

**AN ASSESSMENT OF CHANGES EXPERIENCED BY SMALLHOLDER FARMERS AS A RESULT OF SMALL-SCALE IRRIGATION INTERVENTION: A Case Study of Smallholder Farmers in Amudat District, Karamoja Sub-Region, Uganda**



A research project submitted to Van Hall Larenstein University of Applied Sciences  
in partial fulfilment of the requirements for the Degree of MSc in Management of Development,  
specialization Rural Development and Food Security

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September 2019

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## **ACKNOWLEDGEMENT**

My utmost gratitude to Almighty God for giving me good health and protection throughout the course of study. Special appreciation to my supervisor, Dr. Evers Heinz for investing your valuable time, skills and experience for the success of this study. Many thanks for the professional guidance, criticism, patience and understanding during this study.

Sincere thanks to Dr. Pleun Arensbergen, MOD programme coordinator. Thank you for your expert guidance during the research project process. Dr. Suzanne Nederlof my mentor and specialization coordinator, although you could not be with us for long due to illness, your intelligent counselling to me when I first arrived at VHL was so constructive. Of course, we missed you dearly during your absence!

All lecturers and colleagues of MOD programme, your input was valuable, thank you.

I am so grateful to the Dutch Government for the generous scholarship support extended to me through the NUFFIC- Orange Knowledge Programme (OKP). Thank you for investing in me so I can invest in others.

To the project staff of ZOA, Amudat, thank you for the help offered during data collection.

To my family, your support was immeasurable. Ambrose Omoding, Toto Josehone Opolot and all the others, thank you for the immense support.

Finally, my special appreciations go to my dear wife, Regina Isagaite and my son Sebastian Rufus Opolot for the big sacrifices you made to ensure that this study is accomplished. The support and encouragement you gave was enormous.

## **DEDICATION**

I dedicate this work to my family; my wife and son. Your sacrifices were colossal.

## TABLE OF CONTENTS

ACKNOWLEDGEMENT .....	i
DEDICATION.....	ii
LIST OF ACRONYMS .....	vii
ABSTRACT .....	viii
CHAPTER ONE: INTRODUCTION .....	1
1.0 Background.....	1
1.1 Introduction.....	1
1.2 Uganda.....	1
1.3 Karamoja Sun-region.....	1
1.4.0 Organisational background.....	2
1.4.1 Mission .....	2
1.4.2 Strategic Plan.....	2
1.4.3 Vision .....	2
1.4.4 Strong foundation .....	2
1.4.5 Core values .....	2
We are faithful.....	2
We value people.....	2
We are good stewards .....	2
We serve with integrity.....	3
1.4.6 Key thematic areas.....	3
1.5.0 ZOA Uganda.....	3
1.5.1 ZOA Amudat district.....	3
1.6.0 Study area.....	3
1.6.1 Population and Demographics .....	4
1.6.2 Climate.....	4
1.6.3 Soils.....	4
1.6.4 Vegetation .....	4
1.6.5 Relevant cultural and ethnic issues .....	4
1.6.6 Livelihoods.....	5
1.6.7 Women’s livelihoods.....	6
1.7 Selection of study area.....	6
1.8 Project description .....	6
1.9 Research problem .....	7
1.10 Research objective .....	7
1.12 Research sub questions.....	8
CHAPTER TWO: LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK.....	9

2.0 Introduction.....	9
2.1 Household.....	9
2.2 Household income.....	9
2.4 Smallholder farmers.....	9
2.5 Small-scale irrigation (SSI).....	10
2.6 Small-scale irrigation in Sub-Saharan Africa .....	10
2.7 Small-scale irrigation in Uganda .....	11
2.8 Small-scale irrigation in Karamoja .....	12
2.9 Conceptual framework of the study.....	12
<b>CHAPTER THREE: METHODOLOGY.....</b>	<b>14</b>
3.0 Introduction.....	14
3.1 Research strategy.....	14
3.2 Case study.....	14
3.3 Unit of analysis .....	14
3.4 Population sample .....	15
3.5 Methods of data collection.....	16
3.6 Data analysis.....	16
3.7 Limitations of the study .....	17
3.8 Ethical considerations .....	17
3.9 Time schedule of the research project .....	17
4.0 Introduction.....	18
4.1 The respondents.....	18
4.2 Crop production and productivity .....	19
4.3 Household income generation.....	20
4.4 Household food security .....	21
4.5 Other changes realised.....	23
Challenges faced by the irrigators .....	24
Suggestions for improvement.....	25
4.6 Comparing the effect (outcome) of SSI project between male and female headed households .....	25
<b>CHAPTER FIVE: DISCUSSION.....</b>	<b>27</b>
5.0 Introduction.....	27
5.1 Household crop production, productivity and food security .....	27
5.2 Household income generation.....	27
5.3 Other changes irrigating households have experienced .....	28
5.3.0 Knowledge and skills.....	28
5.3.1 Adaptation to climate and weather variability.....	28
5.3.2 Diversification of livelihoods .....	28

5.3.3 The importance of working in groups. ....	29
5.3.4 Empowerment of women. ....	29
5.3.5 Accumulation of household assets.....	29
5.4 Outcome of utilising irrigation between male and female headed households .....	29
5.5 Challenges related to Small-scale Irrigation.....	30
<b>CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS .....</b>	<b>31</b>
6.0 Introduction.....	31
6.1 Conclusion .....	31
6.2 Small-scale irrigation improving g household crop production, productivity, and food security .....	31
6.3 Small-scale irrigation contribution to increasing household income.....	31
6.4 Other benefits of small-scale irrigation.....	31
6.5 Outcomes of SSI between male and female headed households .....	31
6.6 Problems associated with small-scale irrigation.....	32
6.7 Recommendations .....	32
<b>BIBLIOGRAPHY.....</b>	<b>34</b>
<b>APPENDICES.....</b>	<b>37</b>
<i>Appendix 1: Activity implementation plan.....</i>	<i>37</i>
<i>Appendix 2: Data collection tools .....</i>	<i>38</i>
<i>Appendix 3: Household Semi-Structured Interview.....</i>	<i>39</i>
<i>Appendix 4: Key Informant Interview Guide (Local Council I chairperson) .....</i>	<i>41</i>
<i>Appendix 5: Key Informant Interview Guide (AOs, PO).....</i>	<i>42</i>
<i>Appendix 6: Focus Group Discussion guide .....</i>	<i>43</i>
<i>Appendix 7: Household data summery .....</i>	<i>44</i>
<i>Appendix 8: An example of a summary of respondent interview .....</i>	<i>45</i>
<i>Appendix 9: Consent form.....</i>	<i>46</i>
<i>Appendix 10: Photo gallery .....</i>	<i>47</i>

## LIST OF TABLES

Table 1: Population distribution .....	5
Table 2: Livelihoods, by sub-county and town council .....	6
Table 3: Focus Group Discussion attendance .....	15
Table 4: Marital status of HH heads.....	19
Table 5: Main crops grown in Amudat.....	19

## LIST OF FIGURES

<i>Figure 1: Map of Uganda and Karamoja showing Amudat district .....</i>	<i>4</i>
Figure 2: Perceived benefits of SSI vis- a- vis household food security and incomes.....	13
<i>Figure 3: Education level of HH heads .....</i>	<i>18</i>
<i>Figure 4: Main seed planted in Amudat.....</i>	<i>20</i>

## LIST OF ACRONYMS

AO	Agricultural Officer
FGD	Focus Group Discussion
HH	Household
HHI	Household Interview
ILO	International Labour Organisation
KI	key informant
KIDDP	Karamoja Integrated Disarmament Development Programme
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MOD	Management of Development
NGO	Non- Governmental Organisation
PO	Project Officer
S/C	Sub-County
SSA	Sub-Saharan Africa
SSI	Small-scale Irrigation
VSLA	Village saving and Loan associations



## **ABSTRACT**

Small-scale irrigation is considered one of the options for increasing agricultural productivity and supporting development in Sub-Saharan Africa, including Uganda. (Kamwamba-Mtethiwa, Weatherhead and Knox, 2016). It is critically important as an innovative practice in smallholder agriculture in Sub-Saharan Africa. Mango et al (2018). Small-scale irrigation (SSI) technologies can be useful not only to increase crop productivity, income, and poverty alleviation, but also as a viable adaptation practice to climate variability Balana et al (2019).

ZOA, Uganda implemented a two-year small-scale irrigation project (2017-2018) in Amudat district, Karamoja sub-region in Uganda among the resource poor farmers. The district is a semi-arid and prone to drought. However, since the project ended in 2018, it was not known what the beneficiaries of the intervention perceive to have changed as a result of utilising the irrigation system; in terms of food security and income generation; which was the main objective of the intervention.

The objective of this study therefore was to explore the experiences of small holder farmers as a result of small-scale irrigation intervention in Amudat district, Uganda. The research question that was addressed was, "What changes are smallholder farmers experiencing as a result of small-scale irrigation (SSI) project in Amudat district?"

The study was limited to a case study strategy in respect to the research objective and main research question. Both primary and secondary data were used to collect data. Secondary data formed part of the scoping and desk study exercise. Primary data was collected from households, Focus Group Discussions and key informants using semi-structured interviews, and checklists of open-ended questions.

The study results revealed that from the perspective of SSI beneficiaries, there was improved household crop production, productivity, and food security and especially of high value crops and horticultural crops; secondly, the results showed that there was increase in farm income of households; thirdly, small-scale irrigation intervention was perceived to have contributed to many positive changes among participating households and groups. These benefits included; acquisition of knowledge and skills, adaptation to climate and weather variability, diversification of livelihoods, benefits of working together in groups, empowerment of women, and accumulation of household assets. The study also discovered that female household heads were viewed to be more negatively affected by the outcomes of irrigation activities than male household heads because of limited time for irrigation activities due to women's triple role. Besides, the use of treadle pumps was more tedious for women. On the other hand, smallholder farmers experienced some problems of small-scale irrigation. The main ones that the study revealed were those related to water shortages, crop pests and diseases, high input costs, drought, flash floods, labour related problems, ineffectiveness of irrigation equipment, and transport challenges.

Because of the positive changes irrigating households are experiencing, ZOA is encouraged to scale up the intervention to cover more areas and beneficiaries, but also address challenges and problems revealed by irrigating households so as to maximise benefits.

## **CHAPTER ONE: INTRODUCTION**

### **1.0 Background**

#### **1.1 Introduction**

This chapter presents a brief background of Uganda, its rainfall patterns and temperature; and Karamoja sub-region, its climate and main livelihood. It also describes the organisational background, ZOA (the commissioner) and briefly highlights its mission, strategic plan, vision, strong foundation, core values, and key thematic areas. The chapter then narrates the study area, underscoring the key elements of the study location such as population and demographics, climate, soils, vegetation, cultural and ethnic issues, livelihoods and women's livelihoods. It finally underlines the project under study (Bees and horticulture).

#### **1.2 Uganda**

Uganda is a landlocked country in Eastern Africa located at the equator. It has a total area of 241 550 km<sup>2</sup>, with cultivated area of 91 000 km<sup>2</sup>, representing 37.7 percent of the total country area. The country borders South Sudan to the north, Kenya to the east, the United Republic of Tanzania and Rwanda to the south, and the Democratic Republic of the Congo to the west (FAO, 2014). Uganda has a tropical climate characterized by strong seasonality in rainfall because of the influence of variations in altitude, the seasonal latitudinal movement of the equatorial low- pressure trough, and the intertropical convergence zone (ITCZ) (Wanyama et al., 2017). The soils are of fair to low productivity and a favourable climate helps communities to depend on rain fed agriculture. Most regions of Uganda, apart from the dry area in the north, have an annual rainfall of between 1,000mm and 2,000mm. There is heavy rain between March and May and between October and November. Mean temperatures show great variation depending on elevation and landscape, temperatures range from 4-32°C (NEMA, 2016).

Agriculture is the backbone of the country's economy and the livelihood of many people. However, most of the agriculture in Uganda depends on rainfall and therefore inherently sensitive to climate conditions. This makes agriculture one of the most vulnerable sectors to the risks and impacts of climate change and variability (Mubiru, 2010).

#### **1.3 Karamoja Sun-region**

Karamoja sub-region is unique and unlike much of the rest of Uganda, the region has only one rainy season with persistent droughts having a strong impact on livelihoods. The main ecological characteristic of the region is its inadequate and highly erratic rainfall. The rainfall is not only too little – averaging 350 mm to 1,000 mm per annum (although a few areas like Namalu reach about 1,300 mm) but is unreliable. There are three livelihood zones within the sub-region, namely the semi-arid pastoral zone in the east, the agro-pastoral zone (most of central Kaabong, most of Kotido, central Moroto, and central Nakapiripirit) and the wetter agricultural zone in the west.

In Karamoja livestock is one of most prevalent livelihood strategies, with statistics estimating there to be 6 million head of livestock, representing about 19.8% of the national cattle herd (2.3 million head); 16.3% of the goats (2.0 million head) and 49.4% of the sheep (1.7 million head). The sub region is part of the pastoralist corridor which is largely populated by semi-nomadic pastoralists (OPM, 2015; FEWSNET, 2016).

Karamoja is the least developed sub-region in Uganda characterised by poverty, marginalisation, poor infrastructure, conflict, cattle raiding, insecurity, drought and chronic food insecurity, limited market opportunities, natural resource degradation and its long-standing dependency on external aid (DRT, 2008; Mubiru, 2010; FEWSNET, 2016; WFP, 2017; Akwango et al., 2017; Taylor et al., 2015). Karamoja has predominantly experienced chronic food and nutrition insecurity over the years; the region is

structurally deficient in terms of food availability. The problem has been exacerbated by climate variability characterised by erratic rainfall, long dry spells, increased incidence of pests and diseases, drought, and floods. This intermittent variability of rainfall often produces undesirable effects on livestock and agricultural production and productivity; sometimes resulting into complete crop failure. As a result of this, the region intermittently depends on food aid (IRIS, 2017; Swidiq Mugerwa and Anthony, 2014; Mubiru, 2010).

#### **1.4.0 Organisational background**

ZOA is an international relief and recovery organization supporting vulnerable people affected by violent conflicts and natural disasters in fragile states, by helping them to realize dignified and resilient lives. ZOA operates in more than 15 countries, including Uganda where it provides assistance to the most vulnerable victims of displacement.

##### **1.4.1 Mission**

ZOA supports people who suffer because of armed conflict or natural disasters, by helping them to rebuild their homes and their livelihoods and to live peacefully together in stable communities. The organisation believes in the biblical message of reconciliation and restoration for a broken world. And believe they have a specific responsibility to restore hope for people, particularly those in vulnerable positions. Inspired by faith, they reach out to people in need, irrespective of their race, ethnicity, religion or gender.

##### **1.4.2 Strategic Plan**

The organisation's mandate can be summarized in these two terms: 'relief and recovery.' The context in which they operate is often fragile. It strives to be in areas where added value is greatest and seeks to reach out to the most vulnerable.

##### **1.4.3 Vision**

The organisation believes that God calls us to bring peace, reconciliation, and hope to a broken world. "We work towards a world where people have hope and live dignified lives in peaceful communities and have faith that one day, we will experience the true peace."

##### **1.4.4 Strong foundation**

The programmes are focused on long term results. This means that they provide emergency assistance, but also provide support during reconstruction. This is done in cooperation with local population, led by organisation's core values to guide what is done and help them stay sharp.

##### **1.4.5 Core values**

The organisation cherishes four core values as presented below:

###### **We are faithful**

We want to bring lasting change and are committed to stay when the initial crisis is over. Even when local circumstances are challenging, we seek to reach out to the most vulnerable.

###### **We value people**

All people are made in God's image and we therefore place people at the centre of our work. We treat people with respect and dignity, irrespective of ethnicity, gender, religion or age. We seek to enable people to live normal and peaceful lives, develop their potential, and to provide hope for the future.

###### **We are good stewards**

We utilise the resources entrusted to us in the best possible and most responsible way. We are efficient, effective, transparent, and accountable to those we support and those who support us.

**We serve with integrity**

We expect from each other the highest standards of personal and organisational integrity. We are open and honest in the way we deal and communicate with our stakeholders. We treat people with respect and speak the truth in love to one another.

**1.4.6 Key thematic areas**

The key thematic areas of ZOA International are; livelihood and food security, water, sanitation and hygiene; basic education; peacebuilding; land rights; and shelter.

**1.5.0 ZOA Uganda**

In Uganda, ZOA is active in food security and livelihoods; basic education; and peacebuilding sectors. The programme areas and target groups are:

- Karamoja: Amudat district;
- Acholi: Nwoya district; and
- West Nile: Rhino Camp Refugee Settlement, Imvepi Refugee Settlement (Arua District), Bidibidi Refugee Settlement (Yumbe District) and host communities.

**1.5.1 ZOA Amudat district.**

In Amudat district, Karamoja region, ZOA supports agro-pastoralist returnee communities who were forced to flee to neighbouring Kenya as a result of intensive intertribal cattle rustling. In a region that is one of the poorest and marginalised of Uganda, ZOA's holistic approach supports sustainable recovery and development. With the long-term support from private donors, ZOA supports quality education and helps communities to engage in agriculture and bee-keeping.

**1.6.0 Study area**

The study was conducted in Amudat and Karita sub-counties of Amudat district. Amudat district, part of Karamoja sub-region has its geographic centroids at 1°57'N 34°57'E. It is bordered by Moroto District in the north, the republic of Kenya in the east, Bukwo District and Kween District in the south and Nakapiripirit District in the west. It is one of the least developed in the country with high levels of extreme poverty (Taylor et al., 2015). There are cases of internal and external insecurity which hampers development initiatives.

### 1.6.1 Population and Demographics

### 1.6.2 Climate

### 1.6.3 Soils

### 1.6.4 Vegetation

### 1.6.5 Relevant cultural and ethnic issues

4

*Table 1: Population distribution*

District total population	101,079
Population Density/sq.km	61.7 compared to 123.9 National
Number of households	17,510
Total fertility Rate	7.2 compared to 5.97 national
Annual population growth rate	5.4% compared to 3.2 National

*(UNDP, 2014)*

#### **1.6.6 Livelihoods**

The district is fundamentally a pastoral zone; however, households also plant crops (mainly maize and beans) which provide food and income in good years only. Therefore, livestock are the mainstay of the local economy, providing milk, meat and income. Livestock numbers here are the highest in Karamoja and with better milk yields. Also, of importance is cross-border trade with Kenya. The Climate is semi-arid and prone to drought. The dry period is for eight months from August to March followed by sparse rainfall for four months (April to July). Due to the long dry period and lack of adequate water for livestock, the people lead a semi nomadic life style including moving to neighbouring districts for water and pasture (Taylor et al, in Amudat District Contingency Plan on Drought, 2011).

Table 2: Livelihoods, by sub-county and town council

Sub-county	Agro-ecological zone	Livelihood
Karita	Apiary Farming Livestock rearing Sand quarrying Tourism Charcoal production and fuel wood Livestock trade Lumbering	Agro-pastoral
Amudat, Loro and town council	Livestock rearing Poultry Apiary Brick laying Stone and sand quarrying Charcoal production Livestock trade	Pastoral

(UNDP,2014)

### 1.6.7 Women's livelihoods

Pokot women are considered inferior and are involved in the entire house hold work, farming, and apiary, charcoal burning, fetching wood fuel and stone quarrying for their livelihood. Men range with cattle for months in search for pasture and water. Most families are being taken care of by women since men move distances far away from home.

### 1.7 Selection of study area

Amudat and Karita sub-counties in Amudat district have been selected for study because these are the two sub-counties where ZOA International, Uganda (the commissioner in this case) implemented the small-scale irrigation project. In addition, Amudat sub-county is within the peri-urban setting, while Karita is in a rural setting; it would be interesting to compare stories, successes and challenges between the two counties.

### 1.8 Project description

The project, Bees and Horticulture, Livelihoods in Amudat aimed at improving and diversifying the livelihoods of vulnerable Pokot families in Amudat. The project focused on increasing the resilience of Pokot families to prolonged droughts and other shocks. By increasing and diversifying their sources of income their resilience can be increased. This has been done by engagement in apiculture and improving horticulture production.

The project targeted 14 groups of beekeepers, with each 20 members. Those beekeepers were trained in beekeeping and supported with equipment as well. Also, 9 reformed surgeons were targeted to start beekeeping. These women received training and equipment too. For horticulture, 9 farmer groups were targeted, with a total of 221 members. Those groups received trainings and some farmers were selected for exposure visits. 4 out of the 9 groups were selected for receiving solarized water pumps.

However, due to time constraints of the research, the researcher chose to look at the sub-component of the project that supported horticultural production.

### **1.9 Research problem**

ZOA International, Uganda implemented a two-year project in Amudat district in Karamoja, Uganda, from 2017 to 2018, entitled livelihoods in Amudat. The objective of the project was to improve long term food security and income generation amongst targeted households. It targeted 9 farmer entrepreneurial groups with a total of 221 households involved in horticulture. These groups received agricultural inputs such as small-scale irrigation kits (portable solar pumps and treadle pumps), improved seeds as well as trainings in horticulture production. The project indicators included:

1. Nine (9) entrepreneurial groups supported by the end of the project.
2. Increasing by 15% the income levels of 50% of the targeted individuals in the entrepreneurial groups;
3. Increasing by 30% household horticultural production in the targeted households amongst males and females;
4. Increasing by 40% the household income in the targeted households amongst male and female headed households in the project area;
5. Ten (10) solarized irrigation systems installed and are operational in the project area
6. Six (6) solarized irrigation systems installed and are operational by non-project farmers in the project area
7. Three (3) vulnerable farmers are using solarized irrigation systems in the project area
8. One (1) market linkage established, ideally with contract listed obligations, in the project area

*Source: (ZOA Uganda, 2018)*

Internal evaluation was conducted which found out that: nine (9) entrepreneurial groups were formed and supported by the end of the project; ten (10) solarized irrigation systems were installed and are operational in the project area, six of which are being operated by non-project farmers as well; production among targeted male and female households increased by 30 percent; there was increase of income by 15 percent of the 50 percent targeted entrepreneurial groups; one market linkage for horticultural produce has been established in the project area.

The project evaluation report presented clear inputs and activities of the project as well as clear targets. Since the project ended in 2018, objectives 1, 5, 6, 7, and 8 above were easily measurable. In the first place, it was simple to measure the number of entrepreneurial groups supported; secondly, solarised irrigation pumps installed were easily established; thirdly, the number of vulnerable farmers using the solar pumps was also simple to determine; in addition, the established market linkage was easy to determine too. However, the objective measure of household horticultural production and income (indicators; 2, 3, and 4 above) was difficult/impossible to measure. It was not easy to measure income of the beneficiaries, let alone income attributed to the SSI intervention alone. In addition, it was also not clear what changes smallholder farmers had since experienced as a result of SSI project. Because of that, it was vital to understand the perception on change of smallholder farmers utilising the small-scale irrigation system in relation to household horticultural production and income.

This research therefore focused on finding out the perception on change by smallholder households in Amudat district, Karamoja due to small-scale irrigation intervention project.

### **1.10 Research objective**

To explore changes small holder farmers are experiencing as a result of small-scale irrigation intervention in Amudat district, Uganda in order to provide recommendations to ZOA Uganda on replication strategies and upscaling of the intervention.

### **1.11 Main research question**

What changes are smallholder farmers experiencing as a result of small-scale irrigation (SSI) project in Amudat district?



### **1.12 Research sub questions**

1. What changes are smallholder farmers experiencing in household crop production and productivity?
2. What changes are smallholder farmers experiencing in terms of household income generation?
3. What changes are beneficiary households experiencing in terms of household food security?
4. What other significant changes may have utilization of small-scale irrigation brought about among participating households?
5. What might be the effect of utilising irrigation among male-headed households compared to female-headed households?

## **CHAPTER TWO: LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK**

### **2.0 Introduction**

This chapter presents relevant literature and concepts important to this study. It looks at definitions of main concepts related to SSI as well as the research questions. It further explores concepts related to the role played by small-scale irrigation in hedging weather variability; increasing food production and farm income; reducing price fluctuations; and improving food security. The following concepts will be examined: household, household income; head of household; small holder farmer; and small-scale irrigation. After examination and discussion of the concepts, a conceptual framework of the study is presented.

### **2.1 Household**

Consists of a group of two or more persons living together who make common source of food or other essentials for living. Members have a common source of major income; they share a common source of food; and they sleep under the same roof or within the same compound (Group et al., 1996). For this study, a household is composed of a group of people who are mostly relatives, sharing the same residence (homesteads), eating together, sharing activities and resources.

### **2.2 Household income**

ILO (2006) defines household income as “Household income consists of receipts in cash, in kind or in services, that are usually recurrent and regular and are received by the household or by individual members of the household at annual or at more frequent intervals. During the reference period when they are received, such receipts are potentially available for current consumption and, as a rule, do not reduce the net worth of the household.” However, for the purpose of this study, household income comprises all incomes of all people sharing a particular household earned from agribusiness related household activities and received at frequent intervals.

### **2.3 Head of the household**

According to Posel (2001), household head refers to those household members in whom more control over decision-making is vested. Posel urges that although the head is typically found to be the oldest household member, there is also a strong relationship between headship and the highest income-earner in the household. Furthermore, heads have final say over decisions even when they do not earn the most income. This is the case particularly in households headed by women.

In this research study, a household head is defined as those members of the household who have more control over decision-making; take care of other household members through providing basic needs such as food, education, and health services. They do this physically or by financing household's needs.

### **2.4 Smallholder farmers**

According to Schoenfeld et al (2013) smallholder farmers are those that produce food and non-food products on a small scale with limited external inputs, cultivating field and tree crops as well as livestock, fish and other aquatic organisms. They are characterised by marginalization, in terms of accessibility, resources, information, technology, capital and assets, but there is great variation in the degree to which each of these applies. Nakawuka et al (2018) defines smallholder farmers as farmers who carry out farming activities on pieces of land that are 2 ha or less. A more comprehensive definition is also provided in the Report of the High-Level panel of Experts on Food Security and Nutrition (HLPE, 2013), thus:

*“an agricultural holding run by a family using mostly (or only) their own labour and deriving from that work a large but variable share of its income, in kind or in cash. The family relies on its agricultural activities for at least part of the food consumed – be it through self-provision, non-monetary exchanges or market exchanges. The family members also engage in activities other than farming, locally or*

*through migration. The holding relies on family labour with limited reliance on temporary hired labour but may be engaged in labour exchanges within the neighbourhood or a wider kinship framework”.*

For the purpose of this research, the above definitions were adopted but excluding fish and other aquatic organisms.

## **2.5 Small-scale irrigation (SSI)**

The definition of irrigation is broad, encompassing all approaches to improved management of soil-water for enhanced crop production. According to Carter and Danert (2006), small-scale irrigation (SSI) refers to a wide range of approaches by which soil-water can be increased and soil-water management improved. These approaches include techniques for catching, storing and using rainfall at or near the place where it falls (usually called rainwater harvesting); diverting flowing water by gravity; using stone/earth/brushwood or concrete structures (run-of-river or spate irrigation systems); lifting water by human or motor power (lift irrigation); conveying water by canal or pipe; and applying water to land by controlled or uncontrolled flooding (gravity), overhead sprinklers (pressurised), or drip irrigation (usually at very low pressure). The description “small-scale” refers not so much to the physical size of the farm plot or the irrigation scheme or system (although these are usually small), but rather to the fact that the plots and the irrigation schemes (where a scheme is present) are managed and owned by the farmers themselves.

Balana et al (2019) defines SSI as a system practiced on small plots using a level of technology that an individual farmer can effectively control, operate and maintain. This definition was adopted for this study.

## **2.6 Small-scale irrigation in Sub-Saharan Africa**

The poorest populations in Sub-Saharan Africa live in rural areas and depend primarily on rainfed production of staple crops for their livelihoods. Yields for these crops are characteristically low and subject to weather-driven fluctuations, and production is typically limited to a 3–6-month rainy season. These present smallholder farmers with two challenges: first, households must stretch their stores of staples through the beginning of each rainy season to the next harvest (or purchase additional food, usually at higher prices); second, access to nutrients and micronutrients via home production or purchase is often significantly reduced during the dry season. (Burney and Naylor, 2012).

According to (Kay, 2001), irrigation has long been seen as an option for improving rural livelihoods by increasing crop production, but massive investments throughout the 1970s and 1980s in sub-Saharan Africa have not borne fruit. Wanyama et al (2017) notes that irrigation has attained increasing importance the world over because of the growing demand for food by a rapidly growing world population. However, food production targets have not been met, development costs are extremely high in relation to returns and there are many technical and management problems that remain unsolved (Tesfaw, 2018). Furthermore, factors such as lack of credit access, farmers’ risk behaviour, supply chain constraints have contributed to low rate or lack of adoption of new agricultural technologies in developing countries (Balana et al., 2019).

To alleviate challenges posed by irrigation decades ago, small-scale irrigation with low cost technologies constitute an option to explore. It is considered one of the options for increasing agricultural productivity and supporting development in SSA. It is characterized by the use of simple technologies to access water for irrigation (Kamwamba-Mtethiwa, Weatherhead and Knox, 2016). As indicated by Mango et al (2018) small-scale irrigation is critically important as an innovative practice in smallholder agriculture in Sub-Saharan Africa. Balana et al (2019) reveals that small-scale irrigation (SSI) technologies can be useful not only to increase crop productivity and income but also as a viable adaptation practice to climate variability. This notion is also highlighted by Tucker and Yirgu (2010), when they stated that small-scale irrigation can promote rural food security, poverty alleviation and adaptation to climate change. It enables households to generate more income, increase their resilience, and in some cases transform their livelihoods. These irrigation technologies should

however be lower cost, water-efficient to have greater potential to expand small-scale irrigation and to significantly improve food security and family income (Purcell, 1997). Irrigation is one of the key pathways for smallholder farmers to build resilience towards climate change (Schmitter et al., 2018). Literature also indicate that adoption of irrigation technologies can play an important role on poverty reduction, food and nutrition security and household income (Burney and Naylor, 2012). Irrigation can enable smallholders to engage in year-round production, increase yield and improve food and nutrition security (Balana et al., 2019) because in many rural areas of the dry tropics, households face chronic shortages of vegetables and fruits during the dry season and this has a direct effect on household's nutrition security (Smith, Alderman and Aduayom, 2006). Magen, Donovan and Kelly (2009) point out that access to irrigation could enable smallholder farmers produce high-value crops and tailor crop types and output supply in response to local demand. Studies by Burney and Naylor (2012) show that the use of small-scale irrigation technologies can help promote diversification and significantly increase returns to land and labour and reduce risk. Magen, Donovan and Kelly (2009) disclose that there is a link between irrigation interventions and positive nutritional outcome. This argument is shared by Theis et al (2018) who reveals that small-scale irrigation technologies are increasingly being promoted in an effort to improve smallholders' dietary diversity, health, seasonal food security, and resilience to climate change and weather shocks. This notion is linked to what Nakawuka et al (2018) shares that irrigation is an important tool to curb food shortages that are a recurrent problem in several communities. Irrigation also plays a major role in moving farmers from subsistence to commercial farming. She points out that small-scale irrigation expansion would significantly increase agricultural production and reduce food insecurity and poverty levels in East Africa.

## **2.7 Small-scale irrigation in Uganda**

Agriculture in Uganda is mainly rain-fed with only 1.3% of total cultivated land under irrigation (The World Bank, 2018). Therefore, the sector is very vulnerable to climate change and variability. According to World bank (2018), irrigation development in Uganda is essential for food security and agriculture transformation- it can increase agricultural productivity, manage the increasing climate risks and enable commercial cultivation in the country. However, agriculture and irrigation are performing well below their potentials. To date, a total of some 15,000 ha of public small-scale irrigation schemes (largest 600-800 ha) has been developed, mostly in the form of valley tanks and river diversion schemes. Wanyama et al (2017) urges that irrigation development in Uganda has been slow compared with other countries in the East African region like Kenya and Tanzania. He notes that the major constraints to irrigation development in Uganda are; inadequate national irrigation capacity, economic aspects of irrigation, inadequate access to water for irrigation, and unfavourable land tenure systems and management.

In recognizing the critical roles of irrigation, the government in the Vision 2040 and NDP II (2016-2020) lists irrigation investment as a high priority along with agricultural value-chain development. The goal is to transform the small-holder subsistence cultivation into modern commercial farming to increase production, productivity and farm income (NPA, 2007; GoU, 2015). The National Irrigation Policy (2017) lays out the guiding principles and general institutional arrangement for irrigation development and management, including coordinated planning, implementation, and service delivery, as well as cost recovery and beneficiary participation through water user associations (WUAs). The policy recognizes the role of farmers managing small-scale schemes and encourages a community-based irrigation management approach. The National Irrigation Master plan (MWE 2011-2035) stipulates the priority irrigation development areas and schemes over short, medium and long terms. Irrigation, also called water for agricultural production (WfAP), is a shared responsibility between the Ministry of Water and Environment (MWE) and the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). MWE takes overall responsibility for irrigation and off-farm irrigation development while MAAIF for water use and management of on-farm agricultural water facilities.

## **2.8 Small-scale irrigation in Karamoja**

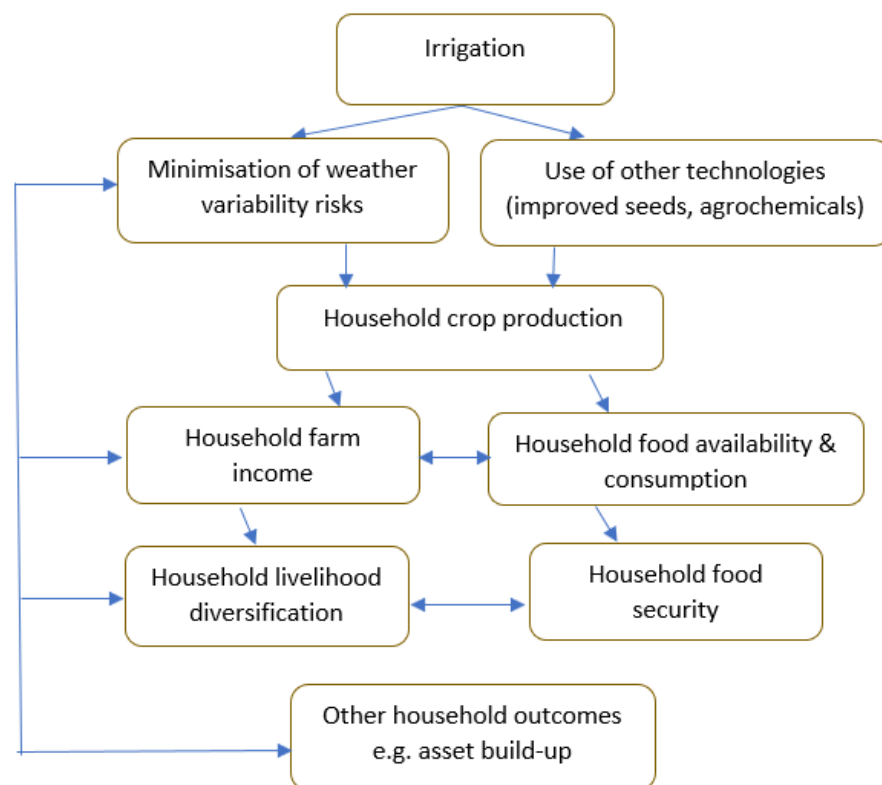
Since the rain patterns only allow one cropping season in Karamoja, it is critical to recognize the importance of increasing access to irrigation. According to Adrian Cullis (2018), a number of programmes have been and are being undertaken in the region mainly to promote food security and sustainable development. Government led development through Karamoja Integrated Disarmament and Development Programme has carried out a lot of projects including distributing small-scale irrigation kits. Government through the office of the prime minister developed a five-year plan to tackle water shortage in Karamoja region. The plan captures among others increasing the functionality of existing facilities for water for production (dams & valley tanks); promote and support water harvesting techniques (dams, river, gravity, springs, wind mills and household water storage facilities); construct small size valley tanks at parish level; and monitoring of the contamination of the water sources by pathogens and toxic substances (OPM, 2015).

There are a lot of other projects and programmes by non-governmental organisations (NGOs) in trying to address the issue of climate variability in Karamoja through micro-irrigation initiatives. These NGOs distribute small-irrigation equipment such as treadle pumps, drip irrigation kits, buckets, etc (Mitchell, 2016). In addition to distributing irrigation equipment, organisations also provide other technologies such as improved seeds, fertilisers, and agrochemicals in an attempt to improve production (Adrian Cullis, 2018).

## **2.9 Conceptual framework of the study**

To better understand the perceptions of smallholder farmers on the changes small-scale irrigation regarding their household food security and income generation, the conceptual framework in figure 2 was used for the study. From figure 2, the study focused on describing perceptions of smallholder farmers (project beneficiaries) regarding their experience about irrigation and climate & weather variability; household crop production; household farm income; household food security; and any other significant changes households perceived due to the intervention. In figure 2 below, it should be noted that household food security incorporates household food availability and consumption and therefore, treated as one concept in this study, thus captured in research sub-question number 3. Similarly, other household outcomes and household livelihood diversification is treated as one theory/impression. This concept deals with research sub-question number 4 which seeks to find out perception of small-scale farmers regarding other significant changes they have experienced due to SSI intervention.

Figure 2: Perceived benefits of SSI vis- à-vis household food security and incomes



Source: Adapted from Nonvide (2018)

## **CHAPTER THREE: METHODOLOGY**

### **3.0 Introduction**

This chapter gives an insight into how the research project was conducted. It discusses the research strategy employed, unit of analysis, sampling population sample, methods of data collection, data analysis, and the time schedule of the research project. This chapter also highlights the limitations and some ethical considerations during data collection.

### **3.1 Research strategy**

### **3.2 Case study**

This research study was limited to a case study strategy in respect to the research objective and main research question. A case study focuses on the detailed inquiry of a unit of analysis as a bounded system (the case), over time, within its context. Its designs can address a wide range of questions that ask why, what, and how of an issue and assist a researcher to explore, explain, describe, evaluate, and theorize about complex issues in context. This can lead to an in-depth understanding of behaviours, processes, practices, and relationships in context (Helena et al, 2017). Crowe et al (2011) describes a case study as “a research approach that is used to generate an in-depth, multi-faceted understanding of a complex issue in its real-life context.” This study therefore focused on real-life context or specific situation of beneficiaries of the small-scale irrigation in Amudat district in Karamoja, Uganda. It pursued a more detailed understanding of respondents’ perspectives about improvements households (beneficiaries) have experienced as a result of small-scale irrigation project, in terms of household food security and income generation. The study therefore sought to describe extensively the opinions, experiences, attitudes and behaviour of beneficiaries in relation to SSI intervention.

The research employed more of qualitative approach. Qualitative research according to Golafshani (2003) is “a naturalistic approach that seeks to understand phenomena in context-specific settings, such as “real world setting where the researcher does not attempt to manipulate the phenomenon of interest.” He stresses that “it is any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification and instead, the kind of research that produces findings arrived from real-world settings where the ‘phenomenon of interest unfold naturally.’”

The qualitative approach therefore assisted the researcher in unveiling data such as description of community; household activities vis-à-vis horticulture production; how irrigation is being utilised by households; perceived changes in food security and income generation due to SSI intervention; the effect of utilising irrigation among male-headed households compared to female-headed households. In addition, background information for households selected for interviews was also gathered. These included; the sex of the household head, marital status of household head, education level of household head, number of members of the household, household total cultivated land area, and household total irrigated area. This background information constituted some quantitative data.

### **3.3 Unit of analysis**

The study considered a household as the unit of analysis. During data collection at household level, the household head was interviewed. In the case where the head was not available, another informed member of the household was interviewed. These respondents responded on behalf of the entire household. During data collection exercise, female house heads as beneficiaries of the SSI intervention were not necessarily females without husbands as I had earlier on thought. Apart from a few who are widows, it also included those whose husbands are polygamous and these husbands don’t always stay in their homes since they have other wives. In this case these women manage almost all the affairs of the household.

During the FGDs, responses from participants represented their households. The views from key informants represented particularly the beneficiaries of the SSI intervention, but generally the

population where the intervention took place. The study explored respondents' perspectives of changes realised as a result of SSI at household level.

It must be noted that during one of the FGDs, a project staff for ZOA was present and his presence might have influenced participants' discussions. However, participants were encouraged to speak as there was no implication whatsoever from the organisation to what was being said. Additionally, previously talking about disarmament in Karamoja was a sensitive issue and the researcher had his reservations. However, participants were more willing to talk about it, so it made the researcher feel free to ask more questions about it.

### 3.4 Population sample

The project targeted nine (9) groups with a total of 221 households; 155 female-headed and 66 male-headed. These households constituted the population size of the study. In qualitative research, a smaller number was needed compared to quantitative research because the aim was not to generalise information, but to gather an extensive understanding of a social phenomenon (O'Leary, 2013). A small number of respondents with similar characteristics that were relevant to the research topic was essential (Laws et al 2013). In this research, a sample of more than 10% was used, which was expected to offer an extensive understanding of the opinions and experiences of irrigating farmers in Amudat district. For this study therefore, a total of 30 respondents were selected in a systematic way. A list of farmers who benefited from the SSI project was obtained from ZOA office, and names of males and females rewritten. From these separate lists, every nth member was selected for household interview. From the written lists, 15 male-headed and 15 female-headed households selected. A ratio of 1:1 of respondents for male and female headed households was used. This choice was made so as to compare the effect of utilising irrigation among male-headed households and female-headed households, therefore answering research sub question five. Meanwhile for the Focus Group Discussions, two groups of 7 and 8 members respectively were purposively selected to take part in the discussions. The invitation was initially made for 8-10 participants. One group was in Amudat sub-county and the other was in Karita sub-county. In Amudat sub-county, more men than women attended the focus group discussion and it was the reverse in Karita sub-county as shown in table 3.

*Table 3: Focus Group Discussion attendance*

Location	Male	Female	Total
Amudat S/C	5	2	7
Karita S/C	3	5	8
<b>Total</b>	<b>8</b>	<b>7</b>	<b>15</b>

Source: *Field data, Amudat, Uganda (August 2019)*

The invited women in Amudat sub-county did not come for the FGD because they were preoccupied with other household activities, for example one woman had taken the sick child to the health centre. On the other hand, invited men in Karita sub-county were absent because they had taken cattle for grazing. Two group leaders took part in the discussions, and it is noted that in one of the FGDs, the leader was encouraging participants to speak more. He was quoted to have said, "you talk everything you know, because when I talk, they will say it came from the leader." On the other hand, the leader was more dominant during FGD in karita sub-county, but the facilitation gave room and encouraged the other participants to have their views expressed.

Five key informants were selected for interview. The key informants included project staff (Project Officer/Agriculture); two Sub-County Agricultural Officers (one for each sub-county); and one Local Council I chairperson (in areas where the project was implemented). Initially some group leaders were planned to be key informants, but since they participated in the FGD, it was not necessary to again



include them as key informants. The key informants provided data on a general overview of how SSI intervention has influenced household food security and income generation amongst beneficiaries and community at large. They also provided data on other changes the utilisation of SSI has brought among participating households, thus answering research sub-question four.

### **3.5 Methods of data collection**

In this research, both primary and secondary data were used. Secondary data formed part of the scoping and desk study exercise. Literature on previous studies was used to conceptualize and give theoretical understanding of main concepts in the study as well as gaining different perspectives from previous researchers. Secondary data collection also involved a review of project documents such as baseline reports, project proposal, final report, evaluation report, training manuals and field reports. This was to review whether the irrigation equipment was fully installed; status of household horticultural production and income at baseline and evaluation period. It provided some insight on the state at which beneficiaries were in terms of household food security, income generation, and other effects that the project has had on beneficiaries through using small-scale irrigation system. For primary data, semi-structured interviews using a checklist of open-ended questions, key informant interviews, household interview and Focus Group Discussion were used. During pre-testing of the data collection tools, irrelevant questions were removed and replaced. Some interview questions that were similar and could draw similar answers were also deleted. Sub-questions were also adjusted to depict perspective of smallholder farmers using SSI from the sub-question that were more of factual/objective.

Using household interview, data regarding perceived changes/improvements in household food security situation; household income generation; other significant changes households are experiencing due to utilisation of irrigation, and how irrigation has affected female-headed households compared to male-headed households was collected. These data therefore answered sub-questions 1, 2, 3, 4 and 5. The FGD was used to triangulate and supplement data collected from household interviews. The FGD contributed and supplemented data that answered research sub-questions 1, 2, 3, 4, and 5. Key informant interviews were used to gather data on a general overview of how SSI intervention has influenced household food security and income generation amongst beneficiaries and community at large; household crop production changes; and the effect SSI has had on female-headed compared to male-headed households. This information answered sub-questions 1, 2, 3 and 5. The key informants included project staff (Project Officer/Agriculture); two Sub-County Agricultural Officers (one for each sub-county); and one Local Council I chairperson (in areas where the project was implemented). In addition, participatory observation was applied to find out if the irrigation systems were fully installed and operational and practices farmers use in the vegetable fields.

### **3.6 Data analysis**

The process of data analysis started right away in the field during data collection in which summaries of every interview was done to capture key points or aspects which were interesting. Stimulating statements of respondents were quoted and recorded on a daily basis (see appendix 8 for an example). Primary data was recorded using note book for the responses from household semi-structured interviews, key informant and focus group discussions. Phone recorder was also used, and pictures were taken (see annex 10).

For each research sub-question, data was sorted, arranged and developed into themes of sub-questions for household questionnaires, FGDs and key informants' responses. For research sub-question one, household interview responses about perceived changes by individual households regarding production and productivity was grouped together and assessed on how irrigation has contributed to improvements in household horticultural production and productivity; its contribution to food availability, accessibility and stability. The FGD, key informants and observation were used to

triangulate data from household interview, but also household activities and constraints faced by irrigating households were described. Research sub-question two which assesses changes in terms of income generation, responses from household interview and FGD as well as key informants comprised data on improvements regarding household income generation as a result of small-scale irrigation project. For sub-question three (other changes households are experiencing due to utilisation of small-irrigation), were used to narrate any other significant outcomes the utilisation of irrigation has brought on participating households using household interview responses, FGD as well as the key informant. Data for sub-question four (the effect of utilising irrigation among male-headed households compared to female-headed households) were analysed using data from household interviews and FGD to describe differences in outcomes between female and male-headed households utilising irrigation. Demographic characteristics data such as sex, age, marital status, etc were presented in tables and analysed using excel spread sheet.

### **3.7 Limitations of the study**

The research was conducted with the help of the interpreters. Two interpreters (one for each sub-county) were engaged to help in collecting data for the focus group discussions and household interviews. These interpreters were not professional but had completed secondary school education. The use of interpreters was required since the researcher was unable to speak the Pokot and Kiswahili languages commonly used in the research area. The interviewers were briefed about the entire process of data collection. However, loss of research data could have happened since there is a chance of misinterpretation or mistranslation. To minimise this chance, the researcher had to probe in case he felt that the response from the interviewee was not satisfactory.

Secondly, since it was a busy period with a lot of agricultural and market activities in the area, some of the people were either in their gardens or travelled to the market, it was difficult to find those who were selected to participate in the research at home. To overcome this problem, the researcher had to reschedule to interview those respondents that were missed earlier.

A chance of respondents giving false information could not be ruled out with the possible thinking that the data from the researcher was going to be shared with ZOA (the commissioner). This could have been in a way to please ZOA (project implementers) such that more of the support keeps coming. However, to minimise this, the researcher introduced himself as a student and emphasised that responses that interviewees gave were purely for research and could not in any way influence ZOA's association with its beneficiaries.

### **3.8 Ethical considerations**

Proper channels of entry to the community were observed. ZOA project staff guided the researcher on the best approach to gain entry into the respondents. The researcher was introduced to local council chairpersons of the community as a student researcher. While in the field, the researcher highlighted the purpose of the research as purely academic to guard against deeming it as precursor to gain government or NGO support. At every meeting with respondents, he also identified himself as a student researcher. Furthermore, consent for participation from respondents was sought and respondents clearly told that any issues they felt uncomfortable to answer were respected. It is important to note that the researcher prepared a written consent form, but it was not used, instead verbal consent was given at every interview and discussions. Additionally, names of respondents even when captured were not used for this research.

### **3.9 Time schedule of the research project**

This study was undertaken starting from the end of June 2019 and completed at the end of September 2019 (see appendix 1).

## CHAPTER FOUR: RESEARCH FINDINGS

### 4.0 Introduction

This chapter presents findings of the research study. The findings are structured in line with the research sub-questions. They are based on the responses from household interviews, focus group discussions and key informants' interviews. The results give a picture of how beneficiaries of the SSI project perceive changes that they have experienced due to the intervention. It highlights the general information and characteristics of the respondents. The chapter discusses perceived changes that smallholder farmers have experienced in household crop production and productivity as well as household income generation due to utilisation of irrigation. It further discusses perceived changes in household food security due to small-scale irrigation and other changes the utilisation of small-scale irrigation is said to have brought about among participating households as well as some effects of utilisation of small-scale irrigation has had among male-headed households compared to female-headed households.

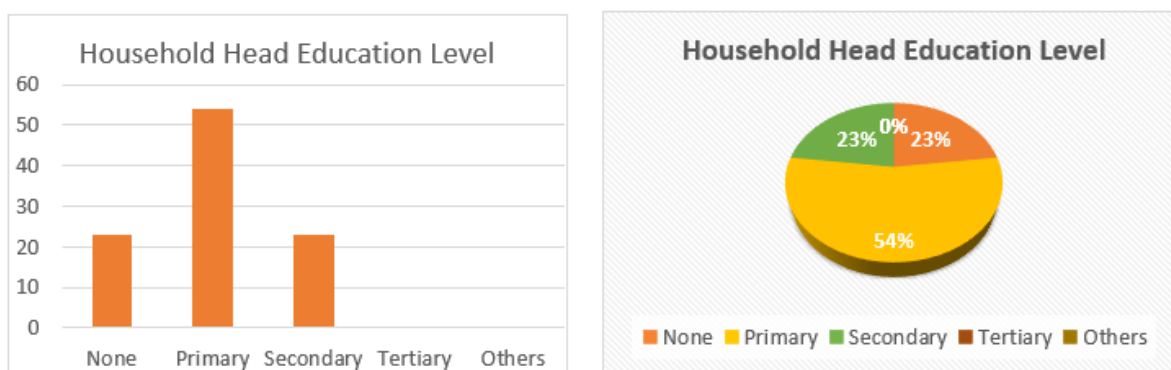
### 4.1 The respondents

The respondents constituted the Household members that belonged to the groups that benefited from the small-scale irrigation project. For household interviews, there were 30 households interviewed, but in the households, there were 19 female respondents; 9 male respondents and there were 2 households where both male and female answered the interviews together.

The average age of the household heads was 42 years. The households that were interviewed had an average of 7 members. The average total cultivated area of participating HHs was 2 acres; while the average total irrigated area was 0.5 acres (see appendix 7).

Figure 3 and table 4 respectively show the education level and marital status of the household heads:

Figure 3: Education level of HH heads



Source: Field data, Amudat, Uganda (August, 2019)

Table 4: Marital status of HH heads

Marital status	Number	Percentage
Single	0	0
Married	26	87
Divorced	0	0
Widowed	4	13
Total	30	100

Source: Field data, Amudat, Uganda (August, 2019)

From figure 3, 54 percent of the respondents had attained at least primary education, while 23 percent had attained at least secondary education. Meanwhile 23 percent had not attained any level of formal education. However, it was difficult to directly link education status to households joining groups and their participation in and benefits from the small-scale irrigation project.

Table 4 shows that 87 percent of HH heads were married, while 13 percent were widowed. There were no household heads that were single or even divorced.

#### 4.2 Crop production and productivity

This section addresses the research sub-question: “What changes are smallholder farmers experiencing in household crop production and productivity?” Data collection tools used to answer this research sub-question were household interviews, focus group discussion and key informant interviews. The section discusses a summary of responses of household interviews and focus group discussions as well as key informant interviews.

The main crops grown in Amudat district are maize and beans. More than 75 percent of the HHI respondents indicated that they grow maize and beans. However, other crops like ground nuts, sorghum, and green gram are being grown by a few farmers. There were 7 percent that said they grow green gram; 10 percent, ground nuts; and 17 percent grew sorghum. Vegetable growing is now being integrated into farming activities since the small-scale irrigation project was introduced in the two sub-counties. All HHI respondents said they grow at least some type of vegetables. According to the key informant, perennial crops such as cassava are not preferred in Amudat because the people like to grow faster maturing crops due to short rainfall periods. In addition, sorghum is not widely grown in the district because of wild birds which is a major pest. Table 6 presents the crops grown in the study area.

Table 5: Main crops grown in Amudat

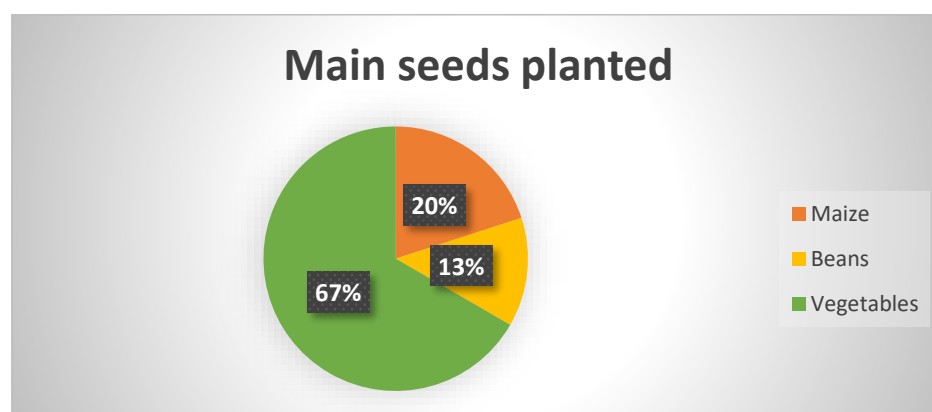
Crop	No.	Percentage
Maize	27	90
Beans	19	63
Green gram	2	7
Ground nuts	3	10
Sorghum	5	17
Vegetables	30	100

Source: Field data, Amudat, Uganda (August 2019)

According to respondents, their vegetable production levels are now better-off due to inputs and tools they received from ZOA. In order to increase smallholder farmers’ production and productivity, ZOA distributed farm inputs to households organized in groups. The households received hand tools, vegetable seeds, and small-scale irrigation equipment. *I received many things from ZOA; treadle pump, hoe, solar pump, panga, watering can, bucket, and of course vegetable seeds. Now I can produce vegetables all year round. I plant three times in a year. For Sukuma wiki (Kale), I plant once,*

*but harvest many times so long as I continue watering them. Life is now better for us* (household interview – Karita sub-county, August 2019). At the same time, most of the respondents prefer vegetable seeds because they said it is easy to irrigate vegetables. This was ranked highest during the FGDs both in Amudat and Karita sub-counties; followed by maize and then beans as shown in figure 4. *We prefer vegetables seeds because they are easy to irrigate, they don't require a lot of water and even children can irrigate* (FGD – Amudat sub-county, August 2019).

Figure 4: Main seed planted in Amudat



Field data, Amudat, Uganda (August 2019)

Crop production output according to research participants, has also improved compared to three years ago before the small-scale irrigation project. Before the project, crop production was very low, resulting into little or no harvest at all. Farmers used to plant one season in a year. As a matter of fact, many respondents reported that crop production levels have greatly improved with the introduction of the irrigation project. Some respondents reported that they now plant two to three times in a year. *Before this ZOA project, production was very low, sometimes even losses, no rains. We only used to cultivate one season. But now we can plant and get food especially vegetables, we can't miss on them. Other crops like beans and maize are also irrigated and the harvest has improved.* (focus group discussion – Karita sub-county, August 2019). The key informant from Amudat sub-county reported that more men are now engaged in crop production activities compared to three years ago. Men's main activity was to look after livestock, but now more of them have started to grow crops as well. *'Initially crop production was left for women alone, now men have started to join.'*

*Growing of crops has now become a livelihood. Rainfall is erratic here, but they even supply during dry season* (KI interview – Amudat sub-county, August 2019).

All the research respondents mentioned that labour for agriculture is shared by all household members. Agricultural activities include land clearing, fencing, planting, weeding, watering, harvesting, and selling. However, land clearing is mostly done by the men although women also do it. Similarly, selling of agricultural products is done by mostly men, especially maize and beans. On the other hand, vegetable selling is mostly done by women. Weeding and harvesting is also mostly performed by the women. Other activities like planting, watering, and weeding are also performed by mostly women. Children help in some of the activities such as planting, weeding, watering and harvesting. Children normally do their activities in the evenings after coming back from schools and during weekends.

#### 4.3 Household income generation

This sub-chapter responds to the research sub-question: "What changes are smallholder farmers experiencing in terms of household income generation?" To answer this research sub-question, household interviews, focus group discussions and key informant interview data collection tools were

used. This sub-section therefore comprises a summary of responses from the above category of respondents.

Most of the research respondents said, before the small-scale irrigation project, households depended on unsustainable activities to generate income. Such activities ranged from charcoal production, selling firewood, to cattle rustling. Many households however, depended on livestock as a main source of income as well as growing of maize and beans. Some hired out labour in order to earn some income while others engaged in 'aloe Vera business' where they could squeeze aloe Vera juice, pack it in containers and take to town to sell. *Living a life was hard for me, I used to burn charcoal if I wanted to send a child to school or buy some food* (Household interview – Amudat sub-county, August 2019). *Households used to gamble with maize and beans. Majority relying on livestock. Others on firewood sale, charcoal processing, hiring labour out* (Key informant interview Amudat sub-county, August 2019) On the other hand, since the project started, households now earn money from growing and selling vegetables. They earn between (Ugx 150,000 – 1,000,000) per annum. They can now afford other foods that they don't produce like meat, cooking oil, and rice. Money earned from vegetable sale is used to pay school fees for children in primary and secondary school, buy household items like mattresses, clothes, shoes, bicycles, etc. The money is also reinvested in vegetable growing through buying seeds, pesticides and hiring labour. They have also been able to buy livestock like cattle, goats, sheep and chicken. Besides irrigating households can now be able to save money in community social groups, also known as Village Saving and Loan Associations (VSLAs), thereby increasing their social capital as well. Never the less, ability of households to make more money depends on availability and access to markets. Farmer groups who have means to transport(tricycle) have more and cheaper access to markets than those who don't. Some households have started businesses through borrowing from these VSLAs, for example women living near town borrow to start businesses such as food eating joints and clothes selling. These eating joints are set up in market places and towns/trading centres. While men borrow to start livestock trading business where they sell livestock within Amudat and across neighbouring Kenya markets. *'We now rear more animals, cultivate vegetables for sale. Even during dry season, we still plant, there is now business even during dry season. If you don't have a garden, you can hire one.'* *'.....We now have savings in our groups, we educate our children in secondary schools.'* (focus group discussion Karita sub county, August 2019).

It is important to note that all households reported that vegetables are sold for cash only. They either sell at farm gate or take their vegetables to the nearest market. Households not only depend on on-farm activities to earn income, some are engaged in off-farm activities like boda-boda riding (means of public transportation), motor cycle repair, selling motor cycle spare parts and tailoring.

#### **4.4 Household food security**

This sub-chapter addresses the research sub-question: "What changes are beneficiary households experiencing in terms of household food security?" To answer the research sub-question, the following data collection tools were used: household interviews, focus group discussions and key informant interviews. This sub sector includes a summary of responses from the above categories of respondents.

All the respondents stated that the food security situation of Amudat and Karita sub-counties was so bad three years ago. The people used to depend mainly on livestock as a source of food. The main food crops available were maize and beans which were in insufficient quantities. Drought is a major factor in the sub-region which sometimes results into total crop losses and reduces the productivity of livestock. Many of the households used to eat only one meal a day with a few affording two meals. Vegetable production was not a known agricultural activity among farmers. The only planted vegetable was cowpeas and the rest were wild vegetables. *There was food in houses, but only local vegetables (cowpeas) and maize, but not even much. The people used to rely on supplies from Mbale and Kapchorwa for vegetables* (key informant interview – Karita sub-county, August 2019).

*People used to depend on livestock and maize and beans. Now they depend on vegetables and beans (key informant interview – Amudat sub-county, August 2019).*

*Before there was a lot of hunger. Rain could come late, and people suffer, and the crops were destroyed by sun (FGD – Amudat sub-county, August 2019).*

*The situation was very bad. Eating was only once a day. Children used to eat at school (wfp food aid). Elders could drink a cup of water then sleep (FGD – Karita sub-county, August 2019).*

*‘We used to suffer a lot, there was little we could do to get food. We used to do aloe Vera business (squeeze aloe Vera juice for sale).’ ‘.....If you want school fees for example, you had to produce charcoal. ‘We used to do cattle raiding (rustling) for survival. People could steal neighbours’ chicken and slaughter for food, even if he/she is caught, he/she will say its hunger sending me! (FGD – Amudat sub-county, August 2019).*

*We were eating once in a day or twice, breakfast and supper (HH interview – Amudat sub-county, August 2019)*

*There was only one source of food (beans and maize). When it got finished, you had to look for other ways (HH interview – Karita sub-county, August 2019).*

After the introduction of the small-scale irrigation project, the household food security situation, according to all respondents, has since improved. Households now have 2 to 3 meals a day compared to when they used to have one or no meal at all three or four years ago. Households eat a balanced diet (meat, beans, meat, milk, variety of vegetables – tomatoes, kale, onions eggplant, carrots, water melon, okra, cabbage, green pepper, etc). *...now days, things have changed, I come from the garden, pick some vegetables, cook for my children.... they used to cry for hunger, but now.... (HHI – Karita sub-county, August 2019).*

*We have benefited a lot from this irrigation project. Before we used to have a few cattle and goats, but now we have many. Now we stay in the gardens instead of thinking of raiding. Women don’t depend on their husbands any more for food. They can sell their vegetables and buy soap, salt, and sugar (FGD – Amudat sub-county, August 2019).*

*We now have a balanced diet. Before we used to eat only posho and beans, plus milk. But now we take tea, eat all greens (onions, kale, tomatoes, cooking oil. We even buy meat from town and whatever you wish to, you buy. Even when maize is not ready in the garden, we buy food from the market (FGD – Karita sub-county, August 2019).*

*Now farmers are getting vegetables within here, we can now have fresh vegetables and as consumers, we have benefited from fresh supplies. As farmers, they have benefited from money. Farmers can now buy bulls. Farmers make money (KI interview – Amudat sub-county, August 2019).*

Although it may be true that SSI intervention is said to have improved the livelihoods of irrigating households, there are other factors associated with these improvements among households in Amudat district. These include the disarmament of the Karamojong by the government of Uganda, support from various NGOs in the district and Karamoja in general, improvement of the road network connecting people to markets. *When disarmament was done, people cooled down and NGOs started operating freely. Now the mothers can carry food to town without any worry. (FGD – Amudat sub-county, August 2019).*

*Development partners are also engaged, reaching out to people and giving civic education (KI interview – Amudat sub-county, August 2019).*

*Markets are also available, government has tried to work on the roads connecting farmers to markets in Amudat town and Kenya (Konyao, Kalapat, Orolwo, and Kacheliba markets). (KI interview – Karita sub-county, August 2019).*

However, some of these roads become so bad and difficult to use during rainy season. A key informant commented that access to markets becomes a challenge when there are too much rains.

#### **4.5 Other changes realised**

This sub chapter responds to the research sub-question: “What other significant changes may have utilization of small-scale irrigation brought about among participating households?” Questions were also asked about who has been affected by the SSI intervention; relevance of the inputs distributed by the project; functionality of groups; challenges faced by irrigating households; and suggestions for improvement. Data collection tools used to answer this research sub-question were household interviews, focus group discussion and key informant interviews. The section explores responses from all these groups of respondents.

Over 90 percent of the respondents expressed that they have gained knowledge and skills in vegetable production, including maintenance of the irrigation equipment. They have also gained knowledge on vegetable preparation (cooking) and balancing their diet. Knowledge and skills were also acquired through participating in exposure visits, trade shows and field days. Additionally, households have accumulated physical and other assets from the sale of vegetables and related businesses. *‘The greatest benefit is that when we sell our vegetables, we can buy goats, chicken, and cows. We can now dress our children, buy mattresses and many household items.’ ‘Before the project, we didn’t know anything: how to plant, manage in garden, harvest, spray, weeding, prune, etc’ (FGD Amudat sub-county, August 2019).*

*‘We have also been trained and have gained skills and knowledge that has prospered us. Our children now are attending school, eat well, dress well, we even now teach other people.’ ‘.... people didn’t have knowledge of balance diet. We now know how to grow vegetables (Sukuma, green paper, onions, cabbages, tomatoes). We know that these foods can help our children with balance diet. You can now feed children with different food. they are now healthy, smart, not diseased, environment is smart’ (FGD Karita sub-county, August 2019).*

*‘I never used to know how to prepare (cook) vegetables, learned from sellers and a few women that knew how.’ ‘I now know how to prepare the nursery bed, land preparation, transplanting, spacing, spraying, weed control, irrigating...’ (HHI Karita sub-county, August 2019).*

As much as 28 out 30 HHI respondents mentioned that they had received training in horticultural training, 17 out of 30 HHI of them said they did not receive training on how to maintain irrigation equipment. From the observation of the researcher, this explains why some irrigation systems were malfunctional (see appendix 10).

Not only has utilization of SSI and vegetable growing caused positive changes among participating households, it has also impacted on the community. Respondents conceded that more people have got interested in the irrigation activities and non-groups members are now learning from the members. The environment is also being preserved, given that community has alternative ways of livelihood, therefore minimising cutting down trees for charcoal production and firewood for sale. There is more access to affordable vegetables because it is being produced within the district and does not come all the way from Mbale or Kapcwora anymore. *People access vegetables, prices have dropped. Other non-groups members are also learning from group members (KI interview – Karita sub-county, August 2019).*

*There is a multiplier effect, other HHs have copied the intervention. Our work is to give technical backstopping. Some non-group members now hire irrigation equipment from groups (KI interview – Amudat, August 2019).*



*'Our trees are safe now, there is no more cutting down of trees for charcoal.' 'We have turned our grass thatched houses to iron sheets....' Food was difficult to get, we used to buy food at high prices.....' people have got knowledge and skills of irrigation, there is sustainability, even if ZOA leaves us.'* (FGD – Karita sub-county, August 2019).

From observation and probing, some of the households were/are beneficiaries of environmental management interventions by other NGOs and/or government.

According to respondents, as a consequence of the small-scale irrigation project, the effect has been realised by mostly the direct beneficiaries, but also the communities where the intervention is found. In addition, they said the inputs and tools distributed by ZOA were relevant because they could be applied in their situation and communities. However, some said that treadle pumps were tedious to use while others said solar motorised pumps were not sustainable because when it breaks down, they cannot repair them. On functionality of the groups, 26 out of 30 household respondents said their groups were still functional and active. Even so, some respondents reported that some members had abandoned/left the groups. On the contrary, 4 out of 30 household respondents said their groups were no longer functional. From key informant interview, it was reported that, out of the nine groups formed for the SSI, 7 were functional and active. In the sub-county of Amudat, 4/5 groups were functional. When asked about why some members left/abandoned the group and why some groups failed to work, the responses from household interviews reported that some people became ill and abandoned working in the group, others went away a long distance looking after cattle, while others got too busy and could not find time for group activities. The focus group discussions on the other hand said that those members dropped out because they were interested in immediate benefits, wanted handouts, and some were just lazy. Key informants on the other hand said it was because the selection of beneficiaries was not done well; some people were not interested in agriculture, follow up was lacking since the groups were handed over to government, the groups needed material support.

*I left group work because I fell so ill, to the point of death, I could not continue with group activities.* (HHI Amudat sub-county, August 2019).

*Some members dropped out of the groups because they were interested in immediate benefits, when they failed to see, they left us, they were not patient.* (FGD Karita sub-county, August 2019).

*Some other members were just lazy, they could not meet the expectations of the group.* (FGD Amudat sub-county, August 2019).

*During formation, groups did not have a common goal, so some others leave along the way* (KI interview – Amudat sub-county, August 2019).

### **Challenges faced by the irrigators**

The following were put across as the main challenges that the beneficiaries of the small-scale irrigation project are facing:

For irrigation to be effective, there must be sufficient availability of water. 11 of the 30 household interviews said they didn't have enough water for irrigation. Some were located far away from the river, others could only access seasonal rivers, while others relied on small ground water catchment areas, others depended on borehole water which they said was salty water and not good for irrigation. This sentiment of seasonal water sources and salty water was also shared by one key informant.

Climate change issue. According to the key informant, there was intense drought which at times dried even the rivers where irrigators harvest water from. Flush floods were common causing crop destruction, these demoralise farmers. A focus groups discussion in Amudat sub-county also mentioned drought as a challenge for irrigation activities.

Use of treadle pumps is labour intensive and in away has caused some farmers to drop off the groups. This challenge was cited by most HHI respondents and was also highlighted by 4/5 key informants.

As revealed by 9/30 respondents, the use of solar powered pumps is also challenging in that solar pumps work well when the sun light is intense, and yet plants need to be irrigated either in the early morning hours or late in the evening. At times, all members need to work at the same time, but the solar is not able to support/help all of them at the same time. This issue was also stated by 2/5 key informants' respondents.

According to 16 of the 30 HHI respondents, pest management is another serious challenge. Farmers struggle with this issue. In addition, pesticides and fungicides are located too far away to either Mbale or Kenya, hence too costly to buy. This sentiment was strongly shared by key informant.

Transport to the market according to 7 of 30 HHI was another challenge groups experience. It is costly to transport their vegetables and produce to the market for lack of transport means. However, 11 out of 30 HHI said that they had a tricycle donated by ZOA to help them move their produce to markets. 3/30 of the HHI mentioned that they hire tricycles from other groups to transport their produce from garden to the collecting store and to the market. On the other hand, 1/5 key informants said transport is normally a challenge for farmers.

### **Suggestions for improvement**

The following as proposed by respondent are suggestions for improvement of the SSI activities:

Providing water tank to harvest water such that this water can be used at all times of the day.

More support for solar pumps for groups that only use treadle pumps so as to reduce on labour intensity especially by women irrigators and provision of generators to be able to pump water even when the sun is not intense.

Training on pesticide control. These trainings should be spread to capture all group members. ZOA is reported to have only trained one or two members in the group.

Establishing model farmers/contact farmers so that other farmers can learn from them. These can be learning centres where interested farmers can learn from.

Concentrate the irrigation schemes for effectiveness instead of establishing them everywhere, they will not be effective

Expand on the project and establish a big water supply to cover large areas/acreage

Devising a technology that can reserve power to be used later so that water can be pumped even during morning or evening hours.

More exposure visits as these is one of the effective ways of learning. Members should be taken for these visits as groups, not only one person selected to represent the group.

Famer field school approach could be effective in pest and disease management.

Linking farmers to agro-input dealers at subsidised prices

### **4.6 Comparing the effect (outcome) of SSI project between male and female headed households**

This sub-chapter addresses the following research question: "What might be the effect of utilising irrigation among male-headed households compared to female-headed households?" To answer this research sub-question, focus group discussions and key informant interview data collection tools were used. This sub-section therefore includes a summary of responses from the above category of respondents.

The respondents reported that there are differences in outcome of utilising irrigation between male and female headed households. To them, women have limited time for irrigation activities because of women's triple role. Hence force, more than three quarters of the focus group discussions both in Amudat and Karita sub-counties agreed to this. All the key informants interviewed pointed out that the irrigation project negatively affected female headed households compared to male headed households. At the same time, less than three quarters of the focus group discussions in both sub-counties agreed that there are differences in effect, but only negligible. *'Women have short time for garden work as compared to men. Their time is spent in cooking washing utensils, sweeping the compared, fetching water, prepare tea for garden work.'* *'Treadle pump requires more energy to utilize, so women get tired faster compared to men.'* *'it's difficult to do other activities because the garden work requires a lot of time.'* *'For women without husbands, it's very difficult to do work because when you fall sick, then nobody works on your behalf. Some men/women can send their spouses to work in the group when there is some problem.'* (FGD – Karita sub-county, August 2019).

*'You are supposed to be in church, school, but the garden needs you, as one person it's difficult.'* *'There is a difference because she is single. Other households work together. Labour is short/limited.'* (FGD – Amudat sub-county, August 2019).

*'.... Only that the treadle pumps are tedious, it affects women negatively'* (KI interview – Karita sub-county, August 2019).

*'Treadle pumps were labour intensive and caused some farmers to drop off, especially female headed households.'* (KI interview – Amudat sub-county – August 2019).

## **CHAPTER FIVE: DISCUSSION**

### **5.0 Introduction**

This chapter presents analysis and discussion of the key findings of the study. The discussions compare the study findings with literature reviewed in the previous chapters of this report. It discusses household crop production, productivity and food security of irrigating households; household income generation of irrigating households; other changes irrigating households have experienced due to SSI intervention; outcomes of SSI intervention between male and female headed households; and challenges of irrigation.

### **5.1 Household crop production, productivity and food security**

From the study findings, it is clear that small-scale irrigation has significant importance in increasing household crop production, productivity and food security. This is true of especially high value crops and horticultural crops. All respondents indicated that crop production and yields had improved from the time the small-scale irrigation was introduced. I realised this from my own observation as I noticed fresh food stuffs available in rural markets, both women and men seen harvesting vegetables for both home consumption and market (see appendix 10). These findings are consistent with various literature. For example, Kamwamba, Weatherhead and Knox (2016) state that farmers with access to affordable irrigation can achieve high yields and greater income than farmers relying on rainfall. Moreover, irrigation also enables famers to produce more grain and fodder for their families and livestock in areas where households engage in subsistence agriculture. Maphosa et al., (2014) indicates that food insecurity can be addressed through the use of small-scale irrigation as it enables households to grow more food at shorter intervals than they would under rain fed agriculture. Equally important is that small-scale irrigation is an important tool to decrease food shortages by increasing production and reducing food insecurity and poverty that are a recurrent problem in several communities (Nakawuku et al, 2018). Small-scale irrigation in the same token improves smallholders' dietary, health, seasonal food security, in addition to building resilience to climate change and weather shocks (Theis et al, 2018). Domènech (2015) also adds that "Irrigation can also be very important to boost vegetable production and consumption." Moreover, Irrigation interventions can improve nutritional outcomes by increasing productivity and availability of food supplies and improved diets. In my own opinion, the irrigating households in Amudat are moving towards achieving this if water access and other challenges are properly addressed.

### **5.2 Household income generation**

The study results showed that small scale irrigation schemes when well implemented increases farm income of households. From the research study, all the respondents indicated that the farm income of households had significantly increased. These farm incomes are translated into other household items such as food stuffs, clothes, shoes, mattresses; as well as important household assets like livestock (goats, sheep, cattle), bicycles, motorcycles, and constructing iron-roofed houses. Some of these household assets were observable during household interviews. This implies that the household assets accrued by irrigating households will be significant for household resilience to food insecurity vulnerability as they can be used as coping strategies during periods of food shortages. These findings agree with other studies. For example, small-scale irrigation is an important source of income for smallholder farmers since the systems are frequently used to grow vegetables, fruits and other cash crops that are usually marketable and highly profitable (Domènech, 2015a). Tucker and Yirgu (2010) also note that small-scale irrigation enables households to generate more income, increase their resilience, and in some cases transform their livelihoods. Wichelns (2014) argues that because of small-scale irrigation, households get higher yields and higher incomes. This enhances irrigating households' ability to pay for food.

### **5.3 Other changes irrigating households have experienced**

#### **5.3.0 Knowledge and skills**

The study further revealed that training, education and sensitisation are key to successful uptake of irrigation and agricultural practices by the project beneficiaries of small-scale irrigation. This was acknowledged by 28 out of 30 respondents who disclosed that they received training and guidance from the project staff during the implementation course of the SSI project. Knowledge and skills were further acquired through support participation in exposure visits, trade shows and field days. This is in line with the Uganda's ministry of agriculture, animal industry and fisheries (MAAIF) agricultural extension policy of promoting application of appropriate information, knowledge, and technological innovations for commercialisation of agriculture (MAAIF, 2016). I realised that in much as respondents mentioned that they received trainings, much of it was on agronomic practices, as 57 percent of them said they did not get any training on maintenance of irrigation equipment. Such trainings are only offered to few selected members of the groups with expectation that knowledge and skills are transferred to members. Through probing, I discovered that those members that were taken for knowledge and skills training are reluctant to transfer the knowledge and skills in order to realise the trickledown effect. A follow up on this is needed to ensure that right participants for these trainings are identified so that the objective of knowledge transfer down to the rest of the group members is realised.

#### **5.3.1 Adaptation to climate and weather variability**

Additionally, the research study suggested that small-scale irrigation increases smallholder farmers' adaptation to climate and weather variability. There was a strong testimony from respondents that planting is now done more than once a year compared to the period before the small-scale irrigation intervention was introduced where they used to plant only once. Additionally, respondents also pointed out that they can still harvest their crops and especially vegetables whether there is rain or not. For me, this helps to keep food prices low and affordable to most households especially of those food stuffs produced under irrigation. In literature, Theis et al (2018) and Mango et al (2018) note that small-scale irrigation technologies are increasingly being promoted to increase the resilience of smallholder farmers to climate change and weather shocks. Moreover, farmers can produce during off-season because they can supplement their crops with irrigation water in case of long dry spells. This therefore, reduces climate risks, improves crop production and reduces overdependence of agricultural production on rainfall. However, from the focus group discussions and key informants, this all year-round vegetable production is only viable for those irrigators who have sufficient access to water. This therefore is critical for the implementing organisations of SSI projects to make certain, that sufficient access to water by irrigating households is key to increasing adaptation to climate and weather variability.

#### **5.3.2 Diversification of livelihoods**

Equally important is that the research study results revealed that small-scale irrigation can lead to diversification of livelihoods amongst irrigating households. From the research interviews, almost all the respondents highlighted that there were now more ways and activities of making a living other than depending only on livestock. Irrigating households are now engaged in livelihood activities such as vegetable growing and selling, small-scale trading, public transportation (boda-boda riding) and tailoring. This will imply that negative coping strategies of charcoal production and firewood cutting will be minimised, thus conserving the environment. A study in Ethiopia also found out that SSI has a positive impact on the livelihood development of the rural people as it increases food security, asset ownership and well-being of rural farm households. Moreover, it is noted that there are clear increases in agricultural production through diversification and intensification of crops grown, household income, sources of animal feed, human health improvements, and asset ownership (Mengistie and Kidane, 2016). In the research study area, some households were observed to have

planted bananas and sugarcane which were crops never heard of from Karamoja sub-region a few years ago, thus increased livelihoods diversification.

### **5.3.3 The importance of working in groups.**

This study results found out that organising farmers in groups proved to be a pivotal factor for success of the project as it enabled farmers to share experiences, lessons, practices and knowledge with other group members. Moreover, some of the group members were willing to transfer their knowledge to non-group members. In the same way, a study conducted in Tanzania revealed that smallholder farmers working in groups contribute more to their well-being. For example, farmer organisations members access more services than is the case with non-members such as extension services, use of pesticides and inorganic fertilizers, as a result this enables them to raise their productivity (Pelimina and Justin, 2015). However, for these groups to remain functional members should all have a common agenda and proper processes of formation should be followed. If this is not done properly, they are bound to fail. This is exemplified by over 20 percent of the non-functional groups in the study area as highlighted by the key informants. Appropriate processes of group formation and dynamics are a crucial factor to ensuring sustainability of groups, in addition to regular follow up.

### **5.3.4 Empowerment of women.**

This study results indicated that small-scale irrigation can lead to women's empowerment. This is evidenced by more than half of the respondents who urged that women can stand alone and no longer depend on their husbands for every need, especially household food stuffs. According to the study results, women are now engaged in vegetable production for home consumption and sale. When they don't have household items like salt, soap, cooking oil, etc, they can sell their vegetables and buy such things. Besides, women have been able to acquire and own some agricultural assets and small livestock. The decision to use the money from vegetable sale can also be done by women. Women have also gained a lot of knowledge and skills during the SSI project implementation which skills are crucial for their subsistence. The notion of women's empowerment through small-scale irrigation is well echoed by Domènech (2015b) when she stated that reliable water access is an important entry point for women's empowerment. She argued that enhancing women's access to and control over irrigation can have a positive multiplier effect on reducing undernutrition. However, the impact of irrigation interventions on women's empowerment will largely depend on whether women are farm decision-makers or simply family laborers (Domènech, 2015a). From the study results, it can also be said that technologies that are less labour intensive can even make women better household food producers.

### **5.3.5 Accumulation of household assets**

Furthermore, SSI can lead to accumulations of household assets. According to a research study conducted in Northern Ethiopia (Zeweld et al., 2015), irrigation enables farmers to increase income, cover some medical expenses, accumulate durable assets, purchase non-food items, send children to school, and purchase farm inputs. The results of Northern Ethiopia study are in line with studies of this study research in that SSI can enable smallholder farmers acquire and accumulate household assets. In the case of Amudat, irrigators have attained these assets in form of cash, livestock, iron-roofed houses, motorcycles, bicycles, mattresses, etc, in addition to irrigation equipment itself which is a productive asset. However, sustainability of these irrigation equipment is at stake if owners are not skilled on maintenance as echoed by 57 percent of the respondents. However, these assets as earlier on mentioned act as a buffer stock for households in case of any disasters or shocks.

### **5.4 Outcome of utilising irrigation between male and female headed households**

The results of this research study revealed that female household heads are more negatively affected by the outcomes of irrigation activities than male household heads. This was reported by the focus group discussions where more than three quarters of the participants said that women have limited

time for irrigation activities because of women's triple role. This was confirmed by all the five key informants who outlined that the irrigation project negatively affected female headed households compared to male headed households. However, less than three quarters of the focus group discussions in both sub-counties reported that there are differences in effect, but only negligible. Theis et al (2018) also discovered that treadle pump technology adoption by women positively impacts on household food security, but it would also add on women's workload. Kamwamba-Mtethiwa et al (2012) says that rural women work both for their families and their farms and their workload is particularly heavy where agricultural production is labour intensive. Technologies that reduce on the labour intensity should be promoted especially to women farmers.

### **5.5 Challenges related to Small-scale Irrigation.**

Despite the enormous potential of small-scale irrigation to improve household production, productivity, food security, and incomes of rural households in Amudat district, it is never free from challenges. The household interviews, FGDs, and key informants indicated that the SSI benefits are accompanied by a number of challenges. The main problems of SSI that respondents encounter in the study area are those related to water shortages, crop pests and diseases, high input costs, drought, flash floods, labour related problems, ineffectiveness of irrigation equipment, and transport. About 37 percent of household respondents said they didn't have enough water for irrigation since they have seasonal rivers or water sources located far away from them. Secondly, 53 percent pointed crop pests and diseases as one of the challenges. Thirdly, 23 percent mentioned transport while 80 percent said the treadle pumps were labour intensive. Studies done elsewhere show that irrigating communities share almost similar predicaments. For example, Mengistie and Kidane (2016) found out that SSI development is faced by multi-dimensional problems ranging from biasness of individual perceptions to institutional arrangements of the concerned bodies. From his study, he identified problems related to water shortages, lack of improved seeds, crop diseases, weeding problems, increased input costs among others. Zeweld et al (2015) also highlights that the major problems of small-scale irrigation are lack of capital for input acquisition, markets, water pricing, labour and transport. From my observation, one field of farmers using boreholes was not looking good, probably because of the salty water used for watering plants.

## **CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS**

### **6.0 Introduction**

This chapter reports the conclusions drawn from the results and discussions in order to answer the main question: “What changes are smallholder farmers experiencing as a result of small-scale irrigation project?” The themes under discussion were in household crop production, productivity and food security; household income generation; other changes utilisation of irrigation has caused among participating households; outcomes of SSI between male and female headed households; and problems of irrigation. It also presents applied recommendations to ZOA (the commissioner) on replication strategies and upscaling of the SSI intervention.

### **6.1 Conclusion**

This research study was aimed at assessing changes smallholder farmers are experiencing as a result of the small-scale irrigation intervention in Amudat district, Uganda. The study concludes that: small-scale irrigation is perceived to be significantly increasing household crop production, productivity and food security among participating households; small scale irrigation systems were remarked to be increasing farm income of participating households; there were other perceived enormous positive changes as a result of the SSI intervention to participating households; small-scale irrigation intervention was also said to be presenting different outcomes between male and female headed households; and small-scale irrigation intervention was viewed to be associated with problems.

### **6.2 Small-scale irrigation improving g household crop production, productivity, and food security**

SSI was said to be improving household crop production, productivity, and food security and especially high value crops and horticultural crops. All respondents indicated that crop production and yields had improved from the time the small-scale irrigation intervention was introduced. From the observation, food availability is noticed by the presence of fresh food stuffs in rural market stalls and both women and men seen harvesting food for both home consumption and market.

### **6.3 Small-scale irrigation contribution to increasing household income**

Small scale irrigation is increasing farm income of households. From the research study, all the respondents indicated that their household income had significantly increased. They reported that the farm income is used to buy other household items such as food stuffs, clothes, shoes, mattresses; as well as important household assets like livestock (goats, sheep, cattle), bicycles, motorcycles, and constructing iron-roofed houses.

### **6.4 Other benefits of small-scale irrigation**

The small-scale irrigation intervention is contributing to many positive changes among participating households and groups. These benefits include; acquisition of knowledge and skills, adaptation to climate and weather variability, diversification of livelihoods, benefits of working together in groups, empowerment of women, and accumulation of household assets. However, some of the skills and knowledge especially of maintenance of irrigation equipment is possessed by only a few members of the group, notably the leaders. The trickledown effect to the rest of the group members has not been fully realised.

### **6.5 Outcomes of SSI between male and female headed households**

The female household heads were said to more negatively affected by the outcomes of irrigation activities than male household heads. This was reported by the focus group discussions where more than three quarters of the participants said that women have limited time for irrigation activities



because of women's triple role. Besides, the use of treadle pump is more tedious for a woman. Key informants also outlined that the irrigation project negatively affected female headed households compared to male headed households. However, women who were using the solar powered irrigation pumps did not feel much of the difference.

## **6.6 Problems associated with small-scale irrigation**

Despite the enormous potential of small-scale irrigation to improve household production, productivity, food security, and incomes of rural households in Amudat district, problems were inevitable. The household interviews, focus group discussions, and key informants indicated that the SSI benefits are accompanied by a number of challenges. The main problems of small-scale irrigation that respondents said they encounter are those related to water shortages, crop pests and diseases, high input costs, drought, flash floods, labour related problems, ineffectiveness of irrigation equipment, and transport. If not properly addressed, these problems may undermine the benefits already gained by irrigating households.

## **6.7 Recommendations**

Based on the insights drawn from the research study, the following recommendations are made to ZOA for better replication strategies and upscaling of the SSI intervention to more areas:

The results of the study showed that from the perspective of irrigating households, the small-scale intervention has produced significant positive changes regarding household crop production and productivity; household income generation; household food security; and many other positive changes like knowledge and skills acquisition, asset accumulation, women empowerment, household livelihoods diversification, adaptation to climate change and weather variability, etc. Under those circumstances, ZOA is encouraged to scale up the intervention to cover more areas and beneficiaries. However, the organisation is advised that the SSI intervention can be integrated with food cooking trainings for mothers, more so vegetables. Aspects of nutrition, especially water, sanitation and hygiene (WASH) can also be integrated.

Amudat district and Karamoja sub-region generally is semi-arid, which only receives one rainy season with persistent droughts having a strong impact on livelihoods. The main ecological characteristic of the region is its inadequate and highly erratic rainfall. Based on this, and for the reason that SSI positively impacts on the livelihoods of irrigating households, it is advised that ZOA takes a lead to liaise with the district production office of Amudat and other neighbouring districts of Karamoja, encouraging them to develop a campaign to propagate the advantages of the SSI system to farmers through development agents. Through this kind of arrangement, farmer training centres can be set up where they can be trained on improved agronomic practices, crop protection aspects, irrigation practices, and marketing. In addition, local governments can facilitate credit services to these farmers through the available government loan schemes to allow progress in the introduction of technologies and farming practices, market research (price bargaining power) and profitability of the small-scale irrigation schemes.

The research findings also reveal that over 22 percent of the groups formed for small-scale irrigation intervention failed. Besides, some of the functional groups also have members drop. This was because the selection process was not proper, members had no common goal. Moreover, these groups did not have adequate follow up from project staff. Based on this finding, it is recommended that ZOA follows proper steps and processes in forming farmer organisations for next similar intervention. This will ensure progress and sustainability of the farmer groups.

Similar to the above, the study results indicated that treadle pumps were tedious to be used, more so by female irrigators. This in part caused some members to drop off the group. Based on this, it is recommended that solar powered pumps be promoted to lessen the labour burden.

The study results also showed that over 90 percent of the irrigating households were trained in horticultural production. However, 57 percent did not have any skills in maintenance of the irrigation equipment. A few members of the group were selected for this training with expectation that there will be a trickle-down effect. However, this was not the case. It is therefore advised that selection of group members that are willing to share knowledge with the rest of the group members be selected for such skilling. These members should be followed up to ensure that they participate and skill others.

From the research findings, one of the major problems highlighted by most respondents was the high cost of agricultural inputs. It is stated that inputs are bought from either Mbale or Kenya. Based on this, it is recommended that the organisation encourages farmers to work together and form cooperatives. This will make it easier to access farming inputs such as seeds, fertilizers and pesticides. Besides, it makes it possible to aggregate produce to reach larger markets. Farmers are then able to reduce costs and improve their bargaining power.

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## APPENDICES

### *Appendix 1: Activity implementation plan*

Activity	July				August				September				Location
Weeks	1	2	3	4	5	6	7	8	9	10	11	12	
Designing and writing of research proposal													VHL
Literature review & preparing data collection tools													Library and later Amudat
Field work													Amudat
Data analysis & Thesis report													VHL
Submission of the Thesis													VHL

*Appendix 2: Data collection tools*

Question	Method	Sample	Objective
What changes have occurred among smallholder farmers in household crop production and productivity?	Household interview	30 HHs	To obtain data on how irrigation has contributed to improvements in household horticultural production and productivity; it's contribution to food availability, accessibility and stability
	FGD	2 Groups	Triangulate data from household interview, but also gather data on household activities and constraints faced by irrigators
	Key informants	5	Triangulate data on household interview and FGD
What changes have taken place among smallholder farmers in terms of household income generation?	Household interview	30 HHs	To find data on improvements regarding household income generation as a result of small-scale irrigation project
	FGD	2 Groups	To triangulate data on household interview regarding income generation in households as a result of the SSI project.
	Key informants	5	
What other changes has utilisation of small-irrigation brought about among participating households?	Household interview	30 HHs	To understand any other significant outcomes the utilisation of irrigation may have brought on participating households
	FGD	2 Groups	Explore and triangulate any other outcomes that irrigation has had on participating households.
What might be the effect of utilising irrigation among male-headed households compared to female-headed households?	Household interview	30 HHs	To understand differences in outcomes between female and male-headed households utilising irrigation.
	FGD	2	To triangulate data from household interview about differences in outcomes between female and male-headed households utilising irrigation.
	Key informants	5	To triangulate data from FGD and household interview on differences in outcomes between female and male-headed households utilising irrigation.

### *Appendix 3: Household Semi-Structured Interview*

**Date .....**

#### **Introduction:**

Hello, my name is..... I am a student at Van Hall Larenstein University of Applied Sciences, pursuing a master's degree in Management of Development, Rural Development and Food Security. As part of this study, I am required to conduct research on a topic of my choice. I am researching on the changes/improvements people have experienced as a result of the small-sale irrigation project that ZOA International implemented here in your sub-county. Since you are one of those that participated in the project, I would like to talk to you about changes you have experienced in horticultural production; income generation; household food security; any other significant changes you have realised. With these in mind, I request for your permission to proceed. This interview will last for not more 40 minutes. However, you are free to interrupt if you have urgent issues to address, then we resume the interview.

#### **PART ONE: Information about the household**

- a. Name of household head:..... Gender..... Age:..... Group name.....
- b. Marital status: Single/Married/Divorced/Widowed
- c. Number of members in the household.....
- d. Household head education level: None/Primary/Secondary/Tertiary/Others
- e. Household total cultivated land area.....
- f. Household total irrigated area.....

#### **PART TWO: Changes in household crop production and productivity**

- a. What inputs did you receive from the project?
- b. Which inputs (seeds) do you prefer?
- c. What type of crops do you grow in your household?
- d. How was the production output before the project (3 years ago)?
- e. What is the output now since you started using the irrigation system?
- f. Do you grow horticultural crops?
- g. If yes, which varieties do you grow?
- h. How many times do you harvest your vegetables in a year?
- i. Before the project, how many times were you harvesting your crops in a year?
- j. How is labour for agriculture distributed (land clearing, planting weeding, watering, harvesting, selling)?

#### **PART THREE: Changes in household income generation**

- a. What income generating activities were you engaged in before the project?
- b. What income generating activities are you now engaged since the project started?
- c. Do you sell some of the vegetables you produce?
- d. If yes, where do you sell your vegetables to?
- e. Do you only sell for cash? What other forms of receipts do get from vegetable sale/exchange?
- f. How much do you get from vegetable sale?
- g. What do you use the money for?

#### **PART FOUR: Changes in households food security**

- a. How was the household food security situation before the irrigation project (three years ago)?
- b. How is the household food security situation now (from the start of the project)?
- c. How many meals do you have in a day?
- d. Where do you get most of your food from (own production/market)?



- e. Is the change in household food security status as a result of the irrigation project?
- f. What other factors do you think have contributed to changes in household food security status?

**PART FIVE: Other changes that the utilisation of small-irrigation has brought about among participating households**

- a. What trainings did you receive in horticultural production? (skills, knowledge and attitude)
- b. What training and or/guidance did you receive on management and maintenance of irrigation system?
- c. Do you still belong to a group?
- d. Is your group still active/functioning?
- e. Which crops are you preferring (is it vegetables)?
- f. How has irrigation system helped or affected your daily activities?
- g. What specific changes have you realised since the irrigation project started?

**PART SIX: Comparing the effect (outcomes) of irrigation between male and female headed households**

- a. What challenges have you faced as a person and as a family when using irrigation?
- b. Is there a difference between you and other households that are male/female headed when using irrigation? What are those differences?
- c. Do you think irrigation has a future in this community?
- d. Do you think it is helpful?
- e. What should be done to increase utilisation of the irrigation system?

**Additional information:**

- a. Do you have any additional changes you would like to share that this programme has caused in your household?
- b. Is this programme helping you to solve food security problems here at home?
- c. In your opinion do you think this was a good project and why?

**Conclusion**

Are there any other issues concerning the irrigation project that might have not been discussed and that you find important to discuss?

Would you like to add anything on how irrigation project can be improved?

**Thank you for your time!**

*Appendix 4: Key Informant Interview Guide (Local Council / chairperson)*

**Date .....**

**Introduction:**

Hello, my name is..... I am a student at Van Hall Larenstein University of Applied Sciences, pursuing a master's degree in Management of Development, Rural Development and Food Security. As part of this study, I am required to conduct research on a topic of my choice. I am researching on the changes/improvements people have experienced as a result of the small-sale irrigation project that ZOA International implemented here in your sub-county. Since you are one of the leaders of this community, I would like to talk to you about changes the people have experienced in horticultural production; income generation; household food security; and any other significant changes they have realised, and how this project has affected male headed and female headed households differently. With these in mind, I request for your permission to proceed. This interview will last for not more 40 minutes. However, you are free to interrupt if you have urgent issues to address, then we resume the interview.

- a. What was the food security situation of the village before the programme started?
- b. In your opinion, is the current food security situation much better– better – same –worse or much worse if compared with 3 years ago before the project?
- c. Why do you say so?
- d. Before the project, what activities were people in this village engaged in to generate income?
- e. How is the irrigation project contributing to income generation among households?
- f. Are there any other changes that you have observed in this village as a result of the irrigation project?
- g. How much of these changes can you attribute to the irrigation project itself rather than other external factors?
- h. Who are affected by these changes? In what ways?
- i. In your opinion, were the inputs given to beneficiaries relevant?
- j. Why do you say so?
- k. Are all groups still functional?
- l. Why did some groups abandon work/fail?
- m. Do you have any other questions, concerns or suggestions?

***Thank you so much for your time, we will endeavour to share with you the results of this interview.***

## *Appendix 5: Key Informant Interview Guide (AOs, PO)*

**Date .....**

### **Introduction:**

Hello, my name is..... I am a student at Van Hall Larenstein University of Applied Sciences, pursuing a master's degree in Management of Development, Rural Development and Food Security. As part of this study, I am required to conduct research on a topic of my choice. I am researching on the changes/improvements people have experienced as a result of the small-sale irrigation project that ZOA International implemented here in your sub-county. Since you are one of the leaders of this community, I would like to talk to you about changes the people have experienced in horticultural production; income generation; household food security; and any other significant changes they have realised, and how this project has affected male headed and female headed households differently. With these in mind, I request for your permission to proceed. This interview will last for not more 40 minutes. However, you are free to interrupt if you have urgent issues to address, then we resume the interview.

- a. What was the food security situation of the sub-county before the programme started?
- b. In your opinion, is the current food security situation much better– better – same –worse or much worse if compared with 3 years ago before the project?
- c. Why do you say so?
- d. Before the project, what activities were people in this sub-county engaged in to generate income?
- e. How is the irrigation project contributing to income generation among households?
- f. Are there any other changes that you have observed in this sub-county as a result of the irrigation project?
- g. How much of these changes can you attribute to the irrigation project itself rather than other external factors?
- h. Who are affected by these changes? In what ways?
- i. In your opinion, were the inputs given to beneficiaries relevant?
- j. Why do you say so?
- k. Which trainings were given to the beneficiaries?
- l. Were the trainings relevant and why?
- m. Are all groups still functional?
- n. Why did some groups abandon work/fail?
- o. Do you have any other questions, concerns or suggestions?

***Thank you so much for your time, we will endeavour to share with you the results of this interview.***

## *Appendix 6: Focus Group Discussion guide*

**Date .....**

### **Introduction:**

Hello, my name is..... I am a student at Van Hall Larenstein University of Applied Sciences, pursuing a master's degree in Management of Development, Rural Development and Food Security. As part of this study, I am required to conduct research on a topic of my choice. I am researching on the changes/improvements people have experienced as a result of the small-sale irrigation project that ZOA International implemented here in your sub-county. Since you represent those that participated in the project, I would like us to discuss about changes you have experienced in horticultural production; income generation; household food security; any other significant changes you have realised. With these in mind, I request for your permission to proceed. This interview will last for not more 90 minutes. However, you are free to interrupt if you have urgent issues to address, then we resume the interview.

We are going to base our discussion on the following main questions plus any other issues which may emerge during the course of this focus group discussion;

- a. What was the food security situation of the village before the programme started?
- b. In your opinion, is the current food security situation much better– better – same –worse or much worse if compared with 3 years ago before the project?
- c. Why do you say so?
- d. Before the project, what activities were people engaged in to generate income?
- e. How is the irrigation project contributing to income generation among households?
- f. Are there any other changes that you have observed as a result of the irrigation project?
- g. How much of these changes can you attribute to the irrigation project itself rather than other external factors?
- h. Who are affected by these changes? In what ways?
- i. What effect has using irrigation had on female headed household compared to male headed households?
- j. Do you have any additional changes you would like to share that this programme has caused in your community?
- k. Is this programme helping you to solve food security problems here in your community?
- l. In your opinion do you think this was a good project?
- m. Why do you say so?
- n. Are there any other issues concerning the irrigation project that might have not been discussed and that you find important to discuss?
- o. Would you like to add anything on how irrigation project can be improved?

***Thank you very much for your participation, we will endeavour to share with you the results of this interview.***

*Appendix 7: Household data summery*

<b>Respondent</b>	<b>Gender</b>	<b>Age</b>	<b>Marital status</b>	<b>No. of HH members</b>	<b>HH head education level</b>	<b>HH total cultivated area (acres)</b>	<b>HH total irrigated area (acres)</b>
HH 1	Female	38	Married	5	Secondary	2	1
HH 2	Female	54	Married	10	Primary	3	1.5
HH 3	Female	41	Married	7	Primary	3	1
HH 4	Female	44	Married	8	Primary	1	0.25
HH 5	Male	56	Married	7	Secondary	2.5	0.5
HH 6	Male	34	Married	6	Secondary	4	1
HH 7	Male	26	Married	3	Secondary	2	0.5
HH 8	Female	44	Married	9	Primary	4.25	2
HH 9	Male	74	Married	6	None	1	0.25
HH 10	Female	41	Widowed	14	Primary	3	1
HH 11	Male	54	Married	8	Secondary	4	0.75
HH 12	Male	24	Married	3	Secondary	1	0.25
HH 13	Male	41	Married	7	None	2	0.25
HH 14	Male	52	Widowed	1	Primary	1.25	0
HH 15	Female	30	Married	7	Primary	0	0.25
HH 16	Female	32	Married	6	Primary	2	0.25
HH 17	Male	25	Married	4	Primary	1	0.25
HH 18	Male	51	Married	9	None	3	0.25
HH 19	Female	47	Widowed	8	None	1.5	0.25
HH 20	Female	39	Married	7	Primary	2	0.5
HH 21	Male	42	Married	8	Primary	2	0.25
HH 22	Male	48	Married	7	Secondary	3	0.5
HH 23	Male	54	Married	10	Primary	3	0.25
HH 24	Female	50	Widowed	8	None	1	0.5
HH 25	Male	37	Married	6	Primary	2	0.25
HH 26	Male	33	Married	6	Primary	1.5	0.25
HH 27	Female	53	Widowed	7	None	1.5	0
HH 28	Female	36	Married	5	Primary	2	0.5
HH 29	Female	45	Married	8	None	2	0.25
HH 30	Female	26	Married	6	Primary	3	0.5
<b>Average</b>		<b>42.4</b>		<b>6.866666667</b>		<b>2.15</b>	<b>0.508333333</b>

Appendix 8: An example of a summary of respondent interview

12/07/19

Data Summary  
H# 8:

Janet for Orkono F 54yrs  
Married - 10 H# numbers  
2 acres of land cultivated  
1/2 acre of land irrigated

- Plants maize, cowpeas & vegetables.
- Prefers vegetables because of ease of irrigation.
- Three years ago, there was no production completely.
- Now plants and gets food especially vegetables (green pepper, tomatoes, onions & sukuma).
- Plants vegetables twice a year, but continues to harvest sukuma many more times.
- "I never used to see green pepper, egg plant... I never knew how to cook vegetables. I learned from these women that used to bring them from Mbele."
- Labour distribution: women clear land as well. We (women) weed, harvest. Children help in watering when they come from school. Men also clear land.
- Before the project she used to produce charcoal, sell firewood, but also work in other people's homes.
- Now she sells vegetables - in the market but also from the garden (farm gate) - Receives 100,000-200,000 Pkr year
- Uses the money for to buy household items (Soap, salt, cooking oil). She bought a goat.
- Only sell for cash.
- Learned how to set up nursery seed, plant in rows, spacing, transplanting, weeding.
- ~~Does not~~ Does not have skills & knowledge of maintaining irrigation equipment.
- Treadle pump is too tedious for her.
- They should give them also solar pumps.

*Appendix 9: Consent form*

**CONSENT FORM**

Dear Respondent,

My name is Simon Peter Opolot a student from the Van Hall Larenstein University of Applied Science, Netherlands. I am conducting research on “assessment of changes experienced as a result of small-scale irrigation intervention.” for my programme. I would like to have an interview with you on the above subject since you are one of the beneficiaries of the small-scale irrigation intervention that was implemented by ZOA. The conditions will be the following:

1. I will take records of your responses on my book and phone recorder;
2. I will take pictures of you alone or the two of us and any other interesting thing. This picture may be used as part of the work.
3. Your picture may go international and might be on the internet in case the work is published, and your picture is used.

Despite the recording of the interview responses, the information you give will be kept strictly confidential and will not be disclosed to anyone else. You are under no obligation to answer any question that you feel uncomfortable to answer and I would urge that you provide as honest answers as possible.

For information on this research, I can contact: Simon Peter Opolot +31616322731 or email: [simon.opolot@hvhl.nl](mailto:simon.opolot@hvhl.nl)

I have agreed and will participate  
Signature/tump print (Interviewee)

.....  
Date:

I have not agreed and will not participate  
Signature/tump print (Interviewee)

.....  
Date  
Signature of interviewer (Researcher)

.....  
Date



*Appendix 10: Photo gallery*



***Key informant interviews in Karita***



***Interview with female household head in Karita***



***Interview with male HH head in Karita***



***Focus group Discussion in Amudat***



***Vegetable garden in Karita***



***Vegetable and maize garden (Amudat)***



***Men now engaged in vegetable production***



***Vegetable trader from Kenya packing vegetables***





***Woman after harvesting for home consumption***



***Men also pick vegetables for home consumption***



***A rural food market in Karita***



***Selling of vegetables at farm gate***



***A malfunctional irrigation system***



***Pests affecting a maize field***