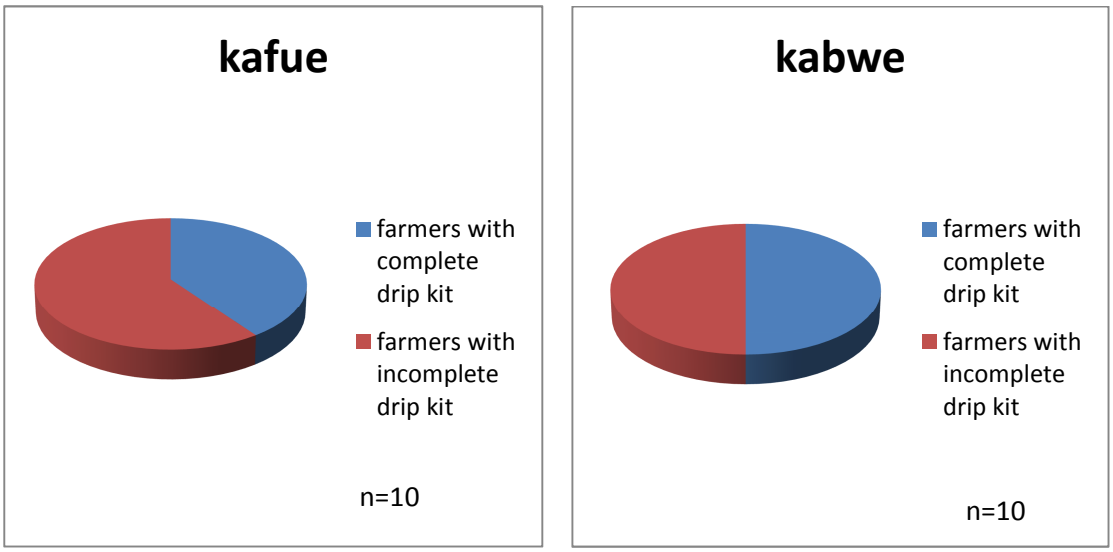

Figure 7. Proportions of farmers with complete and incomplete drip kits

Used and abandoned group

In Kafue there are two farmers who had complete drip kits and two who had incomplete drip kits that used them once and then decide to abandon them. Kabwe had four farmers with complete drip kits and two farmers with incomplete drip kits who used them once and later abandoning them. The farmers in this category (used and abandoned) pointed out that they experienced a lot of blockages and leakages and this is the major reason why they decided not to continue using the drip kits. The other drawback was that these farmers would find it difficult to repair the drip kits because they could not access spare parts and some had no idea of where to find them. This might mean that they didn't have full knowledge on the operation and maintenance of the drip kits which is referred by Rogers (2003) as the '*how to*' and the '*principles knowledge*'.

The other reasons were farmer specific for instance one of the farmers in Kabwe who had a complete drip kit made a complaint about the technical problem he encountered, which was that when he installed the drip kit in his garden, water would not reach the far end of the drip kit. He went on to say that he installed the drip kit without the assistance of a technical expert thus he had no one to ask why the water distribution was not uniform. Eventually deciding to pack the drip kit and not use it. Two farmers in Kafue and two farmers from Kabwe once used the drip kits without tanks by pumping the water straight to the drip lines. The two farmers from Kafue did not buy the incomplete drip kits but were given them for trials. One of them was given by Omnia Company which wanted to conduct fertiliser trials with the use of drip kits with farmers. The other farmer was given by a white farmer who wanted to do a trial of growing cotton with a drip kit. The farmer who did a trial with Omnia said he didn't continue to use the drip after the trial because he wasn't growing those same crops and also he didn't have a tank. He pumped the water direct to the drip lines using his river pump during the trials and Omnia did not come back to check on the progress so he wasn't motivated to continue using it. The other farmer said that the drip kit didn't last that long because the household members used to pump direct to the drip line with treadle pump because they did not have a tank and also improper handling of the technology by the family members.

Never used group

A total of seven out of the twenty farmers interviewed in both areas never used the drip kits at all. They didn't use them because the drip kits were incomplete. The reason why they didn't buy the tanks was because they were expensive for them thus they couldn't afford to buy them. Also all of them bought the incomplete drip kits with a discount in the form of a voucher. This made it cheaper for them to purchase the incomplete drip kit at a price of 30 000 kwacha. van Wijk (2009) in her research on reasons for non adoption of treadle pumps found out that financial constraints made farmers not to buy the treadle pumps. And she went on to say that the credit linkages and voucher system proved not to be able to solve this problem. She also found that it depends on what the farmer prioritise to invest and thus if they do not see treadle pump as a priority they will use the money for something else. She also noticed that the other thing which might have hindered the adoption of treadle pumps

in some areas was the lack of knowledge of the benefits obtained from using a treadle pump. This outcome is similar to the farmers who bought drip kits. The farmers do not have money to invest in a technology and voucher only assisted them in acquiring part of the technology.

5.1.3 Pricing of the drip kits

As the pricing was still vague for me I had to interview one of the IDE employees in order to understand the pricing of the drip kits. The price of the incomplete drip kit without the tank was 50 000 kwacha and the tank was 180 000 kwacha altogether amounting to 230 000 kwacha.IDE Zambia supplied the complete drip kit they imported from India but nevertheless, the tanks didn't sell as was expected because most farmers would not afford buying them. Moreover, there were drums at the markets which were going at a half price of the imported ones and this made them become more unpopular with the farmers. So the farmers made an option to buy the incomplete kit which was selling at an original price of 50000 kwacha and would be 30 000 kwacha when discounted with 40%. The issue of the voucher is explained further in the next segment which talks about how IDE Zambia collaborated with MEDA (Mennonite Economic Development Associates) in the dissemination of the technology.

5.2 The Influence of IDE Zambia and MEDA in the promotion of Low Cost Drip Kits

To better explain how the voucher system came into existence a detailed description of the information obtained from MEDA and IDE Zambia is presented below.

MEDA is an NGO which is more concerned in business development. It targets business solutions to reduce poverty through creating market linkages and providing investment fund to mention but a few. MEDA had a project called Prosperity through Innovative Project which started at the end of 2007. The main aim of this project was to build capacity in market development particularly irrigation value chain. MEDA worked with the farmers and facilitators which are, ZNFU (Zambia National Farmers Union) and IDE Zambia. These facilitators played a role of training the farmers on the operation and maintenance of irrigation technologies. MEDA was facilitating in the supply and demand side of the technology /building the capacity of suppliers. On the other hand IDE Zambia had already kick started the RPI programme in 2006. So since IDE Zambia was up scaling the micro irrigation technologies and MEDA wanted to increase the irrigation value chain of the retailers, they came into an agreement of becoming partners in the distribution of the technologies.

MEDA had a belief that for the adoption process of the micro irrigation technologies to be successful, different factors had to be considered which included knowledge transfer to the farmers, availability and accessibility of technology, and most importantly the price of the technology. So they provided the farmers with a discount certificate (voucher) which would encourage the farmers to invest in the technology. The voucher was issued out under a certain condition that the farmers who were interested in buying the drip kits or treadle pumps had to undergo a training which was facilitated by the IDE Zambia and ZNFU. In order

for MEDA to identify farmers, it had to get assistance from IDE Zambia which already had farmers registered under them. The target areas for MEDA were Central Province, Copper belt Province and the Southern Province.

The transfer of knowledge to the farmers occurred during the training sessions. The farmers were trained on the micro irrigation technologies available which were the treadle pump and the low cost drip kits. The voucher would be used on one of these technologies so the farmers had to choose the technology he/she had to purchase with the voucher. After they had undergone the training they had to go with the discount certificate signed by the trainer to the supplier which showed that they had completed the training. The voucher had an expiry date of six months from the date of issue and this would accelerate the purchasing of the irrigation technologies (voucher certificate, no date).

Some of the companies who were supplying these irrigation technologies include, CHOKWADI enterprises Limited, Thole Irrigation Technologies, Crop-serve and the latter being the main supplier of the low cost drip kits at that time. It was the responsibility of the supplier to make a follow up on the progress of the technology they were selling.

IDE Zambia was in partnership with MEDA for one year and they parted ways after that period. The reason for the two organisations not to continue working together was that IDE Zambia was now supplying its own drip kits. So IDE became both a facilitator and a supplier of the technology which was not the original plan when it was in partnership with MEDA. Nevertheless, IDE Zambia continued to distribute the drip kits in different locations and in their 2009 annual report, they stated that the micro irrigation technologies were introduced to farmers in all the RPI areas and it is still an ongoing process to newly recruited groups. It also went on to say that trainings on operation and maintenance of low cost drip kits were done in most RPI areas except for Kabwe because the field staffs was awaiting support from head office. In the same report, it was stated that the effort to stimulate farmers to purchase the micro irrigation technologies was not very successful even though the promotions were conducted using the voucher system with MEDA (Mennonite Economic Development Association)(IDE Report,2009). There was no analysis done as yet to find out why the farmers didn't purchase the micro irrigation technologies even under the voucher promotion.

5.3 Database of IDE Zambia farmers

The IDE Zambia data base contains the farmers registered under IDE Zambia. The table below shows the number of farmers registered under IDE Zambia in each area and the number of farmers who uses a certain type of irrigation technology in each area.

Table 2. Number of farmers registered under IDE and technologies used in each area

	Area	*Kafue*	*Kabwe*	*Livingstone*	*Choma*	*Lusaka*	*Total*
No of IDE farmers using	**Drip kits**	18	59	0	0	0	**77**
	Treadle pumps	127	226	43	21	32	**449**
	Motorised pumps	147	271	3	0	0	**421**
	Watering can	2083	2239	1399	3781	1648	**11150**
	Not defined	236					**236**
	Total no of (IDE)farmers	2611	2795	1445	3802	1680	**12332**

Source: IDE Zambia

The data base shows that the drip kits were distributed among farmers in Kafue and Kabwe only. The total number of farmers who have drip kits is 77according to this database. However this number is incomplete because the farmers which were interviewed in the field are not indicated in the database that they have bought the drip kits. The table also shows that there are no farmers who are using the drip kits in Livingstone, Choma and Lusaka. The reason for not having farmers who use the drip kits in these areas is because they haven't been promoted in these areas. The most popular way of irrigation the farmers in Zambia are still using is the watering can which has a total number of 11 150 farmers registered under IDE Zambia using it. In Kafue there are 236 farmers whose irrigation technology is not well defined. They are indicated that they use gravity or furrow irrigation but the technology they use for this type of irrigation is not stated. The grand total number of farmers in the database is 12 332. IDE Zambia in one of its documents stated that it so far reached about 14 000 farmers with its RPI program. This figure is not consistent with the one in the database because the Copperbelt and Pemba areas are not included in this database. Overall the inconsistency in the updating of data makes it difficult to see the trends of drip kit purchases. It is also difficult to measure/assess the impact of the introduction of the technology if there is insufficient data.

5.3.1 Purchasing trends of drip kits

Figure 6 shows the numbers of male and female farmers who bought the low cost drip kits in Kabwe from 2007 to 2009. The numbers are based on the database from IDE.

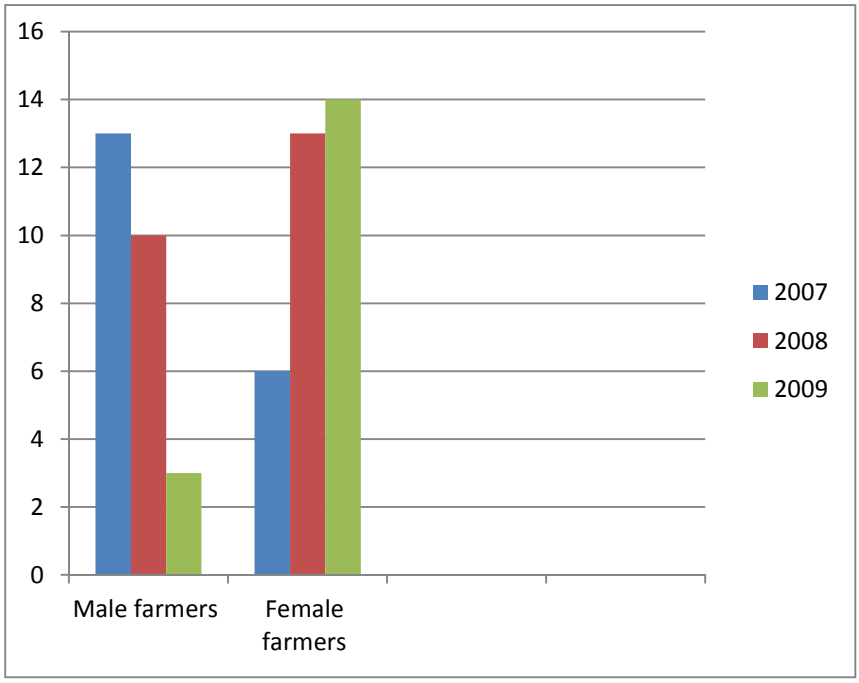

Figure 8.Kabwe purchasing trends of drip kits Source: IDE Zambia Database

Looking at the graph, the first female farmers to adopt the low cost drip in 2007 were 6 out of the total of 19 farmers. Their numbers started to increase in 2008 with 13 female farmers out of the total of 23 farmers adopting the technology. By the year 2009, the technology was becoming more popular among female farmers in Kabwe with their number rising to 14 out of the total 17 farmers.

Basing on this trend of Kabwe male farmers first took the initiative to buy the drip kits. In its initial stages of the programme, IDE would conduct their training programmes with more male representatives than female representatives and this helps explain why the drip kits were bought by more men during the initiative period. Men are the ones who got a chance to undergo the training and thus be entitled to the voucher. The number female farmer participants in the training programmes increased the following years and they could get access to the vouchers and buy the drips at a discount price. Thus from the year 2008 onwards, number of females who bought the low cost drip kits started to increase. The reasoning behind this sudden increase of women purchasing the drip kits is because they became aware of the drip kits when they participated in training programmes. IDE in its RPI programme has a segment of capacity building and gender. Their aim on gender is to achieve equitable prosperity among men and women and the inclusion of women in training meetings is one of its strategies to address this issue. This explains the sudden increase in the number of females who purchased the low cost drip kits. The reason for the decrease in the number of males who purchased the drip kits from 2008 onwards might be because a large number had already bought the low cost drip kits in 2007.

The database shows that there are 18 farmers in Kafue who bought the drip kits in the year 2010 and all of which are women. But there are also male farmers in Kafue who own drip

kits and the farmers which were interviewed in Kafue are not included in this number. This shows that the updating of the database is not consistent.

5.4 Gender and Adoption of the Low cost drip kits

It was interesting to find out how gender influences the adoption of low-cost drip kits and also the impact of adoption of low cost drip kit on gender relations. However the situation in the field wasn't the one anticipated because there were not many farmers using the drip kits and so its effect on gender relations was not visible enough. Nevertheless, a focus group discussion was held with female farmers in Kafue area. This focus group discussion was held to hear the views of the female farmers in relation to the drip kits. The group consisted of female farmers who bought the drip kits and those who did not buy the drip kits. Women in Kafue are not as mobile as their male counterparts; they are usually at their homesteads most of the time. So it became easier to arrange for a focus group discussion with females. Also females are more attached to the gardens than males because they grow their traditional vegetables in these gardens which they use as relish for their meals. So their view on how they perceive the technology was of importance since it is used mostly in the gardens in this area.

Of the female farmers who were present 5 out of 9 farmers had purchased drips kits. Those who didn't have drip kits gave different reasons why they didn't buy them. 2 female farmers said that they didn't buy the drip kits due to financial constraints and 1 female farmer said that her husband was against the idea of buying a drip kit. This is an indication that males have the final say in the household. The last one said she didn't buy the drip because she had no garden.

The female farmers were asked if they preferred to use other irrigation technologies to drip and one of them responded by saying that most female farmers in that area grow a certain types of vegetables like rape, onions and okra. These crops are grown in close spacing so a drip kit limits the number of plants per m^2. So they revert to flooding the land in order to sell large amounts and get a profit. They made a recommendation that if possible the drip should be flexible enough to cater for other crops which can be profitable if they are closely spaced when cultivated.

There is an interesting observation pertaining to gender about how the farmers responded when they were asked the same questions. The same question when asked among men and women would produce a different outcome. For instance, when asked about the benefits of using a drip kit women would give an answer which is more related to their welfare like they were able to buy clothes and send children to school but their counterparts would give answers which are more linked to production like they are able to increase the area under irrigation and purchase more inputs. This shows the nurturing side of the females and the responsibility side of males and gender analysis recognises that men and women's lives, experiences, needs and priorities are different (ADB, 2002). This explains the differences in the response between males and females.

5.4.1 Impact of adoption of low cost drip kits on gender relations

As mentioned earlier the impact of the adoption on gender relations was not visible enough. Only three out of the twenty households were using the low cost drip kit and so its impact was based on these three households. The other seventeen were also interviewed about the gender relations within their households. The description of how the gender relations of the three households were affected/influenced are described in the text below

Kalenga household-Kafue

Mr Kalenga lives with his wife Jennifer Kalenga together with their four children. Both have reached seventh grade of education but they did not proceed to attaining secondary school. Their first two children have reached grade twelve and they help with the farming in the household. In this household not much changed with the introduction of the drip kits in as far as gender relations are concerned. The house hold head is the one who is always in the garden and sometimes together with his sons. The wife doesn't work in the garden; she usually takes care of the children and does the household chores. She doesn't have knowledge of the farming activities within their household. According to her nothing has changed in as far as gender relations is concerned after they had started to use the drip kit. Mr Kalenga makes most of the decisions in the household pertaining to the use of the drip kit, the crops to grow with it and also on how the money is spent. The wife has access to the garden but does not have the power to decide on what to grow in the garden .Mr Kalenga has access to credit facilities and not his wife. He is the one who attends the IDE meetings and trainings which explains why the wife has little farming knowledge. According to Mr Kalenga, labour is reduced when using a drip kit to irrigate the crops. He spends on average an hour/day to irrigate an area which would take 4 hours/day when he didn't have the drip kit. Also he went on to mention that a drip kit can be operated by one person compared to a treadle pump which requires more than one person to treadle and another to direct the water with the pipe. The use of the drip kit has assisted the Kalenga family into buying a motorised pump and they are building a new homestead on their compound.

Mweemba household-Kafue

George and Anita Mweemba are both farmers who live in Kafue with their three children and one niece. Both of them take part in the farming activities of the household. They also had the privilege of attaining secondary school. Mr Mweemba is doing a part time job with the Zambia Ministry of Agriculture and Anita is the contact farmer of IDE group in Kabweza area. According to Anita, using the drip kit in her garden had an impact on the gender relations within their household. Before the adoption of the drip kits, they used to irrigate with the treadle pump flooding the area and this required more than two people because one person will be pumping and the other will be directing the water with the pipe. When they started using the drip kit one person is required to pump the water into the tank i.e. when using either a treadle pump or a motorised pump .In their household it is usually the husband who pumps the water into the tank and will assist when the husband is not at the house. Before using the drip kits all the family members had to engage in activities like land preparation, planting, fertiliser application, weeding and harvesting. After adopting the

drip kits Anita mainly engages in weeding, planting and harvesting of which the latter two activities are her major ones because she says weeds are reduced when using the drip kit. So her farming activities have been reduced since she started using the drip kit thus she has more time to do her housework and plan for her other activities.

Anita and George Mweemba both have access to drip kit but the husband has got control over its use. They might discuss together on the crops to grow with the drip kit but it is the decision of the husband which stands. According to Anita the role of her husband as the decision maker did not change after they adopted the drip kit. The reason she gave was that this has to do with their cultural and religious beliefs that the man is the head of the house and he makes most of the decisions. Despite the husband being the decision maker in the household, they both have access to credit facilities and they both attend the IDE training programmes and meetings. Both have knowledge on the operation and maintenance of the drip kits which explains their consistent use of the drip kit. The money which accrues from farming is used for the benefit of the whole family. The money is used to pay school fees, buy medication, buy food for the family and reinvest in producing other crops.

Shangwa household-Kabwe

Joseph Shangwa lives with his five wives and ten children in Chibombo district of Kabwe. The sizes of his rain-fed field and irrigated plot are 10ha and 2.5ha respectively. Mr Shangwa has reached an education level of grade 9 and he did not finish secondary school. His five wives only attended primary school. Two wives reached grade 7, the other two reached grade 5 and the last one reached grade 6. Mr. Shangwa has got assets which include a tractor, tractor drawn implements, motorised pump and 6 sprinklers to mention but a few which shows that he is not a small scale farmer. The wives provide labour mainly in the rain-fed fields. He uses hired labour in both the irrigation plot and the rain-fed fields. The wives do certain tasks like planting, weeding, fertiliser application and harvesting when cultivating in the rain fed fields. The division of tasks amongst the household members did not change when they started to use the drip kit. The household head remained the manager of both the irrigated plot and rain-fed field after the adoption of the drip kit. Hired labour operates the drip kit and the housewives operate it in the absence of hired labour. It is not certain who amongst the wives will be operating the drip kit if there is no hired labour.
Joseph Shangwa said that he discusses with his wives on how the money should be spent in the household but he has the final say about it. He is the one who has access to credit and attends training programmes offered by IDE in the household. He is also in control of the productive resources like tractor, irrigation equipments and land. The wives have access to land but they are not in control of it. They do not have access to credit facilities and do not attend IDE training programmes. The head of the household also controls the outputs of production and he is the one who goes to the market to sell the produce. The introduction of the drip kit did not change the gender relations in the household of Shangwa.

The other seventeen farmers were also interviewed about the gender relations within their household. The overall decision maker in most of these houses is the household head which

is a male. They are the ones who decide on how money is spent in the household and also on the types of crops to grow in both the garden and rain fed fields. Even though women can cultivate their traditional crops in the gardens they cannot decide on a crop grown for the market like tomatoes. When the households were asked about the person responsible for the repair and maintenance of the technologies they have including drip kits, the prominent response came out to be the males. Most females in the household have access to technology but do not have the power to decide on its use. The farmer's anticipation about the division of labour if they used the drip kits was that the workload would be reduced because there will be less weeding required. Also the number of people required for irrigation will also be reduced. According to the farmers this would have an advantage mostly to the females who usually do the task of weeding because they will spend less time in the field and be able to do other household activities like cooking, washing to mention a few. The conclusion which can be drawn from all this is that a man is a dominant figure in the household arena in terms of decision making and power/control over resources in areas of Kafue and Kabwe.

6. Conclusion and Recommendations

A low cost drip kit is among the micro irrigation technologies which were aimed at alleviating poverty among the small holder farmers in Zambia. It was mentioned in chapter 2 that IDE Zambia with its RPI wanted to raise the annual income of the smallholder farmers with $200 (IDE, 2009). It also wanted to make the farmers switch from subsistence farming to commercial farming through the use of these technologies to produce good quality crops which attract the market (IDE, 2010). A low cost drip kit has got a number of advantages which include water saving, labour saving, reduces number of weeds as it provides water direct to the plant and doesn't need regular shifts or position change. Moreover, it comes in a variety of sizes ranging from a 200m2 to a 1000m2 drip which the smallholder farmers have a variety to choose from. The advantages it possesses and the size variety it comes in would make it a handy technology for the smallholder farmers but they did not adopt the technology. Despite IDE's effort to sell the drip kits with a voucher, many farmers did not buy the technology. This shows that there is a gap between the promotion of the drip kits and the sales/adoption of the low cost drip kits. The gap can be explained by analysing how this innovation (low cost drip kit) was diffused in Kafue and Kabwe. The theory of Rogers is the main framework for which the analysis is based.

6.1 Adoption process in Kafue and Kabwe

The technological innovation had a low relative advantage to its intended users. Though it had objective advantages, the problem was that the farmers had no money to make it functional. For example the farmers who bought an incomplete kit had no money to buy the tank because its price was out of their reach. Thus they never used the drip kits. For those who managed to buy the complete kit, it proved to be both complex and incompatible. It was complex in the sense that the farmers did not have enough knowledge of the operation and maintenance of the drip kits. This is evidenced by many complaints about the blockages and breakages the farmers experienced with the drip kit. One farmer from Kabwe complained about uneven water distribution which he encountered when he was using the drip kit for the first time. He couldn't find an expert to ask about this experience and decided to abandon using the drip kit. This also shows a lack of knowledge and little knowledge of a technology functioning makes it complex to the user. The farmers are not used to go and look for spare parts especially when the parts are not in their proximity. The smallholder farmers especially in the remote areas go to bigger towns like Kafue town, Lusaka and Kabwe town only when need arises. They usually go to bigger towns to look for things like seed and fertilisers and spare parts of a drip kit are not a priority to them. Thus the drip kit is incompatible with their lifestyles. Moreover the smallholder farmers in Kafue and Kabwe do not make it a priority to do regular maintenance of their equipments. Apart from the drip kits most of the treadle pumps used by the farmers in the field are inefficient but they continue using them like that without repairing them.

The low cost drip kits were promoted on a training programme where there were two groups of people at different knowledge levels (Heterophily) (Rogers 2003). In these training

programmes, the farmers would be provided with knowledge on the operation and maintenance of the micro irrigation technologies which included the drip kit and the treadle pump. Fourteen out of twenty farmers interviewed didn't have an idea on how they can access spare parts for the repair and maintenance of the drip kits. The reason for this might be that they were not well prepared to use the low cost drip kits because they were not fully supplied with the different components of the technology.

All the farmers who bought the drip kits had the 'awareness knowledge' which is the information of the existence of the innovation (Rogers 2003). However, the 'how to' and 'principle knowledge' seemed to be lacking among the farmers. The 'how to' knowledge which is the information required to use the innovation properly is one of the major factors which led to the farmers who had compete kits to abandon using them. Inadequate levels of this knowledge prior to adoption of the technology leads to its rejection or discontinued use (Rogers 2003). There are farmers who went on to pump water direct to the drip lines from the pump. These farmers lacked the principle knowledge which is the functioning principle of how an underlying innovation works. Lack of this type of knowledge leads to misuse of the innovation which in the end leads to its abandonment (Rogers 2003).

The farmers could not afford to buy the drip kit at its original price. When IDE realised this, it introduced the voucher to make the drip kits affordable. This was a form of persuasion they used to get more farmers to buy the drip kits. The voucher led the farmers to make a decision to buy the drip kits. Other farmers bought complete drip kits whilst the others bought incomplete drip kits. Those who bought incomplete kits comprises of the group which used the drip and those who never used it. Those who never used the drip kit only reached the decision stage of buying the drip kit but those who went on to use it even if it was incomplete reached the implementation stage. The implementation stage is when the farmers use the innovation but a certain degree of uncertainty will still exist (Rogers 2003). Many farmers who bought the drip kits managed to reach this stage but a few of them went on to the next stage of the innovation decision process which is the confirmation stage. The reason for the farmers not to reach this stage was because of the earlier mentioned reasons which have to do with the malfunctioning of the drip kits. Also the change agents or technical experts did not provide enough assistance to the farmers when they began to use the drip kits. They only provided them with information during the training programmes but did not go on to assist them in the initial use of the technology. Rogers (2003) says that this is a crucial stage, where technical experts are supposed to fulfil their role of providing technical assistance to the farmers for adoption to occur.

Social systems also have an influence on the adoption of an innovation by either facilitating or impeding the diffusion of an innovation. The members of a social system can be individuals, informal groups or organisations (Rogers, 2003). Religious communities play a major role in the farming systems of the people of Kabwe and Kafue. It creates the social system in which the farmer makes certain decisions. For instance most farmers in the Chikongomene area of Kabwe belong to the same religion which allows them to marry more than one wife. That's the reason why most farmers in that area are polygamists. These

farmers stay close to each other. Also the farmers in Kabweza area of Kafue belong to the same religion and they also stay close to each other. Having the same beliefs and living close to each other makes the farmers to have a common opinion. This explains why in these areas there are a lot of farmers who bought the drip kits.

de Graaf and Kessler (2009) stated that a practice is considered adopted only when its execution or use is sustained and integrated in a household's farming system. Most of the interviewed households are not consistently using these drip kits which makes one to conclude that the farmers did not adopt them.

6.2 Analysis of gender relations with the introduction of the drip kits

Gender relations are socially constructed power relations between women and men (Agarwal, 1994). In areas of Kafue and Kabwe, these have an influence on the control and use of the drip kits. The household heads are the sole decision makers in the households. They are the ones who decide on how money is spent in the house and also about the agricultural activities within the family. Their bargaining power is greater than that of their wives. Women do not make decisions on major issues in the households thus their bargaining power is weaker in the household arena. Agarwal (1994) stated that bargaining power of an individual is revealed in whose interests prevail in the decision made in terms of distribution of resources, goods, services and tasks. In this case men's interests are the ones which prevail.

The interviewed households who use the drip kits said that they use the profit /income they get from their sales for the benefit of the whole family. Lynch (1993) commented on this by saying that the notion that the profits benefit the whole family reinforces women's subordination and it becomes harder for them to reap the benefits of irrigation development.

IDE (2009) in one of its researches found out that the literacy and knowledge levels vary and this leads to a differentiation in the capacity of men and women to adopt new technologies. This is true for interviewed women in Kafue and Kabwe. Women's literacy levels in the household are lower than their male counterparts. Most of the female farmers only attended primary level of education. This hinders them from attending training programmes and meetings of IDE and having access to credit facilities. The lower literacy level further reduces their bargaining position in the household apart from religion and culture.

Religion and cultural beliefs shapes the gender relations within the household of Kafue and Kabwe. The wives of Mr Shangwa in Kabwe do the major proportions of farm activities which also involve post harvesting processes but they have a lower social status in their households and community (Padmaja et al, 2006). The man is seen as the head of the household and is responsible for his family's welfare. In meetings or family gatherings the male seat on wooden chairs and women sit on the floors and this shows that the males are already elevated or given a higher position by the society.

6.3 Recommendations

Further research can be done on the access and priority of use of finances within the households in order to get a good picture of farmer's values and interests which might influence the adoption of low cost drip kits and other technologies.

It will also be interesting to find out why the low cost drip kits were only promoted in two area of Kafue and Kabwe and not other areas in which IDE has influence. Since the results of the database shows that there are still a lot of farmers registered under IDE Zambia (11 150) who are still using their inefficient traditional ways of irrigating.

Also a look into the how IDE executes its tasks in trainings, data management and treatment is of importance in order to have the knowledge of how they reach to the farmers and what form of information they provide them with. Data management and treatment enables one to have an idea on the data IDE obtains from the field and what they do with it.

REFERENCES

ADB, (2002). Gender and Development. In. *Gender Checklist –Agriculture*. See

www.adb.org/Documents/Manuals/Gender_Checklists/Agriculture accessed 12 January 2011

Agarwal, B. (1994). Conceptualizing Gender Relations. In. *A field of one's own. Gender and land rights in South Asia*. Cambridge South Asian Studies 58.Cambrdge University Press, pp. 51-81

Bized. (2001). Maps of Zambian Provinces (Biz/ed Virtual Developing Country). See

www.bized.co.uk/virtual/dc/resource accessed 15 February 2011

Chabwela, H. N,. And Mumba, W,. (1996). Integrating Water Conservation and Population Strategies of the Kafue Flats in Water and Population dynamics: Case Studies and Policy implications. Montreal. Canada

CIA. (2011). The World Fact Book, Zambia. See www.cia.gov/library/publications/the-world-factbook accessed 15 February 2011

Crawford, I. (1997). Marketing Research and Information Systems. Food and Agricultural Organisation of the United Nations. ISBN 92-851-1005-3

de Graaf, J., and Kessler, A. (2009). Impact Assessment of Land and Water Management. Environmental Sciences, Wageningen University. Netherlands

Embassy World. (2011). Maps of Zambia. See www.embassyworld.com/maps accessed 24 March 2011

Feldstein, H., Poats, S., Cloud, K., and Huisinga, R. (1989). Conceptual Framework for Gender Analysis in Farming Systems Research and Extension. In. *Working Together*. Gender Analysis in Agriculture. Vol. 1. pp 7-37

Hantuba, M. (2004). Agriculture and Agribusiness. *Government Policy on Agriculture*. See http://thezambian.com/agriculture-agribusiness/b/agriculture/archive/2004 accessed 15 February 2011

Hendreson, K., Chelemu, K., and Boesveld, H. (2009). Gender Differentiated Impact of Low cost Irrigation Technologies.IDE Zambia, 1800 Nchenja Road, Northmead, Lusaka, Zambia

Hobson, R. H., and Williams, G. J. (2011). 'Zambia' Encyclopaedia Britannica. Encyclopaedia Britannica online. Accessed 15 February 2011

Houston, J. F. T. (1982). Rainfall and Recharge to a Dolomite Aquifer in a Semi- Arid Climate at Kabwe, Zambia. Elsevier Scientific Publishing Company, Amsterdam- Netherlands

IDE Zambia. (2010). International Development Enterprises 'Creates Income opportunities for Poor Rural Household'. 1800 Nchenja Road, Northmead, Lusaka, Zambia

Kanyembe, D., and Makulika, K. (2009). Annual Progress Report- 2009. IDE Zambia, 1800 Nchenja Road, Northmead, Lusaka, Zambia

Karlsson, T., Sunberg, S., and Wigren, M. (2001) Agricultural Extension in Kenya- A case study of Farmesa FFS and Monsanto demonstration plots. Swedish University of Agricultural Science International Office. Box 7070 SE-750 07 UPPSALA Sweden ISSN 1402-3237

Larsen, G, D. (2005). Construction Management and Economics. Horses for courses: relating diffusion of innovation process to the stages of the diffusion process. Vol. 23, Issue 8. Pp 787-792

Lievrouw, L. A., and Livingstone, S. M. (2002). The *Handbook of New Media*: Social shaping and consequences of ICTs. Sage Publications

Lievrouw, L. A. (2006). *The Handbook of New Media*. Updated Student Edition. Sage Publications

Lynch, B. D. (1993). The Bureaucratic Tradition and Women's Invisibility in Irrigation. *Proceedings of the 24th Chacmool Conference*. Alberta: University of Calgary Archaeological Association, pp. 333-342

March C., Smyth, I., and Mukhopadhyay, M. (1999). A Guide to Gender Analysis Frameworks. Oxfam GB 274 Banbury Road, Oxford OX_{27} DZ, UK

Matlock, M. (2007). "Water profile of Zambia". In: Encyclopaedia of Earth. See www.eoearth.org/article/Water_profile_of_Zambia accessed 15 February 2011

O'laughlin, B. (2007). "A Bigger Piece of a Very Small Pie: Intra-household Resource Allocation and Poverty Reduction in Africa" Development and Change, Vol.38, No 1

Padmaja, R., Bantilan, M. C. S., Parthasarathy, D., and Gandhi, B. J. V. (2006). Gender and Social Capital Mediated Technology Adoption. International Crop Research Institute for the Semi Arid Tropics (ICRISAT). Patancheru 502 324, Andhra Pradesh, India

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press

Robinson, L. (2009). A summary of Diffusion of Innovations. See

www.enablingchange.com.au accessed 18 May 2010

US Department of State. (2010). Background Note: Zambia. See

www.state.gov/r/pa/ei/bgn/2359.htm accessed 15 February 2011

van Wijk, G. (2009). Report –Reasons for Non adoption Treadle Pump. Wageningen University, Netherlands

World Bank. (2003). See World Bank website:"Environmental Impact Statement for the Lusaka-Chirundu Road accessed 1 March 2011

Zamnet. (2007). "Kabwe: From discovery to recovery" (Daily Mail), www.zamnet.zm website accessed 1 March 2011

APPENDICES

Appendix A: Semi structured questionnaire for interviewing farmers

Semi structured questionnaire

Adoption analysis of low cost drip irrigation kits in Kafue and Kabwe, Zambia.

The questionnaire is going to be used to get information from farmers on the Adoption analysis of low cost drip kits in IDE areas of Kafue and Kabwe. It is also going to be used to determine the factors affecting the adoption of drip irrigation kits among women in Zambia. This information is going to be used to further develop the technology with IDE Zambia and be used also in the University of Wageningen and University of Zambia to comprehend the social construction of technology which has been recently introduced.

Researcher's name:…… Rain-fed farm size.....

Date and time:..... Size of farm/Plot irrigated:.....

Name of farmer..... District.....

Region /zone:…… IDE-Farm Group.....

Household information

Name	Sex	Other occupation	Tribe	Relation to owner	Education attained	Religion

1(a). How did you know about the low cost drip kits?

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(b). Why did you decide to use the drip kits? Or what motivated you to use the drip kits?

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(c).For how much did you purchase your drip kit?

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(d).Is the price justified in relation to how it works?

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2(a). Before using the drip kits what form of irrigation (if any) were you using and if there is have you abandoned it or are you using it in combination with the drip?

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(b).What is the advantage of using it in combination with other form of irrigation? If any

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(c).In which periods of the year do you use the low cost drip kits since the time of adoption?

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3(a) .Which types of crops do you usually grow with the drip kits?

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(b).What is the reason for growing the above mentioned crops using the drip kits?

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(c). Have you been consistently using it and if not why?

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(d).What problems do you encounter when irrigating using drip kits?

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(e).What are the advantages of using drip to irrigate crops?

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(b). What do you do with the income from sales obtained from the use of drip kits?

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.....

.....

(c). Who decides on how to spend the income in your household?

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.....

.....

5(a). Who decides on how the drip kit is to be used in the household?

.....

.....

(b). Which family member/members are constantly using the drip kits?

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.....

(c). In comparison with the time before you had the drip kits, what differences have you noticed in workload while using drip compared to the time without drip?

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(d). Explain the reasons for the differences?

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(e). Who is responsible for the repair and maintenance of the drip kits in the household?

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(f). How do you access parts for the repair?

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.....

6(a).Are there any incentives accompanied with the purchasing and use of the drip kits?

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(b) Where do you sell your produce?

.....

.....

(C)What form of transport do you use to take your produce to the market?

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.....

(d)How efficient is the transport to you?

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.....

(e). How is IDE helping you in the marketing of your produce obtained from using drip kits?

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.....

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(f). What is the effect of the use of drip kits on your produce?

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7. How are tasks/activities divided within a household through the use of the low cost drip irrigation kits?

Before adoption

Task/activity	*Household head*	*spouse*	*Family members*	*Hired labour*
Land prep				
Crop choice				
Planting				
Irrigating				
Procurement of seed				
Weeding				
Fertiliser application				
harvesting				
Taking the produce to the market				
Cooking				

After adoption

Task/activity	*Household head*	*spouse*	*Family members*	*Hired labour*
Land prep				
Crop choice				
planting				
Irrigating				
Procurement of seeds				
weeding				
Fertiliser application				
harvesting				
Taking produce to the market				
cooking				

Appendix B: Focus Group Discussion questionnaire

Focus group discussion questions

Adoption analysis of low cost drip irrigation kits in Kafue and Kabwe (Zambia). /factor affecting adoption of low cost drip kits

Facilitators .....

.....

No of people present.....

Village.....

Start time..... end time.....

1. How many of you bought the drip irrigation kits?

2. How many are using the kits?

3. Are you able to use the kits as women or you need assistance from men?

4. Have you received any technical advice on how to use the drip kits?

5. Is the advice sufficient for you or you need more information/advice?

6. How often are you in contact with the IDE technical staff or officers?

7. How is the drip technology helping you as women?

8. Are you using it in combination with other form of irrigation? Why?

9. How do you benefit from using the drip kits/ are there any significant changes which occurred after using the drip kits?

10. Which types of crops do you grow with drip irrigation?

11. Which ones do you prefer to grow and why?

12. Where do you market your produce?

13. How does IDE help in the marketing of produce?

14. What are the constrains associated with using the drip technology?

15. To what extend are you able to use the drip kits without consulting your husband?

16. How does the technology affect the day to day activities either positively or negatively e.g (women social gatherings)?