

**INTEGRATED SMALL SCALE AGRICULTURAL PRODUCTION AND
FOOD SECURITY IN RURAL KENYA: A CASE STUDY OF SUWERWA
LOCATION OF TRANSZOIA EAST DISTRICT.**

By

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DECLARATION

Declaration by Student

I declare that this is my own original work and has not been submitted for an award of degree/Diploma in any other University/College/Institution.

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ABSTRACT

Extreme poverty and hunger in many parts of Kenya is a common phenomenon. In recent years, there has been deteriorating food supply. In the year 2011, approximately 4 million people were facing severe hunger and starvation. This has been attributed to multiple factors: poor traditional agricultural practices, over reliance on maize and maize products as the major source of food, crop failure occasioned by erratic rainfall pattern, runaway food prices occasioned by a rise in global food price, poor logistics in distribution of food to needy people and influx of refugees from war torn neighboring countries. Another factor that has contributed to food shortage is diminishing land sizes as a result of increase in population. What used to be huge arable land suitable for large scale commercial agriculture has been fragmented making large scale farming untenable. This has led to diminishing returns in food production and its attendant consequences. With dwindling agricultural output, household incomes have also been made worse especially in arid and semi arid regions. This study therefore examines the capacity of integrated agricultural production in realization of food security in rural Kenya. The specific objectives of the study is to examine the features of integrated small scale production in Suwerwa Location of Trans-Nzoia District, to evaluate the capacity of integrated small scale agricultural production in realization of food security in rural Kenya, to find out the challenges facing integrated small scale agricultural production and to explore ways of enhancing it. The research was a case study of Suwerwa Location. The research instruments that were used included questionnaires, interview schedules and focus group discussions. The researcher used purposive and simple random sampling to generate a sample size of 200 respondents. The research used both descriptive and analytical methods of data analysis. Chi square test was used to test hypotheses. This study found out that integrated small scale agricultural production as is practiced in Suwerwa location has ensured food self sufficiency for all because of the numerous challenges that farmers face ranging from financial, technical as well as those posed by weather. The study concluded that it is important to reorient farming practices and lay emphasis on the need to integrate farming activities on tiny land holdings. At the same time, farmers must be taught new ways of integrating farm activities. In addition they must move away from rain fed agriculture to irrigation so that they can grow food throughout the year as well as be provided with credit facilities and extension services. The study findings are beneficial to policy makers at planning level for they not only inform them of the farming trends and food situation but also reflect the capacity of the country to attain food sufficiency through integrated small scale agricultural production.

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TABLE OF CONTENTS

Declaration	1
Abstract	2
Acknowledgements	3
Table Of Contents	4
Appendix I	9
Definition of Terms	10
CHAPTER ONE: INTRODUCTION	1
1.1 Overview	1
1.2 Background to the Study	1
1.3 Problem Statement	4
1.4 Research Objectives	5
1.5 Research Questions	5
1.6 Hypothesis	6
1.7 Justification of the Study	6
1.8 Significance	6
1.9 Limitation of the Study	7
1.10 Scope of the Study	7
1.11. Theoretical Framework	8
1.12 Conceptual Framework	10
CHAPTER TWO: LITERATURE REVIEW	11
2.1 Overview	12
2.2 Integrated Small Scale Agricultural Production	12
2.2.1 Food security	13
2.2.2 Benefits of Integrated Small Scale Agricultural Production	13
2.2.3 General Practices:	14

<u>2.2.3.1 Integrated Livestock-Fish Farming</u>	14
<u>2.2.3.2 Chicken-fish farming</u>	15
<u>2.2.3.3 Rice-Livestock-Fish Integrated Farming</u>	16
<u>2.2.3.4 Integrated Rubber Agro Forestry Farming System</u>	16
<u>2.2.3.5 Integrated crop – Livestock – Tree Farming</u>	17
<u>2.2.3.6 Integrated Maize-Cow-Fish Farming in Malawi</u>	20
<u>2.2.3.7 Integrated Small Scale agricultural Practices in Kenya: Determinants and Characteristics</u>	20
<u>2.2.3.8 Integrated fish Chicken Farming in Kirinyaga</u>	21
<u>2.2.3.9 Integrated Sugarcane-Oil Palm in Western Kenya</u>	22
<u>2.3 Challenges Facing Small Scale Farmers</u>	28
<u>2.3.1 Labor</u>	29
<u>2.3.2 Machinery</u>	30
<u>2.3.3 Lack of Knowledge and Financial Resources</u>	31
<u>2.3.4 Credit</u>	33
<u>2.3.5 Marketing</u>	36
<u>2.3.6 Unfavorable Weather Conditions</u>	37
<u>2.3.7 Chemicals</u>	39
<u>2.3.8 Failure to carry out research</u>	43
<u>2.3.9 Poor / unproductive soils</u>	43
<u>2.3.10 Over reliance on rain fed agriculture</u>	45
<u>2.3.11 Seeds</u>	46
<u>2.3.12 Storage Facilities</u>	47
<u>2.5 Critical Review of Literature</u>	48
<u>CHAPTER THREE: RESEARCH METHODOLOGY</u>	51
<u>3.1 Overview</u>	51

3.2 Research Design	51
3.3 Study Area	51
3.4 Sampling and Sampling Techniques Indicated	54
3.4.1 Sampling Size Determination	54
3.4.2 Sampling Procedure	55
3.5 Data Collection	56
3.6 Data Analysis	57
3.7 Validity and Reliability	58
3.8 Ethical Issues	58
CHAPTER FOUR: DATA PRESENTATION ANALYSIS AND INTERPRETATION	59
4.0 Overview:	59
4.1 Background information	59
4.1.1 Education level	59
4.1.2 Age of the respondents	62
4.1.3 Marital status	66
4.1.4 Land status	68
4.1.5 Land under cultivation	69
4.1.6 Land tenure	70
4.1.7 Size of land leased	71
4.2.0 Objective 1. Integrated small scale agricultural production as practiced in Suwerwa	72
4.2.1 Integrated farming	72
4.2.2 Interrelation of Farming Activities (Integration)	74
4.2.3 Use of Animal Manure and Productivity	75
4.2.4 Waste as animal feeds	78
4.2.5 Respondents Use of Crop Waste as Composite Manure	79

4.2.6 Chickens droppings used to grow algae for fish	80
4.3.0 Objective 2	81
4.3.1 Other benefits of integrated small scale agriculture	82
4.3.1.1 Increased productivity	82
3.1.2 Income	87
4.2.2.3 Low Cost of Production	88
4.2.2.4 Variety of food and nutrition	89
4.2.2.5. Reduced risk of monoculture	90
4.3.0 Objective 3: Challenges of Integrating Small Scale Agriculture	93
4.3.1 Market of Farm Produce	95
4.3.2 Adverse weather conditions	97
4.3.3 Drought	98
4.3.4 Loans/Credit Facilities	100
4.3.5 Access to Extension Services	104
4.3.5 Knowledge of mixed/integrated farming	106
4.3.6 Labour at Farm Level	108
4.3.7 Tools at Farm level	110
4.3.8 Storage Facilities	111
4.3.9 Farm Seeds	114
4.3.10 Use of Chemical Fertilizer	117
4.3.11 Use of Pesticides At Farm Level	121
4.3.12 Hypotheses Testing	122
CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATION	127
5.1 Summary:	127
5.2. Conclusion	131

5.3 Recommendations	132
5.4 Suggestions for further study	133
REFERENCES	134

APPENDIX I

ADPs – Agricultural Development Projects

AERL – Agricultural Extension and Research Liaison Services

AGRF - African Green Revolution Forum.

ASAL – Arid and Semi-arid Land

CDTF – European Union Community Development Fund

DFID – Department for International Development

FAO – Food and Agriculture Organization

GMO – Genetically Modified Organism

MDG – Millennium Development Goals

NCPB – National Cereals and Produce Board

IFAD – International Fund for Agricultural Development

KFSSG – Kenya Food Steering Group

SRA – Strategy for Revitalization of Agriculture

UNDP – United Nations Development Programme

USDA – United States Department of Agriculture.

WFO – World Food Organization

WHO – World Health Organization

DEFINITION OF TERMS.

1. Integrated Small Scale Agricultural Production.

This refers to diversified agricultural practices within small land holdings where a large house hold permanently cultivates a small area of land (Woomer 2005).

In the context of this study it refers to diversified agricultural practices in small land holding ranging from 0.1 to 3 acres of land characterized by interdependence and interrelation of various activities which makes it self sustaining because the output from one system can be used as input in another system.

2. Food Security.

This is when all people have physical, social and economic access to sufficient, safe and nutritious food that meets dietary needs and food preference for an active and healthy life at all times.

3. Hidden Hunger .

A situation where farmers appear to have food in the sense that they harvest but in real sense, the food is not sustainable in the long run.

CHAPTER ONE: INTRODUCTION

1.1 Overview.

This chapter lays the basis or the foundation of this research. It includes the problem statement, research objectives, research questions, justification and significance of the study, the scope of the study, theoretical framework as well as conceptual framework.

1.2 Background to the Study

Agriculture is the leading economic activity in Kenya. It is a way of life for people in rural Kenya. It provides an occupation, culture, traditions and value for rural people who have long existed in harmony with nature. For decades it has continued to dominate the economy of the country. In 2007, for instance, agricultural sector accounted for roughly 26% of the country's GDP and 70% of the country's labor force (Ministry of Agriculture, 2009). In 2005, agriculture including forestry and fishing accounted for about 18% of wage employment, 60% of revenue from exports as well as 24% of the country's GDP. However, of Kenya's total land, only 15-17% is fertile enough to support agriculture and approximately 7-8% can be classified as first class land (Ministry of Agriculture, 2009).

Small farms grow most of the corn as well as produce potatoes, bananas, beans and peas. But about one half of Kenya's total output is non marketed subsistence production (Kurt Larsen et al, 2009). Even in farming potential areas, agricultural practices are still traditional and farmers rely on rain waters in farming thus, the country's grain yield has remained flat over the past two decades (USDA, 2009). Despite many well intentioned

efforts and with a growing population of about 3% per annum, the country faces a daunting task to meet food sufficiency. This and the fact that agricultural practices are still traditional have contributed to hunger and extreme poverty in many rural areas in Kenya (FAO, 2009). Food production from 2001 is on the decline as a result of poor methods of farming, erratic rainfall pattern and escalating costs of farm inputs (FAO, 2009). Another factor that has contributed to this is land fragmentation which has been occasioned by population growth. In Trans Nzoia County what used to be viable land has been subdivided into very tiny holdings, some as small as 0.1 acre popularly referred to as “pointi” and are not agriculturally viable because with such small farms, much of the produce is used by the farmers. In addition, small scale farmers are afraid to diversify their farming activities because the risk of trying a new crop is much worse than for a more prosperous farmer; the loss of crop could mean not only monetary loss but also starvation (Cheng Leong and Gillian, 1973).

Small farmers have little extra money to spend on seeds and fertilizer so they find it difficult to change to a new crop variety (Kurt Larsen et al 2009). So within their small farms, farmers in Trans Nzoia East District farm maize (white corn) and are afraid to venture into other farming activities. The problem of poor production is complicated by inaccessibility to credit facilities. Owing to low incomes, most land owners cannot process title deeds and so cannot offer their land as collateral in financial institutions.

At the national level, extreme hunger and poverty is a recurrent phenomenon. In 2003, 56% of the population was still living below poverty line and it is projected that 65.9% of Kenya’s population would be living below poverty line by 2015 (UNDP).

As far as food situation is concerned, Kenya's long term goal of attaining food sufficiency remains unmet (FAO 2010). Frequent droughts have always led to food shortage. The most affected group is the pastoral communities. In March 2011, an estimated 1.4 million pastoralists faced moderate to high food insecurity due to impacts of consecutive poor seasons (WFP). In July 2011 an estimated 4 million people were seriously affected by famine and majority of them were unlikely to meet food needs until September 2011(FAO 2011). It is against this backdrop that the government resorted to importing Genetically Modified Maize (GMM) from South Africa in order to meet growing food demand for the people. However, this is not without controversy: why should the country import Genetically modified maize while as other avenues have not been explored? Why should we rely on maize as our staple food crop? Is maize farming enough to meet our food requirements as well as eradicate extreme poverty? Should we diversify agriculture in order to meet food sufficiency? Is integrated small scale agricultural production able to ensure food security?

It is important to note that food insecurity and extreme poverty also prevails in agriculturally potential regions. Trans- Nzoia East District exemplifies this. The region is potential for agriculture for it enjoys abundant rainfall and has fertile volcanic soil, yet out of a total population of 70,232, about 38,840 people are classified as poor (Ministry of Agriculture -2011-Trans-nzoia district food security report). As of February 2011, the farmers stock in the District was 2,940, 90 Kilograms bags of maize while the traders had a stock of 1,300. This is way below the food requirement of people in Trans Nzoia District. At the same period, NCPB had no stock at all. Thus there is food insecurity in Trans Nzoia East District.

This is attributed to the fact that farmers rely so much on maize as a source of income as well as food. They cultivate other food crops to a far lesser extent. If they could integrate farming activities within their small farm holdings and make it market oriented would they meet food sufficiency as well as eradicate extreme poverty?

1.3 Problem Statement

Since independence, Kenya has emphasized the need to develop agriculture in order to realize food self sufficiency and rapid economic development. It has been widely held that the benefits from market oriented agriculture would trickle down to the population living in regions that are less endowed with agriculture. Unfortunately, the country has never realized food self sufficiency owing to wrong strategies and poor crop production practices that have led to low production. Information available show that hunger is a recurrent phenomenon in Kenya and that food production is on the decline since 2001(FAO2010)

Recent efforts to steer the economy to high height, for example, vision 2030, lay emphasis on attaining GDP growth rate of 10% per annum by 2012 mainly through enhancing agricultural production geared towards export as well as promoting small scale agricultural production. This has not solved perennial food shortage in Kenya. The strategies evolved to address problems facing agriculture sector overlook the need to streamline integrated small scale agricultural production to ensure food sufficiency in small farm holdings and improve on household incomes. The research problem addressed in this study is that despite Kenya's dependency on agriculture as the back bone of the economy, little has been done to analyze the capacity of integrated small scale

agricultural production in realization of food sufficiency, that is, is integrated small scale agricultural production capable of ensuring food security in Kenya?

1.4 Research Objectives

The main aim of this study was to assess the capacity of integrated agricultural production in realization of food security in rural Kenya. The specific objectives were as follows:

- i. To examine the features of integrated small scale agricultural production in Suwerwa location
- ii. To evaluate the capacity of integrated small scale agricultural production in realization of food security
- iii. To find out challenges facing integrated small scale agricultural production.
- iv. To explore ways of enhancing integrated small scale production.

1.5 Research Questions

- i) How is integrated small scale agriculture in Suwerwa location?
- ii) Can integrated small scale agricultural production ensure food security in rural Suwerwa location?
- iii) What are the major challenges?

iv) How can integrated small scale production be improved?

1.6 Hypothesis

The study tested the following hypotheses:

- i). There is a relationship between integrated small scale agricultural production and food security
- ii). There exist a relationship between Challenges that farmers face and food insecurity.

1.7 Justification of the Study

Despite the fact that extreme hunger and poverty are recurrent phenomena in Kenya, little has been done to evaluate the capacity of integrated small scale agricultural production as a solution to food insecurity in rural Kenya. This therefore justified the need for this study.

The choice of Suwerwa location was informed by the fact that this is one region that is suitable for small scale farming yet there were people suffering from acute hunger. The researcher sought to explain why this was the case.

1.8 Significance

This research was significant for it demonstrated that rural Kenya has the capacity to attain food sufficiency by integrating small scale agricultural practices. The study proved that where this kind of farming is practiced, it is productive, viable and economical. The

researcher suggested ways of improving agriculture in order to meet more than just food requirement for the people and their daily expenses but also how to make farming more modern, more productive and market oriented.

The study findings are significant because they inform the policy makers of the numerous challenges that farmers face and proposes ways of overcoming them to make farming more beneficial to rural population. The findings are beneficial to policy makers in deciding what structures to put in place in preparedness to address issues affecting small scale farmers.

1.9 Limitation of the Study

The respondents were scattered all over Suwerwa location which is quite expansive. Thus, it was quite hectic moving all over the location to reach the respondents. The researcher hired a boda boda (a bicycle taxi) to take him throughout the location in order to reach the respondents.

The research took place when farmers were busy preparing for the next planting season so some were reluctant to take a break from their busy schedule to respond to the researcher. In most cases the researcher had to visit the same respondents twice in order to be given time for an interview.

1.10 Scope of the Study

The research was conducted in Suwerwa Location. The researcher studied those farmers who own land within the range of 3 acre and 0.1 of an acre to find out how productive and economical integrated small scale farming is in such small holdings as well as its sustainability

The choice of Suwerwa Location was appropriate to this research because there are many subsistence farmers living in a region that is very potential in agriculture, but which experience hunger. The study therefore sought to find out the challenges that confront them as well as propose the way forward.

1.11. Theoretical Framework

This study was guided by **systems** theory. The theory was proposed by Ludwig Von Bertalanffy in 1940 and was later furthered by Ross Ashby in 1956. Ashby argues that systems are open to and interact with their environment and that they can acquire qualitatively new properties through emergence, resulting in continual evolution. The theory focuses on the arrangement of and the relations between parts which connect them into a whole. This particular organization determines a system, which is independent of the concrete substance of the element (particles, cells, people, etc.)

Separate agricultural practices

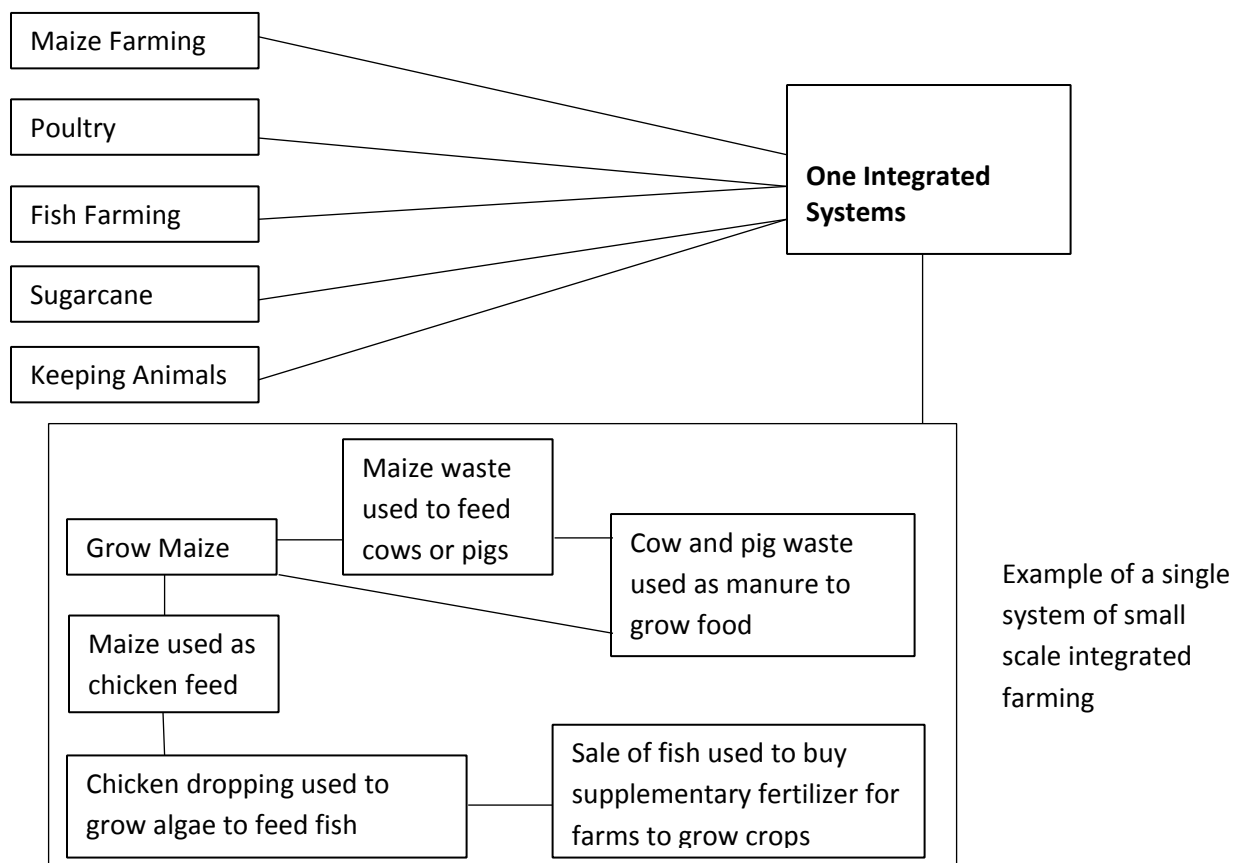


Fig 1.2: Illustration of theoretical framework

Source: Researcher (2012)

A system is composed of many separate parts that interact in order to achieve an objective. Based on this theory, the researcher perceives integrated farming as a system comprised of many separate activities that are characterized by interconnectedness and interdependence and that are capable of ensuring food self sufficiency. In this context farms and food production are an integrated whole; a system in which one activity depends on the other rendering farming easier, beneficial and productive enough to attain food self sufficiency.

1.12 Conceptual Framework

Kenya is among the 192 nations committed to attainment of Millennium development goals. Millennium development goals are time bound development goals aimed at tackling poverty in all dimensions. Goal 1 which is the focus of this study aims at eradicating extreme poverty and hunger by 2015. In Kenya, agriculture which forms the economic mainstay is widely seen as a viable way of attaining food security. However, it has not because of the many challenges facing small scale agricultural food production ranging from poor methods of farming, lack of farm inputs (seeds and fertilizer), poor marketing, reluctance to diversify, lack of skills and modern tools as well as risks associated with farming. This has resulted to food shortage, hunger and extreme poverty. From the foregoing, the researcher conceptualized that integrated small scale production can meet food security if farmers can improve agricultural practices, for example, by diversifying farming practices. This in turn can reduce risks that are associated with monoculture and at the same time increase productivity, thus, ensuring high incomes and food security.

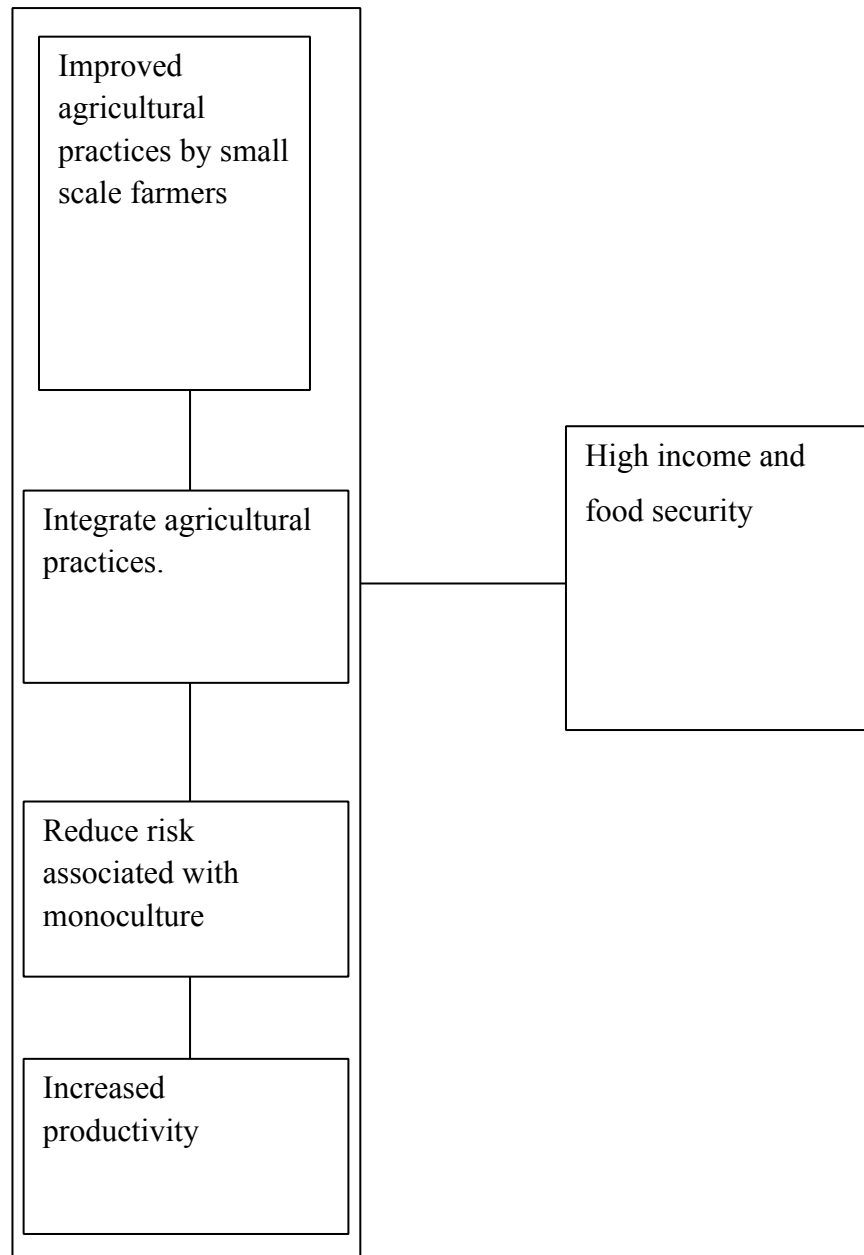


Figure 1.2 Illustration of Conceptual Framework

Source: Researcher (2012)

CHAPTER TWO: LITERATURE REVIEW.

2.1 Overview

This chapter delved into features of integrated small scale agricultural production as well as its benefits. The chapter further examined different types of integrated small scale agricultural production as practiced at global and local level, (Europe, America, Cuba, Indonesia, Japan Malawi and Kenya) their challenges and success and assessed their applicability or not in our rural set up. Finally, the researcher did critical review of the literature in order to ascertain the missing link.

For the purpose of this research, it was important to define terms that were used from time to time. Equally important was to examine the features of integrated small scale agricultural production.

2.2 Integrated Small Scale Agricultural Production

This refers to diversified agricultural practices within small farm holdings, where a large household permanently cultivates a small area of land (Woomer, 2005). For the purpose of this study, integrated small scale agriculture refers to farming in small holdings ranging from 0.1 acres to 3 acres characterized by interdependence and interrelation of various farming activities, that is, this system is self sustaining because it thrives on the interdependence of enterprises.

2.2.1 Food security

According to FAO 2010, food security is when all people have physical, social and economic access to sufficient, safe and nutritious food that meets dietary needs and food preference for an active and healthy life at all times. The words “at all times” stand out and need to be emphasized because even in Suwerwa location, just like many agriculture potential regions, most farmers do not have food at all times, that is, throughout the year. This is worse in ASAL areas inhabited by the pastoral communities who experience severe hunger that is occasioned by drought, loss of pasture and death of livestock which in most cases, is the sole source of livelihood.

2.2.2 Benefits of Integrated Small Scale Agricultural Production.

Integrated small scale farming, is productive. Where it is practiced, it has been found to be a social safety net in terms of food security and a source of employment (Jitsanguan, 2001). This system has helped to improve the feed and food self sufficiency. It has also cushioned farmers against the ravages of hunger often occasioned by natural hazards for example drought and floods.

The advantage of this system of farming is that through application of the waste products from one system as fertilizer or supplementary feed to boost the production in another system the total output of the farm is increased beyond that which would be possible if the different production system were operated independently (Niroj, 1989). An example of integrated farming is where a farmer can keep fish as well as do small scale farming. A major socio economic benefit of integrated fish farming is that inputs to the various

sub systems tend to come from within the farm. Moreover, fish efficiently convert low grade feeds into highly quality animal protein and can be kept alive on maintenance diets without loss of condition, there by allowing greater degree of flexibility in harvesting stages. In this way, a high value and nutritious source of food can be obtained with a minimum effort and external inputs.

The important consideration for the small scale farmer and in the context of global food shortage is that increase in yields can be achieved without resources to costly manufactured inputs and by applying management strategies which are within the capacities of existing small scale farming system. These features of low external inputs and flexibility in the level of management which can be applied make integrated crop-livestock- fish system highly attractive solution especially for those farmers who are experiencing under nourishment and lack of income because substantial returns can be obtained for relatively little cost in the form of labor investment.

Another advantage of this system is that it provides a stable flow of income as well as food through out the year. In addition, waste product of one system can be used as fertilizer or supplementary feed in another system and so nothing goes to waste.

2.2.3 General Practices:

2.2.3.1 Integrated Livestock-Fish Farming

An example of this system of farming is integrated livestock – fish farming system that was introduced in **Thailand** in 1900 but has recently been improved to increase farm income through better resource utilization. This system was developed by pig farmers in

order to increase revenue when pig feed prices started increasing. This entails putting up pig pens near fish ponds or on the pond dikes for convenient washing of pig manure and waste into the pond. Once washed, the pig manure is in turn fed on fish. In this way, the two activities complement each other ensuring no waste.

Stocking of five to ten 10kg pigs per 0.16ha fish pond (31-62 pigs/ha) was most suitable for a stocking rate of two thousand 3-5cm tilapia or tilapia cum striped cat fish fingerlings. When pigs are young and small, low cost supplementary feed (e.g. rice bran, food wastes, and plant wastes) may be required for the fish.

Recommended fish species are tilapia and striped cat fish due to their ability to withstand the fluctuation in pond environment. Hybrid pigs are recommended for this system. They can be fed on mixed and/or concentrated feed. Cassava for example, can be substituted for broken rice to reduce food cost (Niroj, 1990).

The advantage of this system is that four to five months after stocking, tilapia can be harvested. Striped cat fish will grow to a size of 1-1.5 kg each within one year. Fish yield can be as high as 1,800-2,000 kg/0.16ha/year (about 11,250-12,500kg/ha/year). About 60% of the total revenue from this integrated system is cash costs leaving 40% net income for the farmers (Wannakul, 1983).

2.2.3.2 Chicken-fish farming.

In this farming system, the pond is rectangular in shape with 1.5m water depth. Chicken house is built above the pond floor 1.2m above the water level. Recommended fish

species are tilapia or tilapia cum striped fish which have high tolerance to low oxygen level, at a stocking rate of 2,000, 3-5cm fingerlings/0.16ha (12,500 fingerlings/ha).

Fish yield is as high as 1,222kg/0.16ha which translate to 7,637.5kg/ha in case of tilapia cum striped cat fish since striped cat fish can feed better on the nutrients in the pond. This system of farming takes up a very small area yet the returns are high and constant.

2.2.3.3 Rice-Livestock-Fish Integrated Farming

In this system, the main activity is rice growing while farmers keep small fish ponds and let a small number of other animals roam and forage for food making it difficult for the application of animal manures in the fish pond. Animal waste is used as manure to fertilize rice paddies and in turn broken rice is used as fish feed. In this way the success of each activity is dependent on the various farm systems making farming practice affordable, sustainable and economical.

2.2.3.4 Integrated Rubber Agro Forestry Farming System

In **India and Thailand** Farmers have managed to integrate rubber into their livelihood systems (Niroj 1990). They have become resilient in coping with crises because they get stable income flow from it. Rubber is important because its latex is a basic ingredient for motor and vehicle industry, kitchenware and house ware. This farming system has been made possible because of institution support and extension services provided by the Indian and Thai government. Emergence of rubber agro forestry/integrated farming systems illustrates the coping strategies adopted by small holders to overcome the 1997 financial crisis.

Farmers grow rubber tree alongside other food crops that mature quickly to provide food for domestic use and for market purposes. Integrating rubber into the farming system is one of the coping strategies that can enable the small marginal rubber farmers to cope with market uncertainties and changing policy regimes. Evidence shows that various combination of rubber and other crops or activities amply contribute to the households' resilience and ensure the sustainability of their livelihoods (Niroj, 1990).

Viewed from this perspective, there is a strong case for further promoting and scaling up the rubber integrated farm livelihood systems in the small holder producing countries in Asia. The advantage of integrated animal and crop farming is that the two enterprises depend on each other for their growth. The animals feed on the crops grown on it and in turn, the animals' manure is used to fertilize the crop.

2.2.3.5 Integrated crop – Livestock – Tree Farming

Cuban agriculture illustrates the success of integrated small scale agricultural production. One of the responses to the crisis in Cuban agriculture was to study, develop and promote integrated small and medium scale crop-livestock-tree system. Through research program, the project showed that these systems can be productive, efficient alternatives to external input dependent dairy farming (Monzote, 2000). Various combinations of crops, trees and livestock were tested and building on agro-ecological principles, these systems show high potential in terms of sustainability and being environmentally sound.

For many years, **Cuba** strongly depended on trade with socialist countries in Europe and the Far East. The country exported sugarcane, citrus, coffee and tobacco in exchange for

modern inputs to sustain agriculture. In 1990, this trading practice collapsed as USA placed trade embargo with Cuba as well as the collapse of USSR which was her biggest trade partner. The ensuing economic crisis demonstrated the vulnerability of agriculture that strongly depends on imported external inputs .Agriculture became unsustainable because of this disadvantage and also due to ecological and environmental problems- Soil degradation, deforestation, water pollution and loss of biological diversity. This forced Cuban farmers and the government to transform their export oriented, large scale, specialized production systems into diversified, integrated, self sufficient small scale systems (Monzote, 2000).

Conversion of ranching systems into integrated crop-livestock-tree systems reversed the economic and environmental crisis and to provide income and food security for producers was the focus with efficiency as the key factor for success. The efforts to reform agriculture began in 1994 with establishment of research institutes and six years later, it became evident that integrated crop-livestock-tree system can be sustainable, efficient and productive alternatives to specialized, external inputs dependent farming.

Combining the components into consistent whole brings better results in terms of total production, energy efficiency, recycling of organic matter and the use of available resources (Monzote, 2000).

A wide range of tests were carried out to evaluate the productivity of this system. It was found out that milk production in Cuba was about 1 to 1.5 tons of milk per ha – some farms achieved 3 tons of milk and 6.1 tons in terms of food production from crop and livestock. This provided stable source of income throughout the year. At the same time,

bio-diversity was also increased considerably. The number of trees per ha increased by 26-50% and the average number of food crops increased from 14 to 17 to 20. Also the total bio-diversity of wildlife increased from 46-78 species per ha. The evaluation also showed that it is possible to produce good quality organic fertilizer from the by products available in the farms to fertilize both the ranch and crop areas at a rate of 2-6 tons per ha depending on the design of the farm and in this way, the degraded soils are being regenerated into biologically active and nutrient rich soils. In this system of farming, multiple cropping were made that were suited to the local conditions (cassava, beans, groundnuts, soy beans, sesame maize, sorghum, squash, melon, tomatoes, cucumbers, mucuna and canavalia) etc. This resulted in high land use rates proving the vast potential of multiple cropping for intensive land use.

In Asia, especially in Japan, an average farm is approximately 1.5 acres while in India and elsewhere the farms may be even smaller (Leong and Morgan, 1973). Individual peasants are able to grow food crops to effectively support their families and as well as have some surplus for sales. In regions where population is land hungry, people practice intensive small scale agriculture in order to meet food sufficiency as well as earn income from the sale of excess harvest.

In Japan integrated system of arable and livestock means that they use rice waste to feed cows and in turn use cow waste compost as manure for rice paddies (Fujimoto et al, 2008). In this way, production cost is lowered and there is more returns to inputs. Can this experience be replicated in rural Kenya?

2.2.3.6 Integrated Maize-Cow-Fish Farming in Malawi.

In Africa Malawi exemplifies success of integrated small scale agricultural production. The Ministry of Agriculture records (2009/2010) show that Malawi produced 3.5 million tones of maize which was one million tones over and above the national requirement. Of the total harvest, 300,000 tones came from irrigation farming.

The national land policy says land holding sizes in Malawi have shrunk from 1.53ha in 1968 to 0.8ha in 2000 and 0.2ha in 2008 due to an increase in population. Thus only 4.5ha of land is available for small scale farmers who account for 80% of the country's agricultural production (Ministry of Agriculture, 2010).

By making most use of the available land through integrated agriculture Malawi has maximized productivity in small scale agriculture especially on water logged sites and near permanent water sources. Apart from growing maize on irrigated small holdings, farmers grow fish and keep cows in the same tiny plots. This system is self sustaining because it thrives on the interdependence of enterprises (Fox and Liebenthal, 2006).

2.2.3.7 Integrated Small Scale agricultural Practices in Kenya: Determinants and Characteristics

In Kenya farmers practice integrated farming especially in regions with high population density and tiny pieces of land. Farmers have traditionally kept animals and grown crops but at subsistent level. However, the subsistence farming is not enough because as within 2-4 months after harvest, there is no more food to see them throughout the year (FAO, 2010). The result of this is hunger and starvation. Hunger has been a perennial problem

in Kenya especially because farmers have not fully integrated agricultural practices. However, in places where this has been done success stories have emerged.

2.2.3.8 Integrated fish Chicken Farming in Kirinyaga

In Kirinyaga integrated fish –chicken farming is gaining root. Traditionally, farmers in this region have grown tea for decades. But with decline in Tea price in the international market coupled with poor local market, farmers resorted to integrated system of farming that is sustainable, economical, and ecologically friendly and market oriented (IFAD, 2010) Apart from growing bananas and tea, they keep dairy cows. However, with declining land resources, complementary form of farming combining fish and chicken has gained preference with the farmers. Fish and chicken complement each other quite well and quickly gives returns within a short time. Chicken droppings are used in fertilizing fish ponds where tilapia fish are raised cheaply and economically. Chicken droppings are collected and placed in gunny bags. The bags are lowered into the ponds where the nutrients fertilize the water for the growing of algae eaten by fish. The advantage of this system of farming is that building chicken farms over the ponds maximizes space, saves labor in transporting manure to the ponds and the poultry house becomes more hygienic (Gupta and Noble, 2010).

In Mwea, location of Kirinyaga, county chicken-fish farming is gaining popularity perhaps due to availability of water in paddy rice farms. Chicken farms are constructed above the fish ponds so that droppings fall directly into the water. Once the pond has been dug, depending on the number of fish to be reared, black polythene sheeting is spread in the pit to stop water from getting lost through seepage. The pond measuring 10

by 30 meters can comfortably hold over 30,000 tilapia fish. Guano dropping help to promote growth of algae known as planktons which form the main food for fish in ponds. Chicken dropping contain elements such as nitrogen and phosphorous which function as fertilizer to stimulate natural food webs in the water.

Organic waste supports a multiplication of both herbivorous and omnivorous fish. In return fish harvested from the ponds boost household income as well as nutrition. In addition, fish, especially in rice growing paddies has been able to control mosquitoes and other biting flies that spread human and animal diseases. This system can sustain peoples' livelihoods, directly or indirectly, through enhanced agricultural productivity while ensuring that local and global environments are protected.

The advantage of this system of farming is that it is practical in small holdings, ensures steady flow of income from the sale of egg as well as fish (FAO, 2010). In this way farmers are able to get food through out the year. This form of farming has also helped to recycle nutrients and minimize pollution in low lying areas. Self help groups run these projects with funding from European Unions' Community Development Fund (CDTF). The fund with its community environmental facility has been working closely with conservation effort as well as improving livelihoods through income generating activities.

2.2.3.9 Integrated Sugarcane-Oil Palm in Western Kenya

Other possibilities of integrated farming system exist in Kenya. FAO has been exploring the potential of oil palm in western Kenya in partnership with Mumias Sugar Company

and its out grower network of some 60,000 farmers. This will provide much needed crop diversification for local sugar cane growers (Steel and Griffiee, 2001).

Traditionally, in their small plots of land farmers practice livestock-crop farming system. Small scale farms grow most of the corn (maize) as well as produce potatoes, bananas, beans and peas (World Bank, 2010). Since agricultural practices are still traditional, food production has been on the decline from 2001 to date. Small scale farmers have not been able to move away from subsistence production, thus poverty and hunger still remains a big problem among rural farmers. Indeed, every year, the Government is faced with the challenge of feeding over 1.4 million people especially in ASAL regions (WFP, 2010).

However, even in agriculture potential areas, farmers put more emphasis on maize farming because of its “importance”. Kenyans demand white maize flour to produce “Ugali” which forms part of their daily food intake. On average, Kenyans depend on white flour for almost 50% of their daily calorie intake. Maize is a major staple food crop in Kenya and is central to food security since 90% of Kenya’s population depends on it as a food source and an income generating commodity (Nyangito and Nyameino, 2002). Maize is both a subsistence and commercial crop grown on an estimated 1.4 million hectares, which is more than 30% of the arable land, by large scale farmers and small scale farmer (Ministry of Agriculture, 2009).

More that 2/3 of the maize produced comes from small scale growers (approximately 3.5 million) producing on farms that are less than two hectares in size (Ministry of Agriculture, 2009). The remainder of the maize crop is produced by approximately 1000 large scale farmers who own large tracks of land mainly in Trans Nzoia and Uasin Gishu

District of the Rift Valley (ACDI/VOCA, 2007). It is produced in almost all parts of Kenya for home consumption whereas the surplus is marketed for cash. The average maize production for the last five years is 2.4 million tones (2002-2007) for a population of 31 million people and constituted 3% of the GDP. According to Ministry of Agriculture, National Cereals and Produce Board (NPCB) and other sources, maize consumption in Kenya is currently estimated at about 32 million bags per year. This is not enough to feed the country's population of about 39 million people.

The 2007 economic review of agriculture indicates that 51% of the Kenya population lacked access to adequate food. In the same period, 46% of the population was estimated to be poor. The government continuously feeds 1 million people per year especially in arid and semi arid areas.

As noted earlier small scale farmers have not moved away from monoculture to a more diversified and integrated agriculture in Kenya. Thus, incase of drought the country is plunged into a famine situation. In Kenya maize is almost synonymous to food and incase of drought many homes are left vulnerable. Cases of hunger abound because farmers do not practice complementary agriculture to cushion them against this. In addition even where there are permanent rivers, farmers rely on rain water for farming.

In the year 2000, 80% of the total food production failed due to severe drought (FAO, 2000). The North and South Rift received inadequate rainfall and only some parts of Nyanza and Central Province (which are close to self sufficiency) received enough rainfall. In 2008, the country faced a real challenge in food availability. This was

attributed to short rains in 2008 in lower Eastern, North Eastern and parts of Central Province. The Kenya Food Steering Group (KFSSG) comprising of the Government, UN bodies and NGOs carried out an impact assessment of long rain on food production. It was discovered that in 27 ASAL Districts and 3 Districts affected by post election violence where the study was conducted, about 1.38 million people in rural areas faced chronic food shortage and needed support for at least 6 months from March 2009. The report also estimated that the cost of short term intervention by sector ministries would be 5.37 billion Kenya Shillings. The intervention included: Provision of health and nutrition package, Purchase of relief food, Mass livestock vaccination, off take program, restocking and purchase of animal feeds.

In 2008, the attempt to import maize for emergency was frustrated by Tanzania's ban of export of maize. It is important to note that Kenya receives about 2 million bags of maize through cross border trade with Tanzania and Uganda. In the same year, there was a shortfall of about 3 million bags that had to be bridged.

In 2009, Kenya was again plunged into a state of emergency as one of the world's most serious hunger location (FAO, 2009). Failure of seasonal rains, successive years of drought in some regions forced 3.8 million people into dependency on international food aid. 2010 was a repeat of 2009 hunger phenomenon on Kenya. Again the cause of hunger is drought and crop failure. As Stockholm Environment Institute points out, Kenya's inability to adopt to existing climate variability, is its greatest undoing and costs the economy possibly as much as \$0.5 billion per year – which is equivalent to around 2% of GDP.

Whilst drought was the immediate cause of hunger, the food security crisis was the culmination of many years of mismanagement of agricultural sector and its associated risks. According to UN development assistance framework for Kenya for the period 2009-2013, the nutrition situation of the children in Kenya has not improved in the past 20 years. Whilst the Government attributes hunger to drought, the reality is that rural economic policies are fragmented across government departments, leaving small scale farmers with limited access to credit, technical advice or direct financial support (Stolk home environmental institute)

In 2011, rainfall has been unreliable. There has been warning of low rainfall Lanina seasons. There is growing concern that neither farms nor animals will have sufficient time to recover from one period of drought to the next (WFO, 2011). It is against this backdrop that on 30th May 2011, the President declared hunger as a national disaster.

The fore mentioned depicts hunger as a common phenomenon in Kenya. Hunger, as interpreted by most Kenyans is lack of white maize flour which forms the major staple food. Thus, the government tends to “solve” food crisis by importing maize as a stop gap measure and farming more of it to meet increased food demand. It is evident that maize farming alone can not eradicate extreme poverty. In Trans-Nzoia County, for example, more than 95% of farmers cultivate maize and rely on its sale as a means of livelihood (Ministry of Agriculture-Trans-Nzoia district food security report, 2011). As soon as maize ripens, they start drying and selling at very low prices in order to meet their household needs. By the end of the harvesting season, they are left with no stock to last them through the next season. Though this area is agriculturally productive, there exists a

situation of *hidden hunger*. Farmers tend to sell a lot of maize to cater for their needs. Approximately 15% is sold for December festivities; a further 25% for school fees in January and 6% of the total output is consumed (Ministry of Agriculture- Trans-Nzoia district food security report, Feb, 2011). Farmers lack food to last them through to the next harvest.

In conclusion, maize farming alone is not enough to ensure food sufficiency as has been demonstrated by farming practices in Trans-Nzoia. To achieve this, farmers need to diversify agricultural practices as has been done in other parts of the world.

The growth of agriculture sector has done little to alleviate the grim picture that is food scarcity and poverty. In particular, small scale farming has not managed to transform itself from cereal based subsistence farming to mixed enterprise, market oriented agriculture. Experience in Asia in particular and more recently in Africa indicate that farming systems based on the integration of crops, livestock, and fish production can make a significant contribution to this required increase in food supply. More specifically development potentials have been clearly demonstrated to exist in the rural areas of Zambia and local technologies have been tested and fully applied.

Thus, if small scale farmers in rural Kenya were to move away from subsistence practice (monoculture) to an integrated system of farming as is done in Asia, USA, Malawi, and Thailand, perhaps the country would eradicate extreme poverty and ensure food security in line with millennium development goal number 1.

2.3 Challenges Facing Small Scale Farmers

There are a myriad of challenges facing small scale farmers globally. Peasant farmers in Asia produce under very high levels of uncertainties posed by natural hazards, for example, weather pests, diseases, and droughts etc (Ellis, 1992). This is compounded by market fluctuation and social uncertainties, for example, insecurity associated with control of resources such as land tenure and state intervention. These conditions pose a great risk to peasant farmers and therefore they must be very cautious when making production decisions such as what to produce, how to produce and at what cost.

Lipton and Longhurst, (1968) opines that small scale farmers are of necessity averse to risk because they have to secure their household needs from their current production or face starvation. Thus, there is no room for aiming at higher income levels by taking risky decisions. So when choosing among risky income streams, households first opt for safety and from the safe alternatives they choose based on expected utility - and possibly expected income (Leong and Morgan, 1973). This might explain why many small scale farmers are reluctant to diversify their farming practices in order to be food secure. Where farms are small and much of the produce is used by the farmer and his family, the risk of trying a new crop is much worse than for a more prosperous farmer; the loss of crop could mean not only monetary loss but starvation. Small farmers have little extra money to spend on seeds and fertilizer so they find it difficult to change to a new crop variety. In addition small farms are more difficult to irrigate and scattered fields make the application of fertilizer and the control of pests and diseases more difficult, (Leong and Morgan, 1973). In addition, small scale farmers cannot afford machinery and it is always

uneconomical. In Kenya, most small scale farmers practice the traditional jembe and panga kind of farming.

This archaic form of agriculture is inefficient and ineffective ; yet like other small scale farmers else where, poverty makes it almost impossible to embrace modern ways of farming ; to move away from monoculture to mechanized, intensive and market oriented farming. Farmers are averse to risks and would rather do things the old way and that is not quite helpful; especially as land sizes keep shrinking.

2.3.1 Labor

Another challenge facing small scale farmers is lack of labor especially in Europe and America (Banner, 2011). A farmer who for example farms five acres of land finds it hard to cultivate, harvest and process crops on this scale. The farmer can not efficiently seed a plot of this size by hand alone, or weed them, or harvest, or even thresh and winnow them. He seriously needs the help of people. Unfortunately the days when a village would stop whatever they were doing and turn out to help are gone. Thus farmers might decide to plant one crop say maize to avoid unnecessary complications that arise from integrating various farm activities.

In America the young generation is averse to working on the farms (Bob Banner, 2011). Radical changes in life style have seen youth migrate to urban areas in search of employment (white color jobs); and perceive manual labor as demeaning and a preserve of the illiterate and the old. This is a challenge because it creates labor shortage even in Africa which experience hidden unemployment.

2.3.2 Machinery

Lack of appropriate machinery is a big problem to small scale farmers in the U.S. Most machinery available is suitable for big tracks of land (hundreds and thousands of acres.) They are too big to move around an acre of land (Barner, 2011). Imagine a wheat combine harvester moving around a half an acre of land! The equipment needed for small acreage is no longer manufactured and has never been on a mass scale production since 1970s.

Machines reduce the irksomeness or the drudgery of farm chores. Modern farming technology should be labor saving, labor enhancing and labor enlarging. However, according to AGRF (2012,) Africa's agriculture remains poor due to limited application of modern science and technology. The equipment available (sickles, machetes, knives and hoes) are not only cumbersome but time wasting. In contrast to the above, in India and china where small scale agriculture is diversified, equipment for small scale farming continues to be developed with new innovation (Barner, 2011). This perhaps explains why farmers in Asia have been able to switch from conventional to sustainable agriculture.

In Africa even if machines were available, they are made abroad. This implies that they become more expensive to buy. And even if farmers were able to buy them, regardless of how perfect they are, farmers would still need to have knowledge on small machine repair to avoid the inconvenience of having to look for someone to fix them.

2.3.3 Lack of Knowledge and Financial Resources

One of the reasons why small scale farmers are food insecure is lack of knowledge on how to grow on a smaller scale, that is, how to integrate farming activities within their small holdings (Ozowa,2010). How does a farmer grow vegetables, keep livestock(cows, goats and chicken) grow fish and keep poultry in a three acre piece of land? Without necessary skills, farmers practice monoculture.

In Nigeria, agriculture information is not integrated with other development programs to address the numerous related problems that face farmers. Information is essential ingredient in development of agriculture but in Nigeria farmers seldom feel the impact of agricultural innovations either because they have no access to such vital information or because it is poorly disseminated. Institutional and government organs have been put in place to ensure that farmers get to know and adopt agricultural innovations relevant to their situations e.g. agricultural extension and research liaison services (AERLs) the extension services of the agricultural development project (ADPs), Ministries of Agriculture at both state and federal levels, media forum for agriculture, cooperative extension services (CES) of universities and public enlightenment units of the 18 agricultural research centers.

These bodies serve as facilitation of agricultural messages by acting as communication departments. They use different channels (leaflets, newsletters, posters, exhibits, visual aids and radio) to communicate information. In Nigeria, farmers rank extension highest in terms of providing credible information and advice especially on agricultural technology (Ozowa 2010).

The information provided is exclusively focused on policy makers, researchers, and those who manage policy decisions with scant attention paid to the information needs of the targeted beneficiaries of the policy decisions. Non provision of agricultural information is a key factor that has greatly limited agricultural development in developing countries. There is need to take new approaches to information dissemination and management that grow out from a clear understanding of what farmers information needs are.

The general lack of awareness among farmers can be attributed to high levels of illiteracy – low levels of adoption of technology. Extension worker to convey information in a meaningful form to farmers’ e.g. training of a group of model farmers with hope that such farmers come in contact with other farmers – trickle down effect is necessary because farmers outnumber available extension.

In Kenya, farmers grow maize in their small holdings which is not enough to provide food and income throughout the year. Perhaps they need to know that farmers are not just farmers but business men and women and stewards of their land. The government should consider bettering extension services.

In recent years agricultural extension services have declined due to retrenchment, natural attrition, freeze on hiring of new staff, and reduced resources for operation and maintenance. The number of extension service providers declined from 30,000 in the mid 1960s to 4,783 in 2002 (Ministry of Agriculture, 2009).

The crop of extension staff in contact with farmers is not very qualified – most of them are certificate and diploma holders – who numbered 3,532 in 2002. The ratio of field

extension workers to farmers is 1:820. This ratio is grossly inadequate and farmers do not feel the impact of state extension.

Recent studies have shown that alternative extension service system (e.g. by NGOs and CBOs) cannot perform in the absence of state extension, which they rely upon for support and expertise (M.O.A, 2010). There is therefore justification for maintaining some presence of professional state extension workers. There is need to undertake extreme radical reforms of public agricultural extension by for example: Moving away from maintaining a permanent presence in every administrative sub-location, Gradually moving away from actual delivery of extension messages to a supervisor/facilitator to other providers, Funding new initiatives under this strategy including piloting of a number of recent innovations and practices in new methods and institutional frameworks for delivering extension services, and Instituting a new pluralistic, and demand driven extension services as more of the actual delivery of messages will be delivered by players outside the public sector.

To meet the new role of supervisor/facilitator, there is need to develop human capacity. The staff in public extension needs to be better than private providers. Public extension will need replacement by graduate staff that should be trained in new approaches. The existing staff must also be retrained.

2.3.4 Credit

These are Loans advanced to farmers to finance and service production activities relating to agriculture, fisheries and forestry. According to AGRF (2012,) farmers in Africa remain poor due to lack of access to financial and other supportive services. Some

farmers are unaware of existing facilities (Ozowa 2010). There is need for information relating to sources of loans such as names of lenders, location and types of existing credit sources, terms, interest rates and loan able amounts. Credit and rural financial services to small holder agriculture is very crucial.

This problem is compounded by lack of a marshal plan for small scale farmers in Kenya. In U.S and Europe, small scale farmers have enjoyed government subsidies for farm inputs and as a result, they have been able to produce at low cost. (Barner, 2011). For this reason, they have realized food security. Conversely, Kenyan farmers face a daunting challenge of high cost of production resulting from run away cost of farm inputs. How can a farmer who wishes to plant maize, beans, grow vegetables, keep poultry and perhaps keep cows in his plot when all this require heavy investment that is beyond his capability?

Only about 22% of rural farming households in Kenya have any form of bank account (Kosula, 2006). Under such environment, there is a challenge to design strategies that meet the financial service needs of small scale producer that will ensure increased access to finance. In addition to this, most small scale farmers lack title deeds for their plots which could act as collateral in financial institutions. As a result their effort to invest heavily in integrated farming is hampered by lack of funds.

Also important is the need to hasten land registration to protect the interest of small land owners. There are many cases of private titling quickly leading to land being transferred to the rich, adding to the growing list of the landless. A special land policy is also needed for ASAL regions. Irrigation needs to be initiated otherwise the areas are only good for

extensive livestock production. Group titles in marginal areas have proved more successful where common rights have been the norm. This helps people in this region get title deeds.

In the 1970 to early 1990s, farmers benefited immensely because then, Farmer's Co-operative Societies were still active and vibrant (Larsen, 2009). The society extended credit facilities to farmers in form of seeds, fertilizer and even ploughed land for them. At harvest time, the societies bought produce from the farmers to recover the loans earlier extended to them. But towards the end of 1990s, co-operative societies collapsed as a result of mismanagement and rampant corruption. Farmers find it hard to get credit facilities.

Small scale farmers lack money required to initiate intensive farming in their small holdings. To start a zero grazing unit, a farmer needs approximately ksh 100,000. Most of them cannot afford to raise this money. The problem is further complicated by the fact that farmers do not have title deeds which may act as collateral in financial institutions like Agricultural Finance Co-operation.

The number of people with title deeds is estimated at 60%. Due to delays in payment of land rates, the issuance of title deeds to farmers is a slow process in Trans Nzoia East, thus 40% of farmers do not have necessary land deeds (Ministry of Agriculture, 2010). Those who have them are afraid to take loans from microfinance institutions like K-Rep, Faulu Kenya and Kenya Women Finance Trust. The lending rates are so high that small scale farmers are unable to repay comfortably. Those who default are dealt with highhandedly. This has discouraged farmers from borrowing

2.3.5 Marketing

In order to eradicate extreme poverty there is need to make markets work for the poor. In most, rural areas, markets either do not exist or function poorly. Selling is normally at farm gate or road side and farmers have little or no information on the prevailing commodity prices in major market place (FAO, 2010).

Investment is required in strengthening of farmer groups and associations, market information, rural infrastructure, storage processing and capacity building.

Marketing of farm produce is a major challenge to small scale farmers in Africa. In South Africa, small scale farmers face stiff competition from big and well established farmers who control a large market share. On the other hand, farmers choose to cater for perceived customer desire rather than concentrate on what grows best and presenting a balanced nutritious diet to the customer and educating them about it.

Lack of buyers willing to pay better prices is another challenge facing small scale farmers in Kenya. As a result of this, farmers are exploited by middle men. Though some farmers may wish to sell their produce at a better price, the market complexities in Kenya hinder them from accessing good prices. In December 1993, Kenya liberalized the grain market to phase out the monopoly of NCPB and subsequently reduce milling, transport and storage costs. In the previous years, the NCPB controlled the marketing and transport of grains in Kenya and was legally empowered to purchase strategic grain reserves and famine relief stocks. This often distorted market prices for farmers. Farmers were able to sell their produce only at below the market prices recommended by NCPB. The Government effort undermined efficiency in the production and market development,

induced uncertainty and curtailed development of value chain reaction, processing and marketing (Nyameno and Nyangito, 2005). Under liberalized regime, there are many different ways in which maize reaches the consumers. The maize marketing channels vary depending on where it is grown. The main actors include small scale maize traders (14-15%) medium scale agents lorry traders (40%) NCPB (25%) other large scale traders (40%) and maize millers (10%) (Larsen, 2009). Even with liberalization, small scale farmers have not fared well. Middlemen (lorry traders) who form 40% of buyers exploit small scale farmers by buying maize and beans at a throw away price (Larsen 2009). But faced by biting poverty, small scale farmers are forced to sell grains to meet their pressing needs and by the beginning of the next season, they have exhausted all that they harvested. Indeed, from producers of food, they become buyers from well off large scale farmers. But in order to earn money to buy food they look for casual employment in larger farms where an adult worker is paid Ksh 100 per day. This is hardly enough to buy food. Currently a 2Kg tin of maize (goro goro) costs Ksh 140. This is hardly enough to feed a large family. In this part of the country, from March to September, small scale farmers experience serious shortage of food as well as money. If they were to integrate farming such that at every time of the year they would be able to sell a variety of farm produces through out the year they would become food secure. This is possible with good planning and management.

2.3.6 Unfavorable Weather Conditions

It has become increasingly obvious that this is an era of increasing climate instability, (Elnino, Lanina, unexpected and sudden temperature rise among others) leading to crop failure. As pointed earlier, farmers have not learnt to cope with the changing climate

pattern. They are always at the mercy of erratic weather patterns. Failure to practice irrigation has not helped the situation. This has harsh consequences on those who practice monoculture. In case of crop failure the consequences are grave (severe hunger and monetary losses) because of failure to integrate their farming practices.

In view of food insecurity that prevails in Trans-Nzoia , the Government through the Ministry of Agriculture gave 7,000 small scale farmers free seeds and fertilizer in 2009 (Ministry of Agriculture , 2010) The target group was farmers with 3 acres and below. The intention was to enhance food production and to fight hunger. This was also after realization that the harvest in 2008 had gone down as a result of the post election violence that displaced many potential farmers in Rift Valley. There was an urgent need to step up food production to meet increased demands for food but this effort never yielded much. From June to July, there was a spell of drought that interfered with tussling and combing of maize. As a result, production was less than expected. The average harvest was 36 bags per hectare as opposed to a target of 50 bags per hectare. This unexpected weather pattern also affected production of beans as well as vegetables.

In 2010, the Government again subsidized fertilizer; farmers were able to buy fertilizer from NCPB at ksh 2000 per bag. There was adequate rainfall and production averaged 50 bags per hectare. However, during harvest time, these regions experienced heavy rainfall and much of the maize went to waste as a result of rotting. For two years that the Government has tried to help farmers directly to boost their production, little has been achieved. Farmers have had to contend with ravages of capricious weather pattern. This

has not augured well with food production and thus a situation of food security has remained a mirage in a region which has great potential to feed its people.

Another challenge facing small scale farmers in Kenya is access to inputs such as fertilizer and seeds. While as large scale farmers tend to increase the rate of fertilizer usage, small scale farmers, on the other hand, are inconsistent in their use of fertilizer. Apart from this, small scale farmers use chemical fertilizers in most of their farming activities rather than use organic manure in form of waste from various systems in integrated farming practices. In Kenya, the cost of chemical fertilizer is very high for poor farmers to afford. Some farmers lack knowledge of deriving organic manure from farm waste products. As a result, they realize low yields when they can not afford to buy chemical fertilizer.

2.3.7 Chemicals

Also critical to production is good use of chemicals. In Kenya, chemical companies introduced bio-pesticides in response to food safety and environmental concerns and also as a part of their market strategy. Bayer East Africa's Green Flagship, for example, focuses on local stockists as the link between the company and farmers. There are 4,500 stockists in Kenya that are linked to about 60 agro-dealers (Larsen , 2009). In contrast to the strong link between Bayer and agro-dealers there seems to be information disconnect between stockists and farmers. Stockists need to provide better service to small holder farmers. Bayer introduced an initiative to build stockists capacity to matching needs and best practices including a regime for spraying that supports sustainable agriculture and the provision of green bins to stockists to collect waste. These green initiatives were

motivated by concerns over adulterate products, inadequate environmental safety and absence of links between product packaging and small holders' needs (Kurt Larsen et al, 2009).

Efforts to link small scale farmers to input suppliers is mutually beneficial because small scale producers will gain access to inputs and the supplier of inputs enjoy greater business, for example, input suppliers could further increase sales by holding farmers' field days where they can demonstrate good use and storage of improved seeds and farm inputs (Larsen et al, 2009). In many cases, intermediaries in the value chain such as processors or wholesale brokers may provide input on credit with repayment due upon sales of the agricultural products. Value chain performance will seriously deteriorate if farmers use good seeds but under use fertilizer, or if fungus ruins the crop before it is harvested. Thus, a full set of inputs with the associated services are necessary to ensure optimal results .In other cases, storage of grains is also a problem. Stock borers destroy harvested grains and so most farmers cannot store them to last them throughout the season.

The growth in grain production during the 1960s and 1970s was due to an increase in land used for farming and government and donor support for new methods of crop production. These included improved techniques for land preparation and weed control, the use of better seeds and the introduction of fertilizer (Oluoch et al, 2006).

Financing the MDGs in Africa still remains a big challenge. With growing economy of 4.3%, the country faces a big challenge in financing MDGs. Kenya has made progress in achieving goal 2 (achieve universal free primary education) and goal 6 (combating HIV

and AIDS, malaria and other diseases) but will need to scale up efforts to achieve other goals. Kenya needs to grow at 7% and must formulate sound policies (Ministry of Planning and National Development). The main objective of targets of MDG 1 on poverty and hunger is to reduce the population who suffer from hunger by half by 2015. Between 1963-1982 agriculture GDP recorded high growth rate of 4% and above per annum but declined significantly thereafter to reach 1% in the last one and a half decade.

The factor that impacted negatively on agricultural growth included: mismanagement of farmer support institutions that affected the areas of marketing, credit, seeds and farm inputs, dumping of agricultural commodities such as dairy, maize and sugar in the local market, depreciation of the Kenyan shilling resulted in large increase in the cost of imputed farm inputs, reduction of donor support reduced resource available for investment in agriculture, and decline in budgetary allocation in agriculture.

The Government has formulated two strategy papers relevant to food security/hunger reduction: the ERS and the strategy for revitalization of agriculture (SRA, 2004-2014). The SRA estimates annual budget of ksh. 13.5 billion (\$168.75 million) is based on traditional activities and budget lines of ministries of agriculture and livestock and fisheries, namely research, extension, credit of rural development. It does not address other programs of hunger reducing actions envisaged in the hunger MDG such as school feeding programs and food - for -work, hence the need to provide additional resources for supplementing the budget in SRA.

The strategies to increase agricultural productivity includes investing in soil health (mineral fertilizers, organic manure and soil conservation), small scale water

management (small holder irrigation, livestock water), improved seed, agricultural extension (gradually moving away from actual delivery of extension managers to a supervisor/facilitator to other providers) and agricultural research.

The intervention for rural income generation include storage, livestock (small holder dairy livestock keepers and pastoralists), credit and rural financial services, farmers associations and community-based farmer training centers, food/cash for work programs (use of labor intensive methods for development of infrastructure), development of small holder markets among others.

Nutrition interventions include children under five years, school meals, pregnant women and lactating mothers, supplemental feeding for vulnerable groups, elderly people, emergency feeding centers (to support situations such as drought and floods, fires and internal displacement) and capacity building for food security and nutrition – this includes development of a nutrition policy that is embedded in food policy.

To achieve MDG 1 the Government will meet the cost of infrastructure, farmer support services and social welfare programs; while small holders will pay for materials and services directly benefitting them such as fertilizer, improved seeds, AI and credit.

Out of the total investment, farmers will pay \$968 million (12%) and the government \$7,285 (88%). Small scale farmers will find it a big challenge to shoulder the costs. The annual cost of achieving the MDG 1 from 2005-2015 is \$8,525 million. Development partners must commit such greater financial assistance.

There are 2.9 million small scale farmers in Kenya holding 1 hectare and less (Ministry of Agriculture, 2009). The Government has targeted this group in increasing agricultural productivity. The main reason for targeting this group is that this category is considered food insecure. In order to meet MDG 1, agricultural productivity must triple. To do so, five interventions have been identified. This includes investing in soil health, improved seeds, small scale water management, extension services and research.

2.3.8 Failure to carry out research

This is mandatory if MDG 1 is to be realized. It is estimated that investment of 1% of agricultural GDP (or \$ 17 million in Kenya case) in research will triple productivity in the small holder sector. The required areas of research intervention for the small holder sector are small holder technology development, on farm research and verification and technology delivery. Analysis show that research costs amount to \$ 6 per small holder per year. This translates to \$ 17 million for 11 years.

2.3.9 Poor / unproductive soils

AGRF (2012) attributes low yields in Africa to high rate of soil nutrient depletion. To improve soil fertility, there is need to integrate physical, chemical and biological methods (Ministry of Planning, 2006). The physical and biological methods include soil erosion control, use of animal manure, crop rotation, agro forestry and integrating crop-livestock production system. This would ensure high yields and diversification of agriculture even in small holding farms (Ministry of Planning, 2006).

AGRF (2012) asserts that Africa's farmers use an average of 8 kg of fertilizer per hectare. The Abuja Declaration on Fertilizer for Africa Green Revolution (2006) resolved to increase fertilizer nutrients per hectare by 2015. In Kenya however, the recommended quantity is 50 kg per acre. The 2.9 million small holders use little or no fertilizer, and the estimated 15% who are able to apply fertilizer do not actually use the recommended amounts because of cash constraints. The major constraints are therefore, affordability, availability, access and information/knowledge on usage. Currently, the main users of fertilizer are large scale producers of maize, wheat and horticulture and also farmers in tea, coffee and sugar sector.

Even government efforts to subsidize fertilizer have not helped much. The logistics involved in distribution does not favor small scale farmers. Subsidized fertilizer is bought at NCPB center in Kitale but not anywhere else. Farmers with one acre or less find it tedious and time wasting to travel from the far end of the District in search of fertilizer. At times they take more than a month to get it. It would be easier if NCPB was to operate from other counties outside Kitale town. This would make it easier for farmers to access farm inputs with ease.

In addition, most farmers do not cooperate to facilitate easy access to farm inputs. NCPB prefers dealing with groups of farmers rather than dealing with individuals. Mistrust and suspicion prevents farmers from forming groups so that they can be assisted by the NCPB.

2.3.10 Over reliance on rain fed agriculture

Another challenge that contributes to food insecurity in Kenya is that farmers rely on rain waters for irrigation. When rain fails, then the result is crop failure, hunger and poverty. In Trans-Nzoia, out of 4,300 hectares that is potential for irrigation, only 500 are put under irrigation. In Suwerwa, location irrigation has not been seriously considered as a viable way of utilizing land. After harvesting maize at around October, the land lies fallow until March. This is enough time to grow vegetables before the next maize planting season begins. Unfortunately, this does not happen.

In Kenya land suitable for irrigation is approximately 540,000 hectares but only 103,233 hectares (19%) are irrigated (Ministry of Planning, 2006). The current structure of irrigated agriculture comprises 48,075 hectares for small holders, 47%, 42,700 hectares for private commercial farmers (41%) and 12,458 hectares Government managed (12%), making a total of 103,233 hectares.(Ministry of Planning, 2006).

Both Government and small holder, managed irrigation programs settle small holders on approximately 13 hectares per family. From experience, it has emerged that government managed irrigation schemes are inefficient due to Government problems. The Government is therefore prioritizing on small holder managed development scheme. The challenge faced in this effort is poor infrastructure and huge costs involved in land leveling and water conveyance. Once complete, farmers bear the cost of sustenance. They will be charged maintenance levy. There is need to form farmers association which will be in charge of production and marketing of the produce.

2.3.11 Seeds

Improvement in agricultural inputs primarily seeds, fertilizer and chemicals can have an enormous potential to leverage the efforts of farmers (Larsen,2009). If used appropriately, improved inputs can mean the difference between a good harvest and starvation. The most obvious result of improved inputs is a dramatic increase in production and a greater profit. Small scale farmers find it difficult to buy the required inputs: fertilizer, chemicals and even certified seeds. From 2007 to date, the price of fertilizer has skyrocketed. This is attributed to various factors, for example, the post election violence which saw prices of almost every commodity shooting up. Even now, the price of fertilizer and seeds is way beyond affordability for the small scale farmers. The researcher will find out if this has affected small scale farmers in Suwerwa location.

To realize food sufficiency, there is need to improve on quality of seeds. Seed systems comprise of certified hybrid and open pollinated varieties, and farmers own selection from previous harvest. NGOs have promoted use of improved small cereal seeds (sorghum and millet) and vegetative propagated material (cassava, Irish and sweet potatoes). But the use of these has not been captured in seed statistics (Ministry of Planning, 2006). Only data on maize and beans exists. It is important to have certified seeds of all types in order to realize high yields.

The government effort to subsidize farm inputs has not helped much. Distribution of free seeds and fertilizer at subsidized price has been riddled with corruption. The very poor who need assistance do not get help because of a number of factors. In many cases, fertilizer arrives long after the farmers have planted. Apart from this poor logistic in

distribution of seeds and fertilizer makes it hard to reach the intended beneficiaries. This does not help much. As a result of this, small scale farmers especially in Kenya realize low yields season after season.

2.3.12 Storage Facilities

Small scale farmers also face insecurity of their produce. Since most of them do not have storage facilities, their produce is stolen either on the farm or even at home. They therefore sell most of their maize and “save” their money rather than have it stolen. This has contributed to hunger. The problem of subsistence farming in Trans Nzoia is that harvest is like a bonus to farmers: a time to feast, to pay debts and to celebrate. This leaves farmers with little food to last them throughout the year (Ministry of Agriculture, 2009).

As by June 2011 food stock had dwindled very fast and this was aggravated by the fact that there was no casual labor to enable people to get food in exchange. Lastly, the price of maize and other essential commodities had risen dramatically. For those who are poor, they faced real starvation. Thus we can conclude this chapter by saying that, although food production in Trans Nzoia East is high, there exists a situation of poverty with about a half the population classified as poor and about 20% lacking food.

Maize production is usually characterized by high costs of inputs and low yields. On average, the production cost is Ksh 11,774 per hectare and the yield rate is 1,334 Kg per hectare (Larsen , 2009). Thus a common feature of maize farming is low returns. In Kenya most of the maize farmers use artificial fertilizers (DAP and ammonia phosphate for top dressing) and just a few use manure. If they would integrate farming activities

such as demonstrated in millennium villages in Kenya, they would say, use animal waste to improve the soil quality instead of always using artificial fertilizer which is costly and at times beyond affordability. In this way substantial returns (food and extra income) can be obtained for relatively little cost.

On farm storage losses are high, estimated at 30%. Small holders sell immediately after harvest when there is glut in the market and prices are low.

Food storage will ensure that farm households have sufficient food to last until the next harvest and fetch better prices for their produce later in the year. It is estimated that only 10% of small holders require community store facilities (Ministry of Planning, 2006).

2.5 Critical Review of Literature.

This chapter has examined different types of integrated agricultural systems, their success and challenges. We have also learned that where it has been practiced, it has contributed to food security. This part delved into the general practice of integrated agriculture, its determinant, characteristics, benefits and challenges as well as factors that have contributed to its success in the different parts of the world as mentioned before and evaluates their applicability in rural Kenya.

This type of farming is necessitated by dwindling land size. With ever increasing population size, there has been immense pressure on available land. This has led to subdivision of land into tiny portions that are no longer viable for large scale commercial agriculture. Another factor that has forced farmers all over the world to adopt integrated small scale agricultural production is the ever rising prices of external farm inputs, for

example, chemical fertilizer. This has of necessity forced farmers to adopt complementary form of agriculture.

We have also noted that this kind of farming is beneficial because it is self sustaining through interdependence of various complementary farm practices. This lowers the cost of production because it is characterized by low external inputs and high internal inputs from various farm enterprises. Each activity complements the others and so the cost of production is minimized while at the same time the farmer is able to make the most use of the available land. Other benefits include high output, constant income throughout the year, enough food and lastly it is a source of employment.

It is also important to note that farmers all over the world produce under different environment and conditions. In USA and Europe the success of integrated small scale agricultural production is attributed to availability of cheap farm inputs because of government subsidies. In Kenya this is not so, thus, farmers face the challenge of producing intensively at low cost. In addition, Kenyan farmers rely on rain water to carry out farming activities. As opposed to Malawi, farmers have embarked on intensive irrigation in their tiny parcels of land and at the same time moved from monoculture to integrated farming activities. In Thailand, India and Japan farmers have been able to reclaim wet area and put them under intensive integrated rice-fish-pig farming system. However, in Kenya, even in the wet land where rice is grown farmers have done little to integrate rice farming with other activities for example fish farming.

It has also come out that farmers all over the world face various challenges. In USA and Europe the major problem is lack of appropriate machinery for their small farms as well

as labor scarcity. This is not the case in Asia because there is mass production of tools that are appropriate for small farms. Whereas labor in Kenya is abundant, the challenge is how to occupy it in a more meaningful way through integrated system of farming. In Asia especially Thailand the challenge facing farmers is uncertainty posed by land tenure system. Farmers fear undertaking long term projects in the leased farms because they cannot be certain about how long they will be allowed to lease the land as leasehold keeps on changing.

Other challenges include lack of knowledge regarding sources of credit facilities, such as names of lenders, terms, interests, location and even types of existing loans. This is a common problem in Nigeria. In addition, problems associated with marketing, extreme weather conditions, scarcity of farm inputs owing to exorbitant costs, storage and post harvest losses are some of the challenges that dog integrated small scale agricultural production in Africa. Lastly we looked at various systems of integrated agricultural production as practiced at global and regional level as well as in some parts of Kenya. It emerged that very little information exists about this type of agriculture in rural Kenya.

The next chapter of this study therefore investigated whether integrated small scale agricultural production is practiced in Suwerwa location, its features, benefits as well as pitfalls. Also important was to investigate if this practice has evolved into farm system that can ensure food security in rural Kenya.

CHAPTER THREE: RESEARCH METHODOLOGY.

3.1 Overview

This chapter deals with the description of methods that were applied in carrying out the research. It is organized under the following sections: research design, research population, sampling techniques, the target/total population of the study, sampling size determination, sampling procedure data collection and analysis. Research design shows the design chosen by the researcher and the rationale behind it.

3.2 Research Design

The research design that was used in this study is a case study. The researcher carried out an in depth study of small scale farming in Suwerwa location in context and holistically in order to have a deeper insight and better understanding of farming methods, productivity, food security and the challenges faced by small scale farmers in Suwerwa location. In addition, the researcher carried a detailed study of this place with a view to investigating whether integrated small scale agricultural production can meet the food requirement and other daily expenses of the people throughout the year. The researcher studied methods of integrated small scale agricultural production and suggested ways of making it sustainable i.e. meet the demand of food for the people throughout the year as well as generating income to sustain their livelihood.

3.3 Study Area

The research was carried out in Suwerwa Location. The choice of Suwerwa Location was appropriate because of the presence of both large and small scale farmers. There are

many small scale farmers who own as little land as 0.1 acre. The researcher studied small scale farmers (from 0.1 to 3 acres) within Suwerwa Location. Suwerwa Location has a population of 15,115 (according to population census carried out in 2009). Out of this population, 3,851 were ranked as poor. The sample size drawn from the universe (15,115 farmers) was 200.

Suwerwa location is in the former Trans-Nzoia east district. The temperature ranges from a mean annual minimum of 10 degrees centigrade to a mean maximum of 37 degrees centigrade. The average amount of rainfall is 11,200 M.M per annum. Rainfall peaks in April to August. September to October is marked by moderate rainfall but from November up to mid March is a dry spell that enables farmers to till their land waiting for the next planting season which begins in April. This region is productive because of the fertile volcanic soil, high rainfall and moderate cool and warm climate.



Figure 3.1 A cross section of Suwerwa location.

Photo taken at Bwake village.

Source: Field Survey

3.4 Sampling and Sampling Techniques Indicated

The researcher used both purposive and simple random sampling to select an appropriate sample for this study. The researcher's choice of Suwerwa Location was purposive because it fits the purpose of the study in the sense that it has 3,581 poor people out of a total population of 15, 115. The location also has a significant number of people who are food deficit. Lastly, it boasts of many small scale farmers who still practice farming at subsistence level.

3.4.1 Sampling Size Determination

The researcher did simple random sampling. It was important to first establish the exact number of small scale farmers in Suwerwa. This was then followed by simple random sampling. It involved listing all small scale farmers and selecting the elements to be included in the sample randomly. This ensured that every small scale farmer had an equal chance to be studied/to be included in the study. This also enabled the researcher to draw generalization.

After listing all the small scale farmers, using a sequence of numbers from a random numbers table, the researcher got a sample size of 200 using the following formula

$$n = \frac{N}{1 + N (e)^2}$$

where n = Sample size that I want
 N = Total population (15, 115)
 e = Margin of error
 1 = Constant

The margin of error in this case is 0.07024.

The researcher decided to use simple random sampling because it yields research data that can be generalized to a larger population. In addition, each element of the population (small scale farmer) is given equal and independent chance to be selected in the sample.

3.4.2 Sampling Procedure

In order to assess the productivity of small scale farmers, the researcher used data from the Ministry of Agriculture. This is quantitative. The researcher got facts and figures from the data captured by Ministry of Agriculture obtained from the county headquarters in Kitale. He also interviewed the officials from the same ministry to find out challenges facing small scale farmers. The data collected was qualitative. The choice of Ministry officials as respondents was informed by the fact that they have data on the recent trends in agriculture as well as data on food situation within the District.

The researcher also collected information from respondents drawn from the list of small scale farmers through simple random sampling. The data collected in this case was both qualitative and quantitative. The researcher used structured questionnaires to collect information about features of integrated small scale agricultural production, the benefits as well as the challenges faced by the respondents.

To suggest ways of enhancing small scale agriculture, the researcher used focus group discussion. The data collected was qualitative. To come up with respondents, the researcher chose respondents who are well versed in matters pertaining to farming, for example, the area extension officer, the chief and his assistant, the Ministry officials, and a small number of small scale farmers in Suwerwa Location.

The respondents and the researcher brainstormed on ways of enhancing small scale agriculture. The researcher sought informants who were credible, trustworthy and reliable. To find out if small scale production can meet food requirements and other daily expenses throughout the year, the research drew informants from the sample derived from simple random sampling. The researcher used structured questionnaires which were administered to the respondents. The data was qualitative and quantitative.

3.5 Data Collection

The researcher used data from the Ministry of Agriculture and Ministry of Planning to collect information on productivity of small scale agriculture as well as food situation in (Suwerwa Location). Data that was collected in this case was quantitative. The researcher also used structured questionnaires which were administered to the selected respondents by the researcher and his assistant. This is relevant because the researcher was able to obtain credible information directly from the respondents. The researcher could clarify questions that the respondent found hard to understand. The data that was collected was qualitative.

The researcher held a brainstorming sessions/focus group discussions with key informants (official from Ministry of Agriculture), and small scale farmer to explore ways of enhancing integrated agricultural production to ensure food sufficiency as well as generate income. This was also used to find out challenges facing small scale production. The researcher interviewed the Ministry of agriculture officials as well as the District Development Officer to find out about food situation and the Government effort

to fast track agriculture. The data that the researcher obtained was qualitative and quantitative.

3.6 Data Analysis.

After collecting data, the researcher ensured that it was processed before carrying out the analysis. The primary purpose of pre-processing was to correct problems that were identified in the raw data. This involved elimination of unusable data, interpretation of ambiguous answers and eliminating contradictory data from related questions. Having corrected any errors that might influence data analysis, the researcher formulated a coding scheme. This entailed creating codes and scales from the responses which were then summarized and analyzed in various ways.

In the coding scheme, the researcher assigned codes to each likely answer and specify how other responses were handled. Then the researcher stored the information generated electronically. The researcher then entered the data in SPSS for analysis. The researcher did thematic analysis of related information following this procedure:

- Identified information that was relevant to the research questions and objectives.
- Developed a coding system based on samples of collected data.
- Classified major issues on topics covered.
- Indicated the major themes in the margins.
- Placed the coded materials under the major themes or topics identified i.e. placed relevant to a certain topic together
- Developed a summary report identifying major themes and associations between them.

3.7 Validity and Reliability

The researcher pre tested the research instruments to ascertain that they would generate the required information before going to the field. This was done in Kiriita Sub-location which has similar weather conditions and farming practices. The researcher found out that the research instruments would generate accurate and consistent data.

3.8 Ethical Issues

The researcher presented the findings and interpretations honestly and objectively to avoid untrue, deceptive or doctored results. He observed confidentiality. The identity of the respondents and the information that they gave was not disclosed to any one. Statistical procedures were applied without concern for a favorable outcome.

CHAPTER FOUR: DATA PRESENTATION ANALYSIS AND INTERPRETATION

4.0 Overview:

This chapter deals with how the data collected was presented, analyzed and interpreted using various methods. The end of this chapter is an attempt at explaining the trends of the flow and direction of data towards resolving the primary concerns and objectives of the study as outlined in preceding chapters.

4.1 Background information

4.1.1 Education level

Majority of the farmers in Suwerwa location have gone to school as illustrated by the pie chart in Figure 4.1. Those who never went to school are the minority making up 25 percent of the respondents, 57 percent attained secondary school education and 25 percent went further to tertiary institutions.

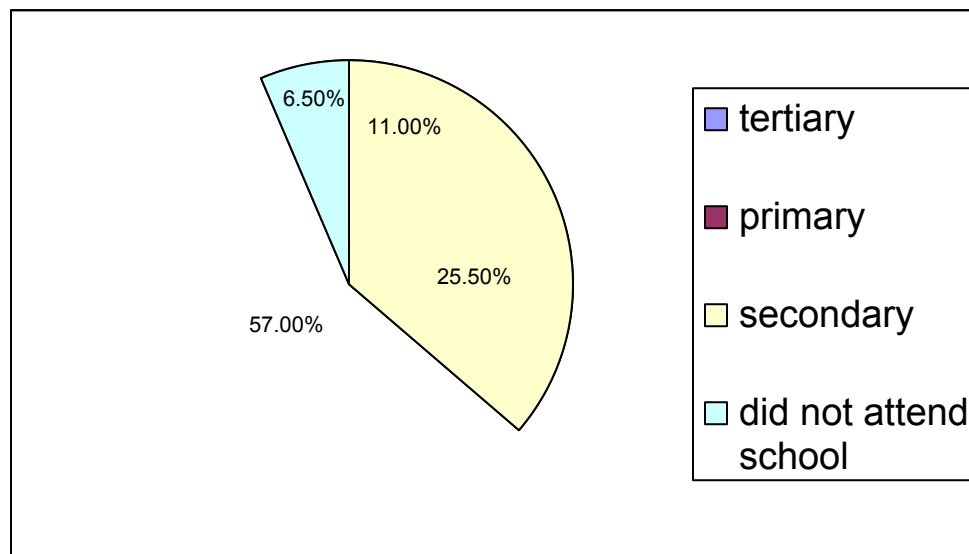


Figure 4.1 Respondents level of education

Source: Field survey (2012)

The researcher also sought to investigate whether the respondents' level of education has any impact on food security. Numerous studies conducted elsewhere have shown that the level of farmers education has a bearing to self food sufficiency. Amaza (2009) opine that the level of education influences the use of improved technology in agriculture and hence farm productivity. It also determines the level of opportunities available to improve livelihood strategies by exposing farmers to new ideas and managerial skills and production skills.

In this way farmers are able to integrate innovations into the household survival strategies to enhance food security and reduce the level of poverty. The researcher wanted to validate this argument and the following emerged.

Education level was cross tabulated against foodstuffs as shown in Table 4.1 .Using the chi-square test at 0.05 level of significance the researcher tested the relationship between the two

Table 4.1. Level of Education and Food Security.

Food security status	Education level attained by the respondent			
	did not attend school in %	Primary in %	Secondary in %	Tertiary in %
Maize				
Secure	6	22	57	14
Beans				
Secure	7	20	62	9
Vegetable				
Secure	8	22	62	6
Potatoes				
Secure	5	15	68	12
Milk				
Secure	4	20	69	7

Source: Field survey (2012)

The following result is obtained in Table 2 below. The P value for beans, vegetables and potatoes is greater than 0.05. Therefore we accept the null hypothesis for the three foodstuffs, and so, education level has a bearing on beans, vegetables and potatoes. However, it has no influence on maize and milk because their P value is less than 0.05. Maize farming is a traditional practice that has been passed down from one generation to another. Thus whether one has gone to school or not all farmers grow maize. This is also the case with milk. Respondents keep cows alongside farming maize. The p-value for beans and vegetable, which is .225 and .198 respectively, reflect the strong influence of education on farming of these crops. Beans and vegetable farming is a bit complex because they are prone to frost and fungal attack and thus farmers have to use pesticides and chemical fertilizers and in the right quantity. This kind of farming is not friendly to those who have not gone to school because they might be reluctant to embrace the use of appropriate means of production, for example, farm chemicals and in the right quantity. The result of this is low productivity and food insecurity

Table 4.2 Chi square test of education and food security

	Maize	Beans	Vegetables	Potatoes	Milk
education level attained by the respondent	8.825	4.362	4.666	3.817	9.856
Df	3	3	3	3	3
Sig.	.032*,a	.225	.198	.282,a	.020*

Source: Field survey (2012)

4.1.2 Age of the respondents

The researcher was also interested in the ages of the respondents. The aim was to test whether age has influence on food security. The respondent age ranged between 20-80 years. The age of the respondents was normally distributed with a mean of 46 years and standard deviation of 12 years as shown in Figure 4.2. The histogram shows that the population was normally distributed as it was dome shaped. Majority of the respondents were aged between 35-58 years. The average age of the respondents was 46years. Respondents in this age group were energetic, productive and versatile and so they were expected to be food secure.

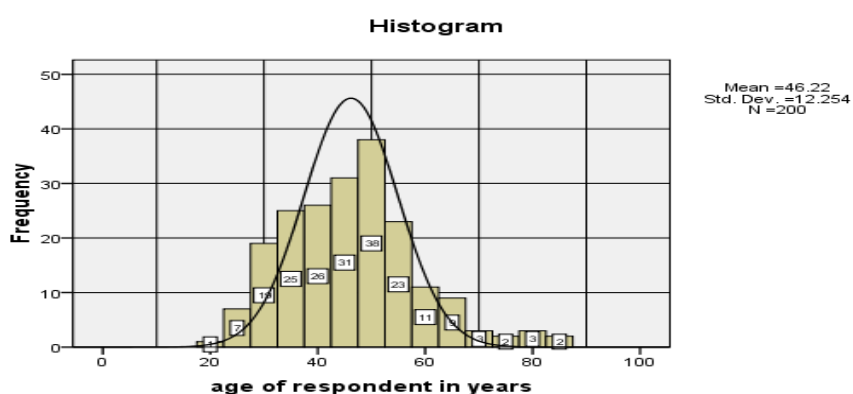


Figure 4.2 Age of the respondents

Source: Field survey (2012)

The researcher interrogated the relationship between age and food security. As shown in Table 4.3. Irrespective of age, over 72 % of the respondents were secure in maize food stuffs. This was attributed to the fact that maize farming was a tradition. All farmers grew maize because it was the source of Ugali which is the staple food stuff for majority of Kenyans. Other foodstuffs were not given much premium. They were secondary to

maize farming. As seen in the Table 4.3, as farmers grow older, they become more productive.

However, productivity may fall latter. This finding supports the argument of other scholars who assert that age has influence on farming productivity and food security. Tanver (1995), for instance says that as farmers age, they gain experience and become more productive with improved managerial skills. On the other hand, Kalirajan and Shand (1985) opines that age and in correlation with farming experience has a significant influence on the decision making process of farmers with respect to risk aversion, adoption of improved agricultural technologies and other production related decisions. This is obvious in the case of beans farmers in Suwerwa location who are very productive between the age of 40-49 after which their productivity falls.

From Table 4.3 we also note that more than 53.3% of the respondents across all ages did not have enough potatoes, milk and vegetables. Focus group discussion revealed that farmers kept indigenous cows because they are better suited to the climatic condition of the region. However, the breed of cows kept were of poor quality resulting in low production of milk. Another factor that contributed to scarcity of milk was lack of pasture owing to small size of land and the failure by farmers to practice better ways of integrating farm activities. Cows were left to roam and fed for themselves or tethered by the road sides where there was no pasture.

Table 4.3. Respondents age and food status

Food stuffs	Age of respondents in % who are food secure
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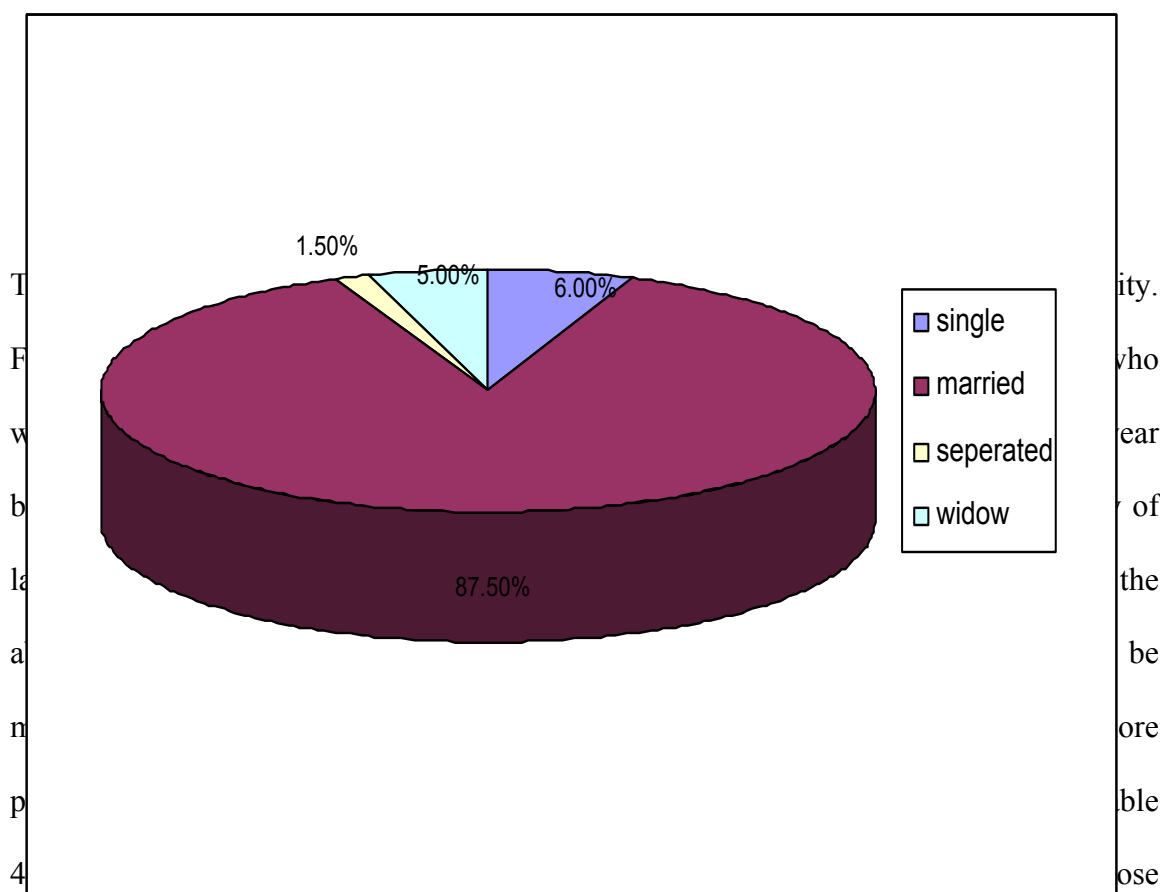
	20-29 years	30-39 years	40-49 years	50-59 years	60 years and above
Maize	75	72	81	76	87
Beans	58	46	64	58	63
vegetables	33	50	45	46	37
Potatoes	8	20	19	20	30
Milk	58	28	55	47	47

Source field survey (2012)

4.1.3 Marital status

Majority of the respondents were married (87.5 percent), while those who were single made up 6 percent, separated accounted for 1.5 percent and widow comprised 5 per cent.

This is shown in Fig 4.3



who were single. Focus group discussion with key informants revealed that big families tended to diversify their activities owing to the need for survival, that is, they integrated farming activities as a coping strategy.

Table 4.4 marital status and food security.

<i>Food staffs</i>	<i>Single</i>	<i>Married</i>
Maize	75	79
Beans	58	58
vegetables	33	46
Potatoes	8	21
Milk	33	46

Source: Field survey (2012)

The researcher also interrogated the relationship between marital status and integration of farm activities as shown in Table 4.5.

Table 4.5 Marital status and integration

Crops grown and animals kept	Single (%)	Married (%)
keep cows	58	77
keep goats	8	19
keep chickens	92	88.
grow maize	100	99
grow sweat potatoes	42	59

grow fruits	42	66
grow sukuma wiki (Kales)	83	79

Source: Field survey (2012)

All the respondents who were married kept animals (cows, goats and chicken) and at the same time grew maize, beans, sweet potatoes and fruits. This ensured that they had enough food to last them throughout the year.

4.1.4 Land status

This study would have been incomplete without looking into the land status of the respondents. Studies conducted in St. Lucia in United States (<http://www.oas.org/dsd>) revealed that various forms of land tenure influenced the stability of rural sector. For example, if large number of farmers had only temporary access to land, social problems were likely to be severe because investment was discouraged. However if land was held on permanent ownership then there was stability. Farmers who owned land permanently were likely to invest in long term projects, put up costly structures and even plant permanent crops while those who leased land did not because they were not certain for how long they would hold onto the land.

Of the 200 hundred respondents interviewed 189 owned land. This translated to 94.5 %. Only 11 respondents that, is 5.5% do not own land. Since majority of respondents owned land they were expected to be stable farmers and therefore food secure.

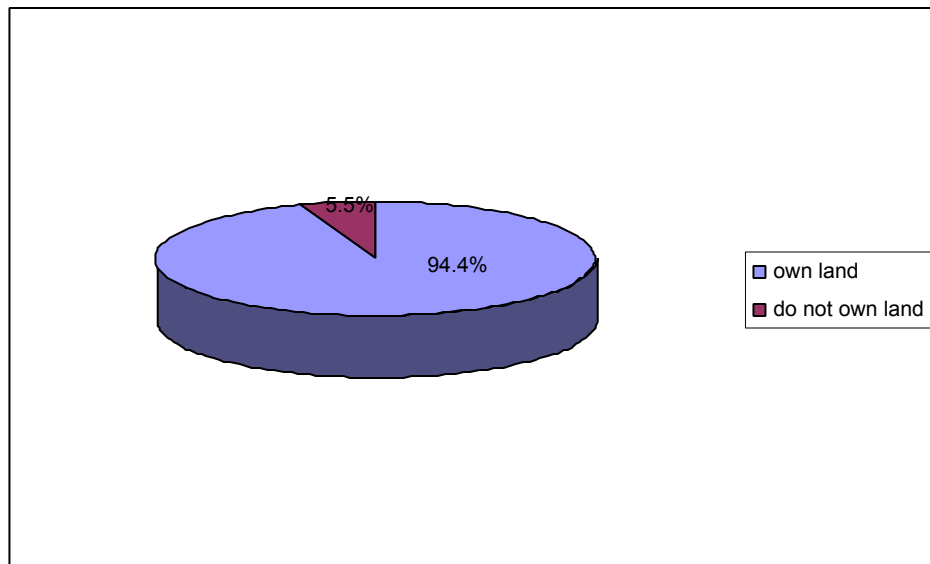
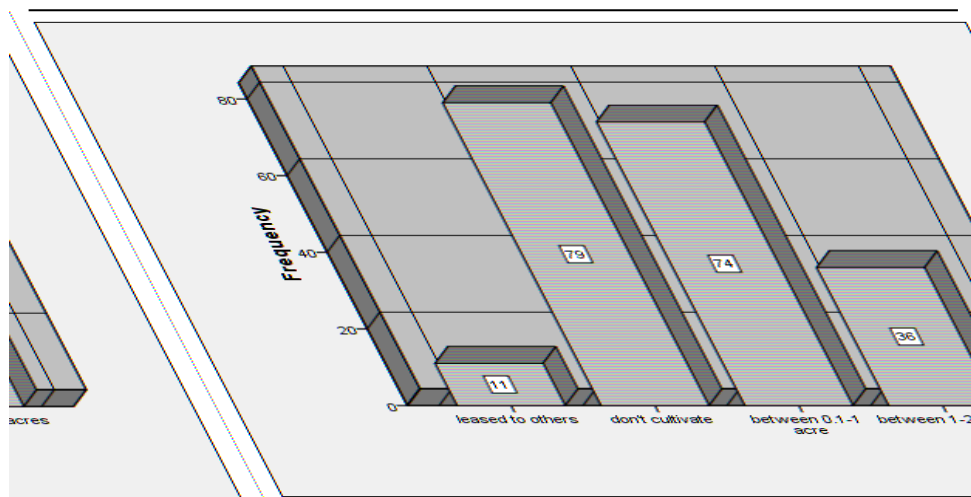


Fig 4.4 Respondents land status

Source: Field survey (2012)

4.15 Land under cultivation.

The land under cultivation for those who owned land was less than 2 acres, that is, between 0.1-1 acres. This translated to 37 per cent of the respondents. Those who cultivated land between 1-2 acres constituted 18 per cent. 5.5 per cent had land which they leased to others. 39.5 per cent did not cultivate but instead used it for other purposes like grazing, for building homestead or the land was unutilised as shown in fig 4.5.



Source: Field survey (2012)

4.1.6 Land tenure

Majority of the respondents leased land, that was, 63.5 per cent as shown in Figure 4.6. However, 36.5 per cent leased land. As mentioned land ownership on permanent basis give farmers the incentive to invest permanently. Such respondents are likely to be better off than those who lease land and so should be encouraged to invest permanently.

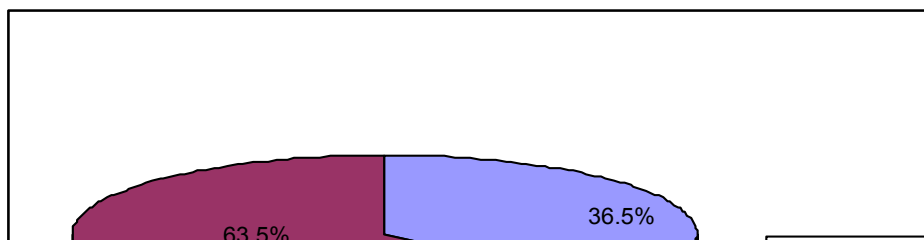


Fig 4.6 Land lease status.
Source: Field survey (2012)

4.1.7 Size of land leased

The acreage of land leased is below 2 acres i.e between 0.1-1 acres (5.5%), between 1-2 acres (6.5%). However, 25.00% are those who lease but don't know the acreage. The rest 63% don't lease. This is illustrated in figure 4.7

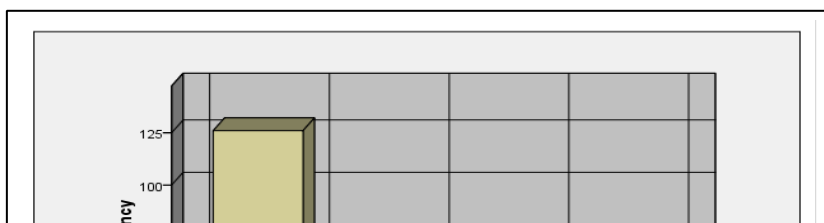


Figure 4.7 Respondents size of land
Sources: Field survey (2012)

4.2.0 Objective 1. Integrated small scale agricultural production as practiced in Suwerwa

The aim of this part was to describe how small scale farming was carried out in the context of Suwerwa location.

4.2.1 Integrated farming.

The researcher found out that respondents kept animals as well as grew a variety of crops as shown in Table 4.6. All the respondents who kept donkeys, bees, fish, ducks chickens and goats grew maize. The study showed that 98.7 % of the respondents who kept cows grew maize. people were accustomed to this practise: they knew how to cultivate maize and enjoyed dishes from this food stuff. Indeed ugali is the traditional dietary staple for most Kenyans. The practise was familiar. More than 80 % of the respondents who kept the animals mentioned above grew beans and Sukuma wiki. Sukumawiki(kales) served as ingredients accompanying ugali. More than 70 % who grew fruits kept the same

animals. However, tomatoes, sugarcane and cabbage farming was not well integrated with keeping animals. Focus group discussion informed the researcher that most respondents were averse to risks associated with growing tomatoes : frost attack. Most of them could not afford to buy chemicals which had to be sprayed to protect tomatoes from pests and frost

	keep cows %	keep goats%	keep chickens%	keep ducks %	keep fish %	keep bees%	keep donkey %
Maize	98	100	100	100	100	100	100
Beans	97	97	97	90	100	82	96
sweet potatoes	57	46	59	50	75	54	28
Sukuma wiki	82.1%	80	82	90	100	90	88.
Cabbage	38.4%	51	37	50	25	36	48
Tomatoes	30.5%	37	30	40	25	27	24
sugar cane	48	37	44	50	25	55	20
Fruits	72	86	71	70	75	91	76

Table 4. 6. Response on integration.

Sources: Field survey (2012)

Of the respondents interviewed 2% kept fish, and a slightly more number, that was 5% kept duck. Focus group discussion with key informants revealed that traditionally, fish was not a popular food stuff among most of the respondents and that was why almost all of them did not keep them. In addition, respondents did not have knowledge of aquaculture especially how to integrate fish keeping and other farming activities. It was therefore important to educate farmers on this novel way of integrated farming

considering that they had resources at their disposal which they could not use because of lack of know how.

More than 80% of farmers who grew sukumawiki also called Kales kept cows, goats, chicken, ducks and donkeys. This was attributed to the fact that they used sukuma wiki waste to feed the animals. In this way they ensured that no sukuma wiki went to waste especially when the prices were very low. At the same time, they used animal manure to fertilize soil in order to boost production of Sukuma wiki. However, there was little integration of tomatoes and animal keeping in the area of study. Less than 24% of the respondents grew tomatoes. The researcher was informed by focus group discussion that most respondents were averse to risks associated with tomato farming, for example frost attack. This practise is costly and labor intensive.

4.2.2 Interrelation of Farming Activities (Integration)

As cited in the literature review, integrated small scale agricultural production is characterised by interdependence of various activities within the farm where waste from one activity can be an input in another farm activity. This study sought to validate if this was replicated in Suwerwa location and the following emerged. That 73 % of the respondents used animal manure (chickens, cows, sheep and goats dropping) to boost production as shown in fig 4.8

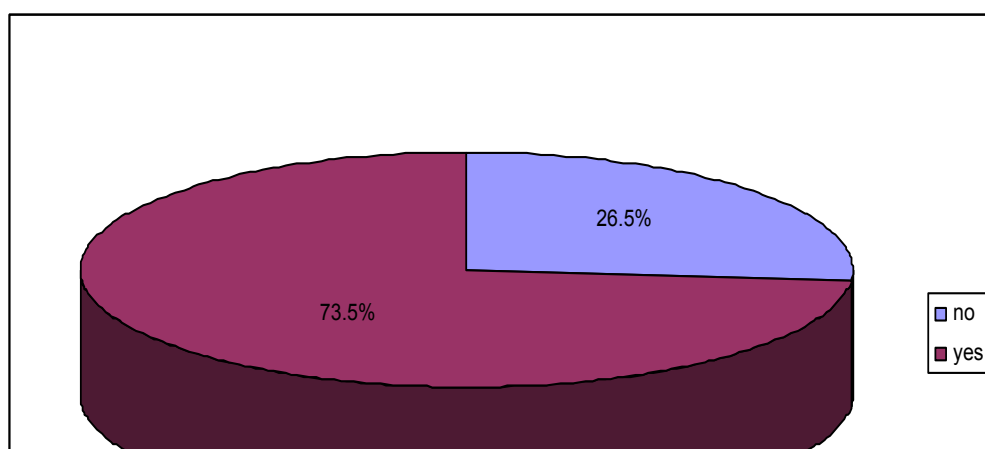


Figure 4.8 Respondent use of animal manure.

Source: Field Survey (2012)

4.2.3 Use of Animal Manure and Productivity

The study could not have been complete without interrogating the relationship between use of organic manure and productivity. Studies conducted elsewhere (Jokela 1992, Koli et al 2003) attest to the benefits of using animal manure. It supplies nitrogen for plants, reduces the need for chemical fertilizer, to increase organic nutrients in the soil and boost farm production. Some farmers, however, used animal manure in the farm because it is a safe way of disposal. In Suwerwa location, farmers use organic manure to boost yield. The study showed that those respondents who used organic manure realized high yields. Of the respondents interviewed 76.9 % who used organic manure harvested between 21 - 30 bags of maize as shown in fig 4.7. According to Ministry of agriculture 2011, this was above the expected average of 20, 90 kg bags per acre which is realized in Suwerwa location when farmers used chemical fertilizers. High yields were also realized in beans and vegetables.



Table 4.7 Organic manure and productivity.

Productivity in bags		use organic manure
Maize	less than a bag	.0%
	1-10 bags	83.8%
	11-20 bags	84.1%
	30 and above	76.9%
Beans	less than a bag	82.5%
	1-10 bags	84.7%
	11-20 bags	85.7%
	21-30bags	100.0%
	30 and above	100.0%

Vegetables	less than a bag	82.1%
	1-10 bags	89.7%
	11-20 bags	85.7%
	21-30bags	100.0%
	30 and above	60.0%
		100.0%
Potatoes	less than a bag	82.7%
	1-10 bags	88.5%
	11-20 bags	100.0%
	21-30bags	75.0%
	30 and above	.0%

Sources: Field survey (2012)

4.2.4 Waste as animal feeds

Other researchers have found out that in an integrated farm system, farmers use crop waste as animal feeds. Owen and Suriya (1989) argue that production of crop residues and the possible use as feed in developing countries offer enormous feed resources. Examples of crop waste abound: products of cereals, sugarcane, roots and tubers, pulses, oil seeds, vegetables and fruits. In the area of study cereal waste (especially from maize) and vegetable leaves were the commonest examples of animal feeds. From figure 4.10 about 68 % of the respondents used crop waste to feed animal. Owing to their small size of land and the need to diversify their activities, farmers were compelled to feed their animals on crop waste. By so doing they ensured that nothing went to waste. This is one benefit of integrated farm systems.

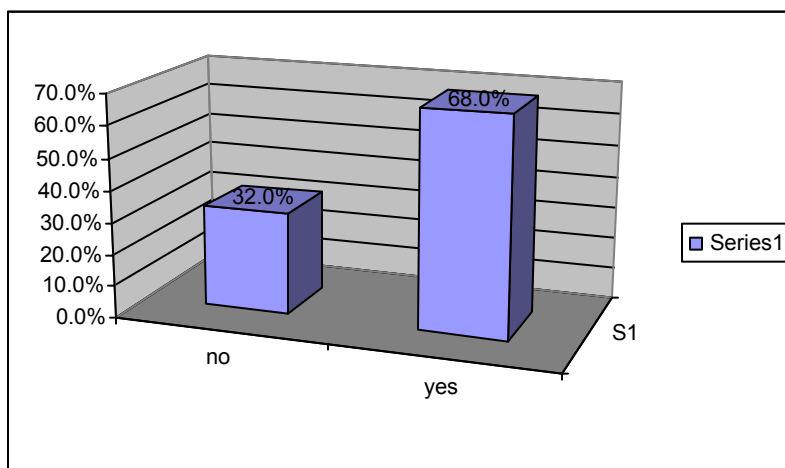


Fig 4.10 Respondents use of waste as animal feed

Source: Field survey (2012)

4.2.5 Respondents Use of Crop Waste as Composite Manure

It was also observed that 70.5 % of the respondents used crop waste as composite manure to increase their harvest as shown in fig 4.11. Food waste, leaves, grass trimming and crop residues were turned into valuable organic fertilizer through composting. Apart from increasing organic nutrient in the soil, composting has the potential to manage most of the organic material in the waste streams (<http://vasat.icrisat/org/crop/mn/organicFAQS>). This is carried out under controlled aerobic conditions. Under integrated farm system what can be otherwise be regarded as waste is used in another farm system.

The researcher learned from focus group discussion that owing to high price of chemical fertilizer, and the need to maximize their resources, farmers had found it necessary to resort to farm manure

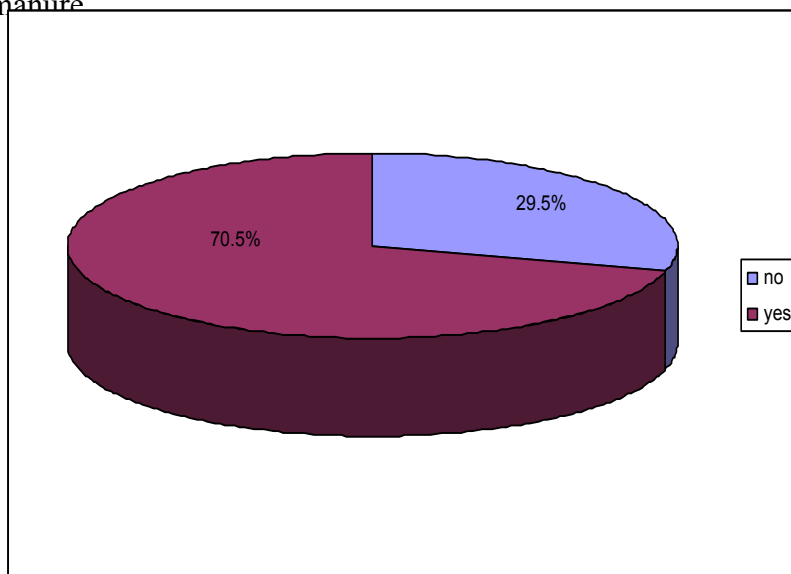
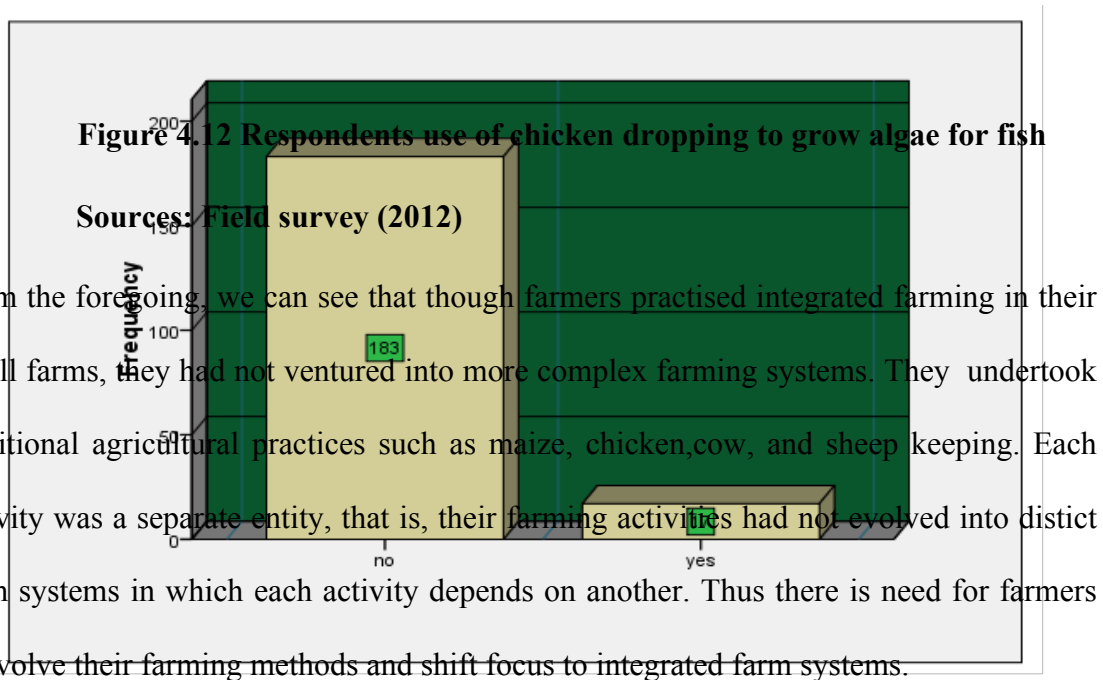


Fig 4.11 Waste as composite manure

Sources: Field survey (2012)

4.2.6 Chickens droppings used to grow algae for fish.

The researcher also observed integration of Chicken fish farming. As shown in fig 4.12 only 8.5 % practiced this kind of farming despite the fact that more than 95% of the respondents kept chicken. Focus group discussion revealed that this kind of farming was not popular because most farmers did not have knowledge of integrating these two activities. Also observed is that chicken and fish were kept separately unlike in Thailand where chicken pens are constructed above fish ponds to allow their waste to drop into the ponds which reduces the burden of carrying chicken waste into the fish ponds. This can be described as a sytem. The condition under which fish was kept in Suwerwa was cumbersome and labor demanding because the two practises were not integrated.



4.3.0 Objective 2

The capacity of integrated agricultural production to ensure food security.

The second objective of this study was to evaluate the capacity of integrated small scale agricultural production to meet food requirements and other daily needs at household level in Suwerwa location of Trans-Nzoia East district. From table 4.8 we obtain the following information:

More than 77.7% of all the respondents who grew maize, beans, potatoes, sukuma wiki, tomatoes and kept chicken and cows had enough of these foodstuffs to last them throughout the year. It is also observed from the table below that less than 60 % of the respondents lacked milk to last them throughout the year despite integration of farming activities. It was observed that most farmers did not keep high quality breeds that could produce enough milk. It also emerged that none of the respondents had a zero grazing unit and that in their small holdings; farmers tethered their cows and fed them with maize waste Napier grass and other farm waste. This resulted to low milk production. Also observed was that the chickens kept were of poor quality, that is, the traditional types that were left to roam freely and fed for themselves. This explained why farmers who kept chickens did not have enough cabbages, the reason being that chicken destroyed vegetables. If they were to be contained in special enclosures, it would be easy to collect their droppings which would be used in another farm activity. With good quality breed and better ways of integration more farmers could be food secure.

crops	Maize	Beans	Vegetables	Potatoes	Milk
	Secure (%)	Secure (%)	Secure (%)	Secure (%)	Secure (%)
Cows	81	83	79	85	96
Goats	19	25	27	32	22
chickens	89	90	96	95	90
donkey	15	14	18	2	22
sukuma wiki/Kales	84	91	99	100	91
cabbage	39	45	51	61	46
tomatoes	33	38	43	56	38
sugar cane	44	50	49	71	51
Fruits	69	75	78	78	77

Table 4.8 Integration and Food Security

Source: Field

Sources: Field survey (2012)

4.3.1 Other benefits of integrated small scale agriculture

4.3.1.1 Increased productivity

The researcher also studied other benefits accrued from integrated small scale agricultural. According to Agriinfo.in (2010) integrated farming is beneficial in that it

provides an opportunity to increase economic yields per unit area per unit time by virtue of intensification of crops and allied enterprises. This ensures food self sufficiency.

Of the respondents interviewed, 55% said that integration of farming activities had resulted to increase in productivity as shown in figure 4.13 while 45 % did not realise this benefit.

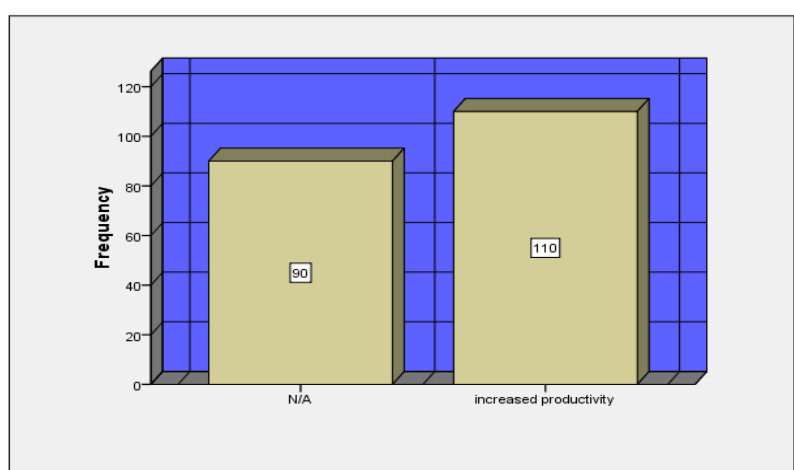


Figure 4.13 Response on increased productivity.
Source: Field survey (2012)

The researcher saw the need to verify if integrating farming activities increased productivity. Output of various food crops was compared to the expected yields per acre in Suwerwa location and the results are reflected below.

While as the expected maize yield per acre according to the Ministry of Agriculture is between 20-25, 90 kilogram bags per acre, only 13 % of the respondents realized more

than this .The rest of the respondents, that is, 83 % got poor yields i.e. below the expected yield. This might be attributed to numerous challenges that farmers faced such as extreme weather conditions during harvesting seasons that resulted to loss of harvest, shortage of labor, lack of certified seeds, and many more that are addressed in objective 3.

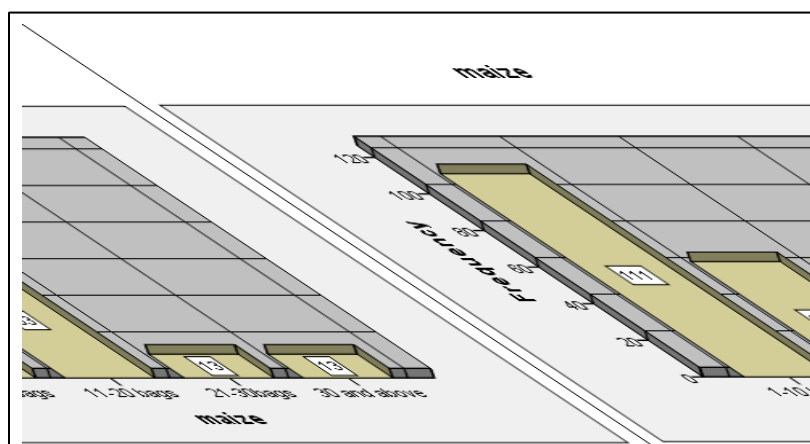


Figure 4.14 Integration and Maize output per acre

Source: Field survey (2012)

The researcher also studied the relationship between integration and beans production. The expected yield per acre was about 10 bags according to the Ministry of Agriculture 2011. Of the respondents interviewed 80% harvested more than 10 bags. This implies that with integration of various farm activities, farmers got higher beans yields.

Table 4.9: Integration and Beans Production

Beans output per acre in bags	Frequency	Per cent
-------------------------------	-----------	----------

less than 1	40	20
1-10	150	75
11-20	7	4
21-30	1	.5
30 and above	2	1
Total	200	100

Source: Field survey (2012)

It was also important to find out if integration can lead to increase in vegetable production. Vegetables are a part of diet because they complement ugali and therefore it is important to boost its production through integration. The researcher found out the following:

From table 4.10 we can see that 58.5% of the respondents harvested less than 1 bag of cabbages per acre. This was low and below the average of 20 bags per acre. The researcher found out that vegetable farming especially growing cabbages was not fully embraced because they take more time to mature than sukuma wiki and other indigenous vegetables.

Owing to their small land size, farmers preferred growing vegetables that take short time to mature such as kunde, sukuma wiki/ kales and other traditional vegetables. Cabbages were also not the best accompaniment for ugali which is the staple foodstuff in Suwerwa.

Table 4.10 Respondents vegetable output per acre.

Vegetable Output per Acre in bag	Frequency	Percent
less than 1	117	59
1-10	68	34
11-20	7	4
21-30	3	2
30	5	3
Total	200	100

Source: Field survey (2012)

As for potatoes output, the study found that the harvest was poor as shown in table 4.11. About 74% of the respondents harvested less than a bag of potato per acre. Focus group discussion attributed this to various challenges key among them being frost , pests, floods, among other challenges as addressed in objective 3.

Table 4.11 Potatoes output per acre.

Potatoes output per acre	Frequency	Percent
less than a bag	147	74
1-10 bags		27
Total	200	100

Source: Field survey (2012)

3.1.2 Income

Other studies revealed that integrated farming is beneficial because farmers get constant income throughout the year due to interaction of enterprises with crops, eggs, fish, milk, mushroom, honey, maize , cabbages and many more (Agriinfo.in2011). The study also sought to verify if integrated small scale farming as practiced in Suwerwa ensured constant income. Of the 200 respondents interviewed, 98 of them answered in the affirmative. This translated to 49 %. This number was slightly lower than those who said that they did not have income throughout the year.

By the time this study was conducted (January to March) farmers had harvested and were waiting to plant again in April when they expected rain. November to March is a dry season in Trans-nzoia; April marks the beginning of long rains up to September. The rainy season is the growing season for farmers in this location. Almost all the respondents rely on rain fed agriculture and that is why land was bare after harvest. This explains why they did not earn income throughout the year. If they were to move away from rain fed agriculture to integrated irrigation farming during dry seasons, they would insulate themselves from the ravages of hunger and at the same time ensure that at no time was their land idle. This would enable them to be food secure throughout the year.

Table 4.12: Response on constant income.

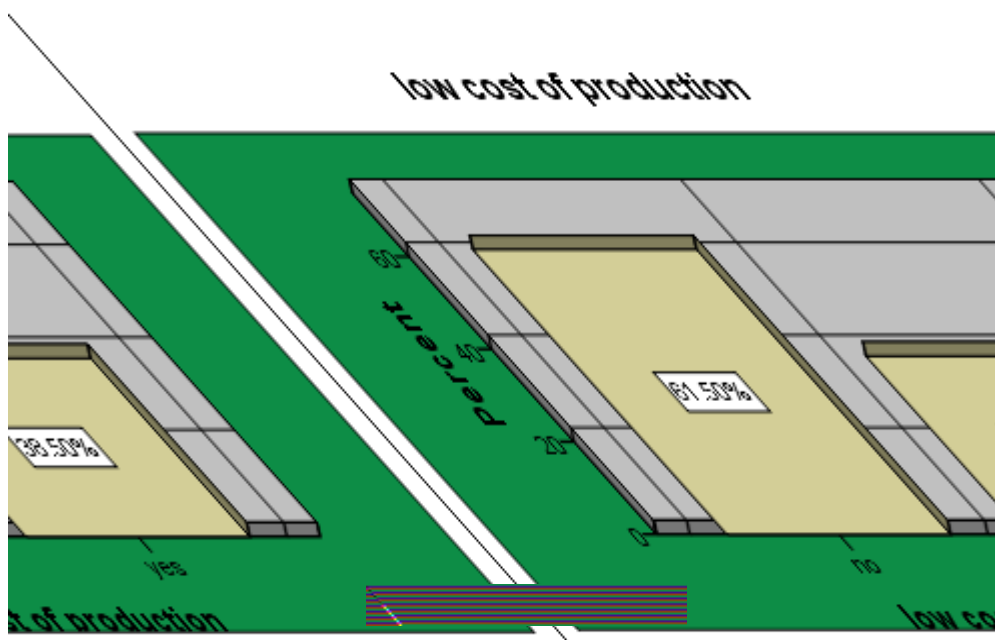
	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	98	49	49	100
Total	200	100	100	

Source: Field survey (2012)

4.2.2.3 Low Cost of Production

The researcher also found out that only 38 % of the respondents benefited from low cost of production. As noted in the literature review, this is one of the benefits of integrating farming activities because waste products from one farming system is used as input in another section. In this way, farming becomes self sustaining because of the interdependence of various enterprises. This reduces costs of inputs, for example, fertilizers. The finding points out that only 76 respondents cited this as an advantage of integration of farm activities as shown below in figure 4.16. Focus group discussion informed the researcher that all farmers were unable to reap full benefits of integrated farming such as low cost of production because they had not transformed their farms into farm systems that are characterised by interdependence of all the activities. Their farm

activities were practised as separate single entities. This is not only labor demanding but also expensive because farmers relied on external inputs as opposed to integrated farm systems where waste from one system is used as input in another activity. This explains why farmers in Suwerwa location did not reap this benefit.



Source: Field survey

Figure 4.15.Response on integration and low cost of production.

4.2.2.4 Variety of food and nutrition

Integrated agricultural production allows for diversity in food production because farmers produce everything and so achieve food sovereignty and all nutrition requirements: carbohydrates from cereals such as maize and rice, sugarcane, potatoes and many more, vitamins from vegetables and fruits and proteins from chicken, eggs, fish among others. The researcher wanted to find out if this is replicated in Suwerwa. Fig

4.16 shows that out of the respondents interviewed through questionnaires, 59 % (118 respondents) cited this as a benefit and 41 % did not benefit from this.

The study revealed that there is a wide range of foodstuffs which include beans, peas, beans, sweet potatoes, fruits, milk, fish, vegetables, maize and others. However they were not given much priority like maize. They were secondary crops. That is why only 59 % had a variety of food. This has a policy implication: farmers should diversify farming practices to ensure that they have a wide range of food and nutritional requirements. This is the way to go if they intend to cushion themselves against risks that are associated with monoculture.



Figure 4.16 integration and food variety
Source: Field survey (2012)

4.2.2.5. Reduced risk of monoculture

The research also revealed that 59 % of the respondents had reduced the risk associated with monoculture as shown in fig 4.17. In Suwerwa location maize was the dominant crop grown as cited earlier. This is risky because in case of poor maize harvest, there could be severe hunger.

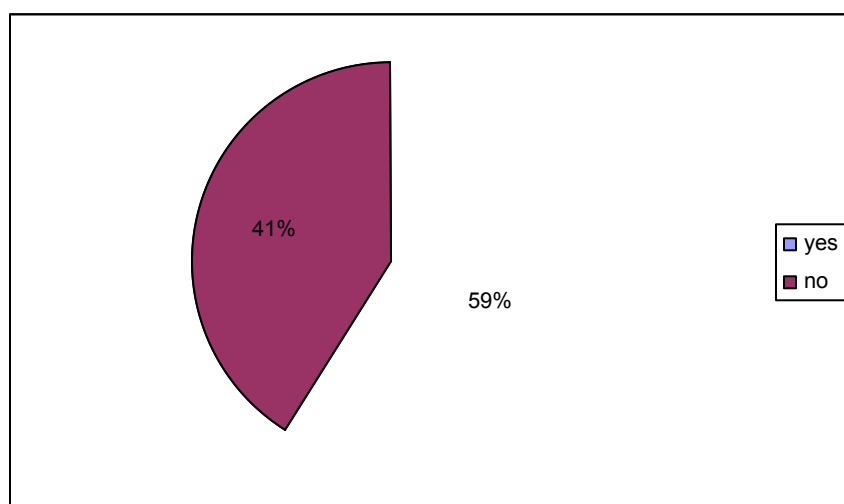


Figure 4.1.7: Integration and reduced risk of monoculture

Sources: Field survey (2012)

Those who had diversified their farming activities planted bananas, sweet potatoes, cassava, nappier grass for feeding cows as well as maize as shown in fig 4.17



Fig 4.17 .Farmers grows sweet potatoes as well as bananas and nipper grass. Sources: Field (2012survey

The researcher sought to find out if respondents realised all the above benefits and found that only 14 % that is, 28 respondents did so as shown in fig 4.18. However, 86 % of the respondents interviewed realised some of the benefits mentioned above. As seen in the third objective farmers were bedevilled by a myriad of challenges that made it

impossible for them to reap full benefits of integration. In addition to this their farming activities were not mutually reinforcing. They should transform their separate farm activities into interacting systems which are synergic in order to have greater total effect than the sum of their individual effect.

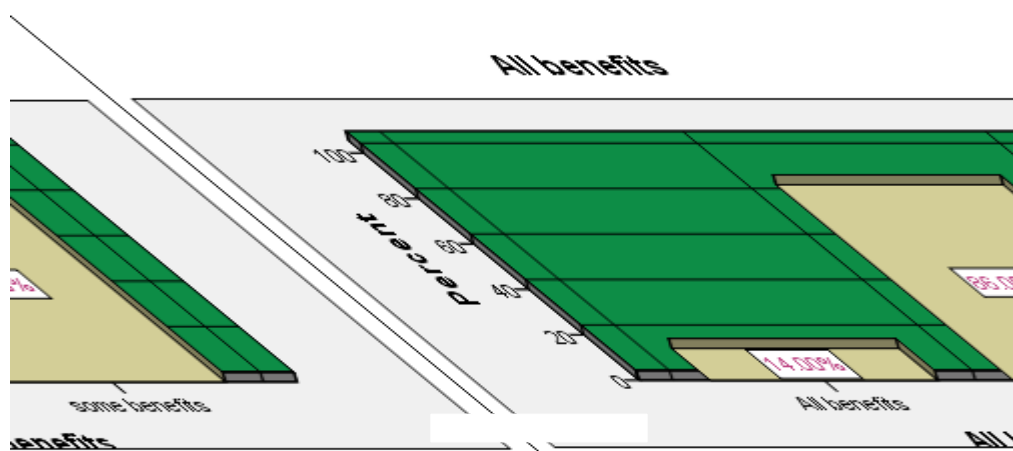


Figure 4.18 Response on all benefits of integration
Sources: Field survey (2012)

4.3.0 Objective 3: Challenges of Integrating Small Scale Agriculture.

In line with objective 3, that is to study the challenges of integrated small scale production, the researcher sought to find out the problems that farmers faced which might have made it hard or impossible for them to integrate farming activities and therefore reap all the attendant benefits. The researcher used questionnaires and came out with the following findings: 120 respondents (60 %) said that they faced risks but 40 % that is, 80 respondents did not face any challenge. This is shown in fig 4.18

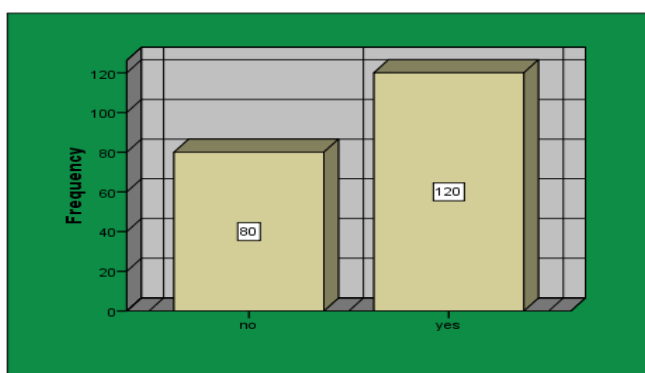


Fig 4.19 Response on Challenge

Source: Field survey (2012)

The research revealed that 28.5% of the respondents cited pests and diseases as a challenge. An equal number of the respondents also cited market fluctuation and land tenure system also as challenges that they faced as illustrated in figure 4.20. Focus group discussion revealed that farmers who lease land were reluctant to invest in long term projects like zero grazing or fish ponds in leased land because of future uncertainties.

Leasehold kept on changing hands from year to year and a farmer might not be sure for how long he would still hold onto the leased land. Temporary ownership of land had discouraged long term investments.

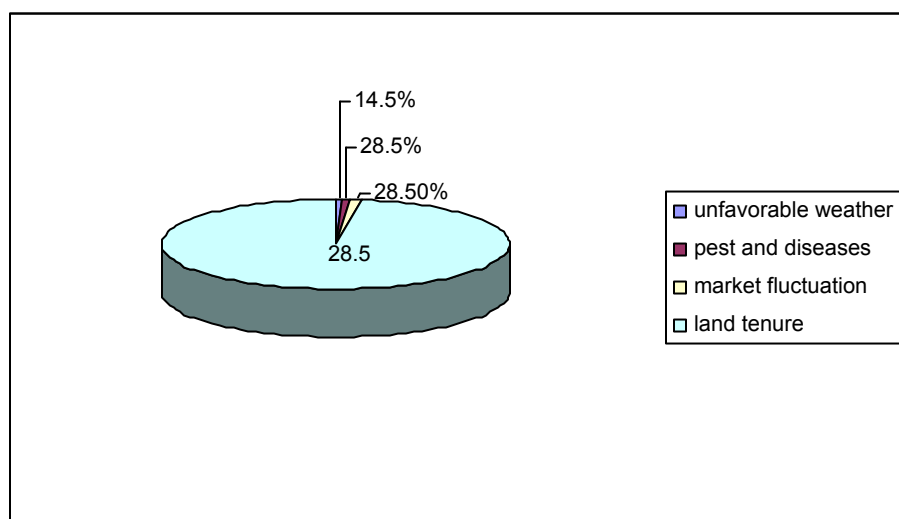


Figure 4.20 Responses on Challenges.

Source: Field Survey (2012)

4.3.1 Market of Farm Produce.

The study looked at marketing dynamics in Suwerwa location . This is in line with the third objective (to study the challenges facing integrated small scale agricultural production). According to FAO (2010), selling of farm produce is normally at farm gates or road side and farmers have little or no knowledge of prevailing commodity prices in major markets. This is a major draw back to most farmers in Africa.

The researcher sought to validate this argument. The finding indicated that, 102 of the respondents interviewed by use of questionnaires had reliable market and 98 did not. This is illustrated in fig 4.21. This translated to 51 % and 49% respectively.

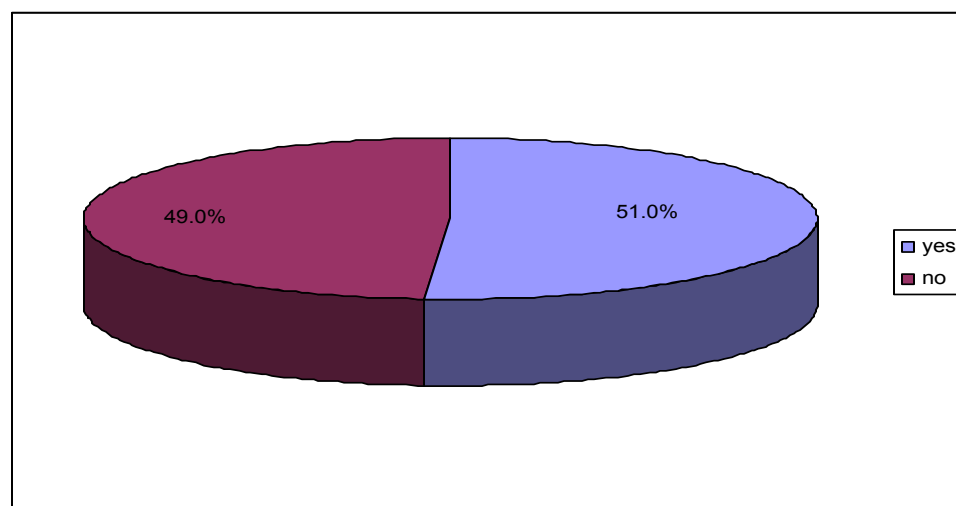


Figure 4.21: Response on reliability of market

Source: Field survey (2012)

It also emerged that there were 4 major markets namely NCPB, municipal market, middle men and neighbours. NCPB was the least favourite accounting for just 4% of the

respondents who used it. NCPB depots were located in Kitale which is about 40 kilometers from Suwerwa location. This implies that in order to sell their produce to the board, farmers had to incur huge transport cost. This did not make any business sense to small farmers. Focus group discussion revealed that most small scale farmers who grew grain found it cumbersome to sell their produce there because of long delays in payment. NCPB has a weak capital base and so payment was not always prompt. Other factor that discouraged farmers from selling to the board included long queues, corruption and stringent standards that they had to meet before their produce were allowed in. To small farmers, NCPB was the market of the last resort. It came to fore that 20 % of the respondents who had reliable market sold their harvest to Municipal market which was also found in Kitale, 40.5 % to middle men, 36 % to neighbours and 3% exported their produce as illustrated in table 4.13. Although the municipal market was reliable, those farmers living very far away from Kitale (especially those who produce negligible quantities) preferred selling to neighbors and middle men to avoid transport cost.

The researcher also learned that farmers who exported their produce grew rose flowers and passion fruits. The fact that only 3 % of the respondents relied on export market imply that farming was still local; indeed, they produced for local markets. Most farmers sold almost all their produce to the middle men (40.5%) for quick money because it was uneconomical for a farmer to take 2 bags of maize to NCPB and wait for payment for two weeks when he could sell to middlemen and get instant pay. They were forced to make a trade off between the two options. However, middle men exploited farmers by fixing artificial prices that were far below NCPB prices.

Table 4.13: Respondents market

Types of markets	Respondent accessing the market in %
NCPB	4
Municipal market	20
Export	3
Middlemen	41
Neighbours	36

Source: Field Survey (2012)

4.3.2 Adverse weather conditions

In the literature, review adverse weather conditions such as drought, frost, floods and windstorm were cited as a challenge to farmers. The researcher wanted to validate this. The researcher administered 200 questionnaires to the respondents. The study showed that 53% of the respondents experienced severe frost, 35 % cited floods as a major obstacle to their farming activities, 55 % and 73 % cited windstorm and drought respectively as shown in table 4.14.

Table 4.14 Response on weather challenges

Farmers affected by weather challenges in %	Severe frost	Floods	Windstorm	Drought

	53	35	55	73
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Source: Field survey (2012)

4.3.3 Drought

Drought was the biggest challenge that affected farmers as shown in table 4.14 yet only 77% were able to irrigate their farms.



Fig 4.22: This land is bare after harvest. The farmer is waiting for the beginning of the next rain season in order to plant. This explains why such a farmer cannot have income throughout the year.

Source: Field Survey (2012)

The study showed that 91 respondents (46 percent) saw no need to irrigate their farms for they relied on rain. This number showed no interest at all. This formed a huge bulk of the respondents. It also emerged that 63 farmers (32 percent) lacked equipment for irrigation and 46 of them (23 per cent) were not close to water sources as shown in table 4.16.

Table 4.16: Respondents reasons for not irrigating land

	Frequency	Percent
rely on rainfall	91	46
no irrigation equipment	63	31
not close to water source	46	23
Total	200	100.0

Source: Field survey (2012)

However there were farmers who had sources of water in their farms yet they did not irrigate their farms because they relied on rainfall. Some had wells as shown in Fig 4.26 yet they did not utilize water to grow crops. For such farmers, it would be technically simple, cheap and beneficial to practice surface irrigation or overhead irrigation because the land is gradually undulating. The researcher also observed that river Kapterit flows across Suwerwa from Cherangani hills. It is a tributary of Nzoia River. This could be effectively used for extensive irrigation during drought season.



Figure 4.23 some farmer has water sources but do not irrigate their farm
Source . Field survey (2012)

4.3.4 Loans/Credit Facilities

Access to credit facilities is key to improvement in agricultural activities. It can be one way of promoting technology transfer. Extending credit to farming families can narrow the gap between the required capital and the capital that households possess for the improvement of agricultural technologies that would increase production and

productivity (Ozowa 1995). In Suwerwa location, 42% of the respondents accessed credit facilities . Majority of the respondents , that is, 117 (58%) did not have access as shown in fig 4.24. This confirmed that lack of credit facilities remained a big challenge to small scale farmers.

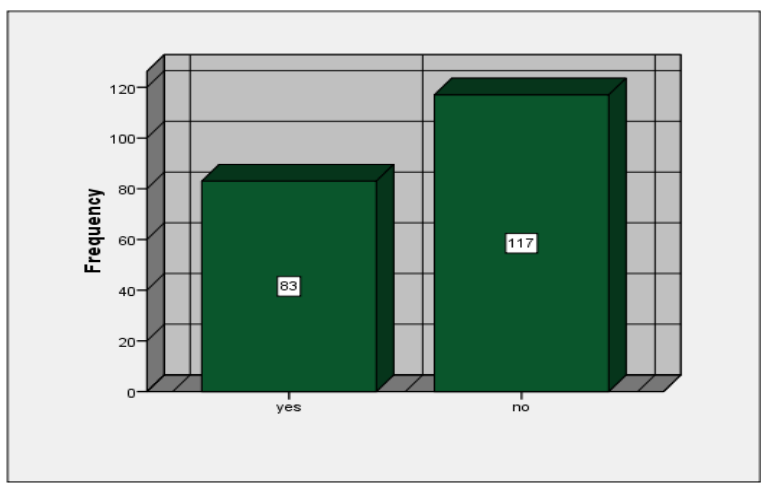


Figure 4.24. Respondents access to credit facilities.
Source: Field survey (2012)

The researcher also sought to find out the sources of credit for the respondents. Questionnaires were used to collect data. Out of 41.5% of respondent who had access to credit, only 36.1% accessed it from banks, A.F.C (7.2%), micro-finance institutions (59%), co-operative societies (39.8%) as shown by Table 4.17. From the figures above micro finance institutions were the major sources of finance for small scale farmers in the area of study. Focus group discussion with key informants revealed that micro finance

institutions were quite flexible in their operations and did not ask for collateral for farmers to obtain loans.

However, AFC which was established to assist farmers by giving them credit to boost agriculture was the least favorite. Most small scale farmers did not realize large production for commercial purposes and so AFC which had a bias for large scale farmers tended to ignore them. In addition, lack of title deeds hindered small scale farmers from accessing loans.

Table 4.17. Researcher Response on sources of loans

Sources of credit	Respondents accessing loans (%)
Banks	36
Agricultural finance cooperation (A.F.C)	7
micro-finance institutions	59
co-operative SACCOs	40

Source: Field survey (2012)

The study found that 58.5% of those who did not access credit cited the following reasons. Of the respondents interviewed 19.7 % had enough capital, 26.5% of the respondents got help from relatives, 26.5% had no security, 18.8 % were not interested but 55.6 % of the respondents were afraid to take risks as shown in table 4.18. As earlier

seen in the literature review, small scale farmers were averse to risks and so the idea of taking loans was not appealing. They always consider what they stood to lose but not what they would gain from getting credit facilities. Access to credit facilities had an impact on food security as illustrated in the table 4.18. More than 52 % of the respondents who did not access credit facilities were food insecure.

Table 4.18. Access to loans and food security.

Food security status		Access loans	Do not access
Potatoes	Insecure	38.4%	61.6%
Vegetables	Insecure	44.1%	55.9%
Beans	Insecure	32.9%	67.1%
Maize	Insecure	43.2%	56.8%
Milk	Insecure	41.8%	58.2%

Source: Field survey (2012)

4.3.5 Access to Extension Services

Previous studies show that extension services played a critical role in knowledge attainment of farmers. It enables farmers to change farm practises and influences the usage of farm inputs in agricultural production (Robert and Mwabu 1998). Extension education is a type of education that is functional rather than formal and is better provided by extension workers who are tasked with disseminating information in a meaningful form to farmers. The mode of learning and content determines its impact on agricultural production. For it to have the desired impact, it must be relevant and aligned to the farmers needs. Of the 200 respondents interviewed, 56 % did not get these services. Only 44 % benefited from extension services. This is shown in figure 4.25 An interview with district agricultural officer revealed that some farmers were ignorant of existence of these services. Focus group discussion with farmers revealed that some extension services were not aligned to their needs and added no value to their activities. This explains why some farmers did not seek the services.

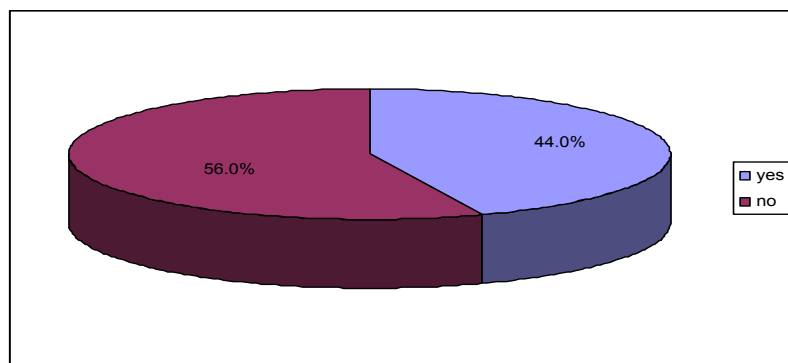


Figure 4.25 Access to agricultural extension service.

Source: Field survey (2012)

It also emerged that those respondents who had access to extension services had more food stuffs than the farmers who did not. Table 4.19 illustrates that 54 % of the respondents who did not get extension services did not have enough maize to last them throughout the year as compared to 46.2 % of those who got the services while 63 % of those who did not have the services lacked enough beans, and 60 % did not have enough vegetables to last them throughout the year. Extension services skill farmers. It is crucial in disseminating knowledge on better quality seeds, pesticides and emerging farming practices and therefore enables farmers to learn or improve production skills

Table 4.19: Access to extension services and food security.

Food security status	Access to agricultural extension services	
	Yes	No
Potatoes Insecure	40	60
Vegetables Insecure	41	60
Beans Insecure	37	64
Maize Insecure	36	64
Milk Insecure	45	56

4.3.5 Knowledge of mixed/integrated farming

Research by Ozowa (2010) attributes food insecurity to lack of knowledge on how to grow on smaller scale, that is, how to integrate farming within small land holdings. Kalirajan and Shand (2000) opined that knowledge of farming can be attained through both formal education and farming experience. This affects the level of adoption of technology, usage of farm inputs and enables farmers to easily adapt to new and better ways of production.

This study found out that 96% of the farmers had knowledge of mixed farming as illustrated in fig 4.26. Despite this, they had not evolved their farming practises into modern farm systems which are integrated and interdependent, for example, only 2 farmers integrated fish, maize, and chicken farming. This kind of farming was recently introduced and need to be popularised.

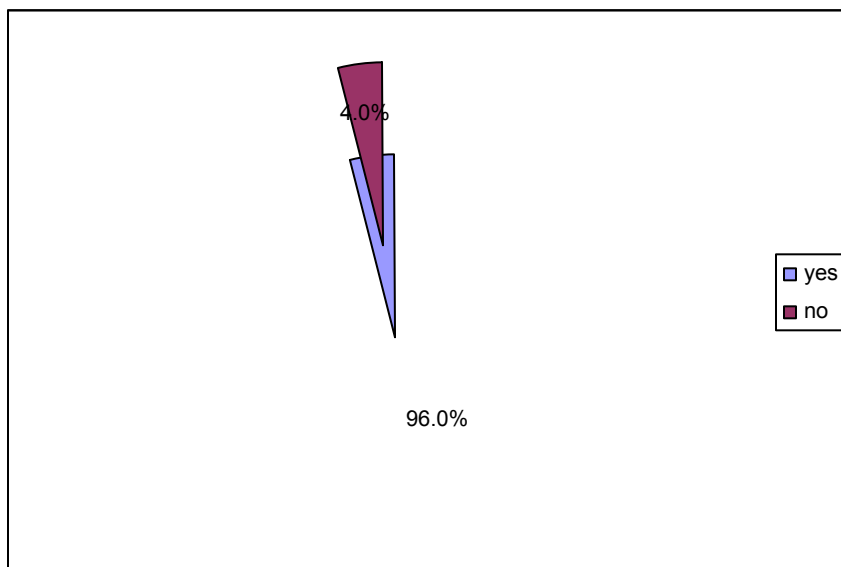


Figure 4.26. Respondents' knowledge of mixed farming

Source: Field survey (2012)

Table 4.20 shows the relationship between knowledge of mixed farming and food security. More than 95 % of the respondents who had knowledge of integrated farming were food secure. They had enough potatoes, vegetables, beans, maize and milk to last them throughout the year.

Table 4.20. Respondents knowledge of mixed farming and food security.

Food security status		Access to agricultural extension services	
		Yes	No
Potatoes	Insecure	40	60
Vegetables	Insecure	41	60
Beans	Insecure	37	64
Maize	Insecure	36	64

Milk	Insecure	45	56
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Source: Field survey (2012)

4.3.6 Labour at Farm Level.

The researcher saw the need to investigate whether labour was a challenge to food security. Banner (2011) cited lack of labour as a challenge to small farmers. Integrated farming involves multiple activities that may run concurrently. It is therefore a limiting factor in integrated small scale agricultural production in which many activities take place concurrently. In Suwerwa location, 57 % of the respondents said that lack of labour made it hard for them to integrate farming activities and 44% dia not find this as a challenge. This is illustrated in fig 4.27.

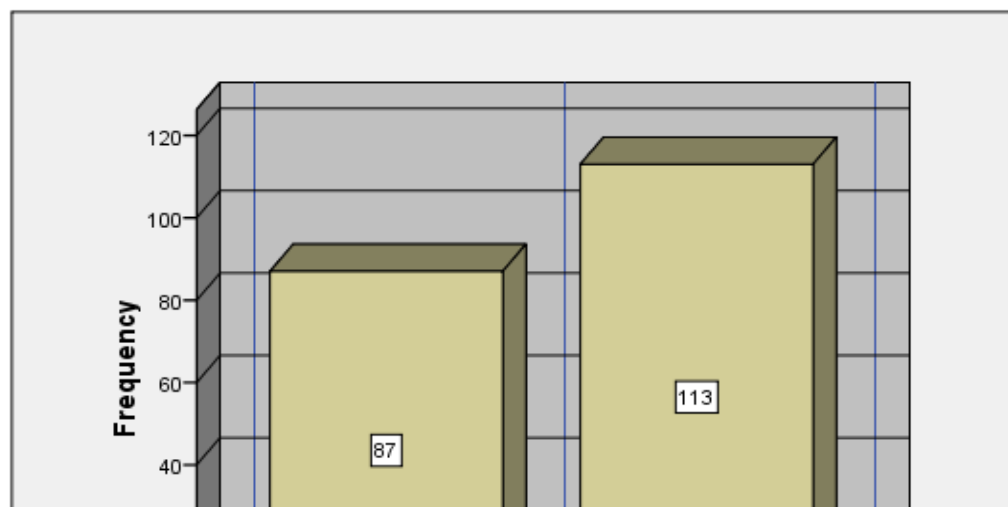


Figure 4.27 Response on labor as a challenge

Source: Field survey Source (2012)

The study revealed that labour had contributed to food insecurity. Of the respondents interviewed through questionnaires, 46 % who cited labour as a challenge did not have enough maize to last them throughout the year, 40 % and 45 % lacked vegetables and potatoes respectively. In addition 46 % lacked enough milk as shown in Table 4.21. Small farms in which farm activities are interrelated is labour intensive and so lack of it makes it difficult for farmers to undertake multiple activities concurrently.

4.21. Respondents lack of labour and food security

Food stuffs	Respondents who are food insecure in %
Potatoes	45
Vegetables	40
Beans	42

Maize	46
Milk	46

Source: Field survey (2012)

4.3.7 Tools at Farm level.

This study would have been incomplete without studying the use of farm tools. AGRI (2000) asserts that agriculture in Africa remains poor because of limited application of modern science and technology. Lack of appropriate tools at farm level that are labour saving, labour enlarging and labour enhancing (Ozowa 2010) are needed if Africa seriously thinks of alleviating hunger. Modern appropriate tools save a farmer from the drudgery of using awkward tools that are also time wasting (Barner 2011).

The researcher noted that the commonest tool of labour was Jembe (hoe) and was used by 97.5 % of the respondents; panga (machete) was the second in popularity with 84 % of the respondents attesting to using it. Tractor was used by 44 % of the respondents. Thus even in small farms tractor was still a popular tool of labour. Those who used tractors in their farms realised higher yields compared to those who used jembes. From Table 4.22, respondents who used tractor on their farms were more food secure than those who did not use it. With appropriate tools for their small farms farmers could get

better yields and realise food self sufficiency. Thus, effort must be made to provide farmers with better farm tools to enhance food production.

Table 4.22: Respondents tools and food security

Food stuffs	Respondents who are food insecure in %
Potatoes	45
Vegetables	40
Beans	42
Maize	46
Milk	46

Source: Field survey (2012)

4.3.8 Storage Facilities.

The researcher also studied the different ways in which the respondents stored their produce. It was found that 56.5 % of the respondents had granaries, 0.5 % stored their produce in silos offered by NCPB through receipt system and in private silos, for

example commercial grain services limited located along Eldoret Kitale high way while 77 % stored their harvest in gunny bags also called polypropylene bags. This can cause deterioration of the produce. According to Irungu (2010), such storage causes caking of grains. He also asserts that storing grains in living rooms is bad due to poor aeration and high relative humidity. Grains stored in this way are usually attacked by fungi. Information from focus group discussion revealed that farmers faced many cases of theft that discouraged them from storing their harvest in granaries. Most farmers preferred keeping their harvests in the safety of their living rooms and in gunny bags away from thieves. That was why gunny bags were very popular among the vast majority of farmers in Suwerwa location. Silos were the least used because they were very costly to build. Indeed it is uneconomical for small scale farmers to build one. They were suitable for storage of large scale harvest.

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for perishable produces like milk, vegetables, potatoes and cabbages. During drought seasons, there was shortage of milk, potatoes and vegetable. This contributed to food insecurity. Thus, farmers must be facilitated with dryers to mitigate against losses incurred during harvesting.

The study also established the link between storage and food security and the following emerged: More than 70% of the respondents who used gunny bags were food secure in all the food stuffs. In addition over 60 % of the respondents who stored their produce in granaries were food secure. Thus, storage was not a major problem in the area of study.

Table 4.23. Storage facilities and food security.

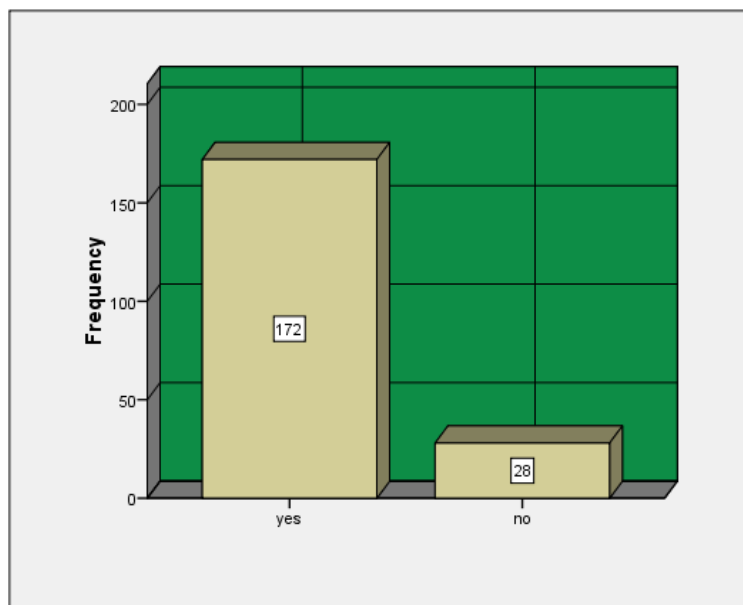
Food Stuffs	Storage Facilities		
	Granary	Silo	gunny bags
	Yes	Yes	Yes
Potatoes Secure	78	.0	71
Vegetables Secure	69	1	75
Beans Secure	63	.9	77

Maize	Secure	62	.6	76
Milk	Secure	64	1.	78

Source: Field survey (2012)

4.3.9 Farm Seeds.

There was need to find out whether farmers in Suwerwa location faced challenges appertaining to seeds. Of the 200 respondents interviewed, 172 farmers, that is, 86 % planted certified seeds while 28 of them accounting for 14 % did not. This is illustrated by the chart below. As reflected in this finding, most farmers planted high quality seed.



Source: Field survey

Fig.4.29 Respondents use of certified seeds

However, those who did not plant certified seeds cited various reasons: 5 respondents said that they lacked finance. This accounts for about 3 % of the respondents. According to Sperling et al (2008), improved seeds were expensive and so certified seeds were not widely used by small farmers. However, the finding from this study negated this argument in the sense that only 5 respondents cited financial problems as a limitation to access to seeds.

A more serious problem was availability of seeds during planting time. This was cited by 16 respondents. An interview with District Agricultural officer confirmed that there was shortage of certified seeds in the year 2011 which forced farmers to resort to alternative seeds. There was delay in release of government subsidised certified seeds during the planting season. That is why 8 % of the respondents resorted to other seeds. The government should streamline seed distribution chain to make it easy for farmers to get seeds without delay. More over 6 farmers were ignorant of the existence of certified seeds (3%), while 1 respondent preferred indigenous type. For the farmers who are ignorant of the benefits of certified seeds, there is need for extension services.

The research revealed that certified seeds had a bearing to productivity as illustrated in **Table 4.24**. About 61% of those who did not use certified seeds realized lower yields that are between 1-10 bags of maize per acre. This is below the expected yields of 20-30 bags

per acre according to Ministry of Agriculture, Trans-Nzoia County. Thus, there was need for farmers to use quality seeds to realize high yields.

Table 4.24: Respondents Usage of Certified Seeds and Productivity

Yield in bags		respondent usage of certified seed in %
Maize	less than a bag	0%
	1-10	55
	11-20	32
	21-30	8
	30 and above	6

Source: Field survey (2012)

4.3.10 Use of Chemical Fertilizer

Information on use of chemical fertilizers was also important in order to determine whether it **had** contributed to food insecurity in Suwerwa. The study revealed that 92.5 % of the respondents used chemical fertilizers as shown in **Table 4.25**. A mere 7.5 % did not use chemical fertilizer.

In the literature review we noted that one advantage of integrated farming was that inputs to the various sub- systems tended to come from within the farm. However, this was not the case in Suwerwa location because 92.5 % of the respondents relied on chemical fertilizer i.e. an external input. In a perfectly integrated farming system, inputs such as fertilizers would be organic such as chicken and cow droppings or even from compost manure. This was not so in Suwerwa location.

It emerged from focus group discussion that respondent's preferred using chemical fertilizer because of ease in application. They thought that farm manure was cumbersome to use and required a lot of labour. As observed earlier, there were no farm systems in Suwerwa and that is why they cited shortage of labour as a limiting factor to use of farm manure. In a farm system where farm activities are integrated chicken pens for example, are constructed above fish ponds and so their droppings fall into the ponds and help to grow algae- fish feed. This is labour saving. This is the way to go for farmers in Suwerwa location.

Table 4.25: Respondents usage of Chemical Fertilizer

Yield in bags		respondent usage of certified seed in %
Maize	less than a bag	100%
	1-10	55
	11-20	32
	21-30	8
	30 and above	6

Source: Field survey (2012)

Of the farmers who do not use chemical fertilizers, 1.5 % was ignorant of its benefits while 6 % lacked money to purchase it. Thus, only a negligible number did not use chemical fertilizers. This is reflected in the table below.

Table 4.26: Respondent reason for not using chemical fertilizer

	Frequency	Percent
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use chemical fertilizer	185	93
Ignorance	3	2
lack capital	12	6
Total	200	100

Source: Field survey (2012)

The study revealed that 7 % of the respondents who used chemical fertilizers did not know the quantity that they used and that 48 % used the recommended 50 kilograms per acre. About 12 % used 75 kilograms of fertilizer, 25 % used 100 kilograms and only 2 % of the respondents used 150 kilograms. From this findings, the researcher saw the need for extension services for the farmers, especially those who did not have knowledge of the right usage of chemical fertilizer.

Table 4.27 Quantity of fertilizer used

Quantity in kgs	Frequency	Per cent
don't know	14	7
25kgs	13	7
50kgs	96	48
75kgs	24	12
100kgs	49	24
150 kgs	4	2

Sources: Field survey (2012)

The study found out that some respondents used organic manure. The researcher administered 200 questionnaires to the respondents and found out that 169 respondents used organic manure and only 31 respondents did not. Some of those who did not use

organic manure preferred to use chemical fertilizers because it was easy to use and did not require a lot of labour. Others said that that they did not have enough animals that could generate enough manure. This is shown in Fig 4.30.

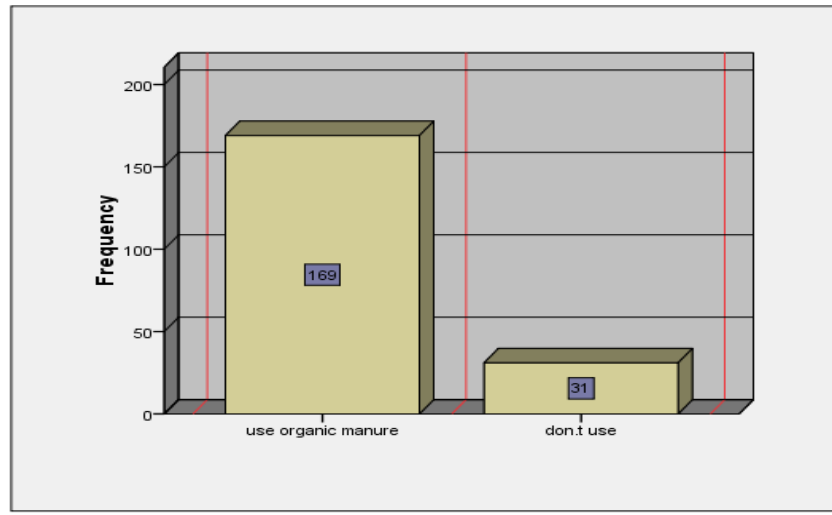


Figure 4.30. Respondents usage of organic manure.

Source. Field survey (2012)

Focus group discussion informed the researcher that farmers collected manure from cow sheds and spread on their farms before the rain came which was later used during planting season



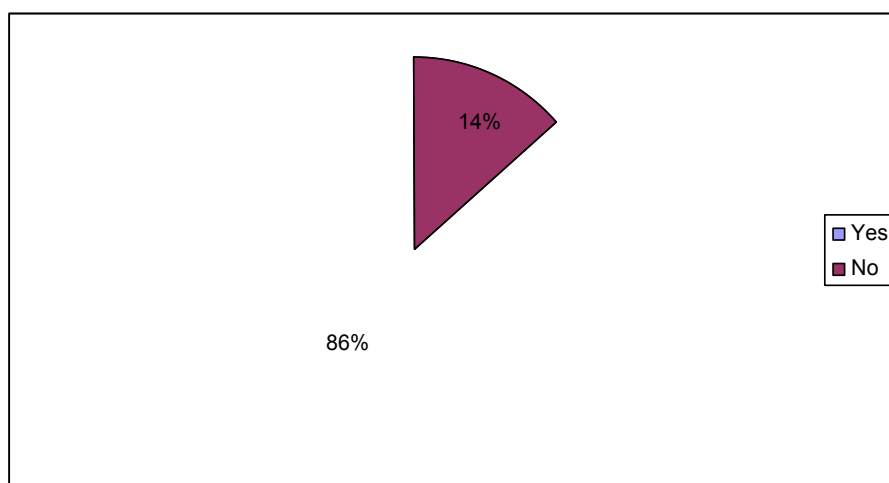
**Fig 4.31 Animal manure in the farm ready for use in the next planting season.
Source: Field survey 2012)**

4.3.11 Use of Pesticides At Farm Level

Scholarly work by other researchers cites use of pesticides as a challenge to farmers.

Wandiga (2001) asserts that due to vagaries of weather, farmers may find their crops

harvest totally destroyed either by drought or outbreak of diseases. It is therefore prudent to use pesticides on plants to prevent frost attack and to control pests. Equally important is the use of pesticides on animals to control ticks, flies among others. The researcher studied the usage of pesticides in Suwerwa location with a view to finding out whether it was a challenge facing farmer. This study revealed that 86.5 % of the respondents used pesticides and only 13.5 % did not. All the respondents who did not use pesticides attributed this to lack of money.



Source: Field survey

Figure 4.32. Respondents usage of pesticides

4.3.12 Hypotheses Testing.

This study was founded on two hypotheses which were tested using chi-square at 0.05 level of significance.

Hypothesis 1. There is relationship between integration and food security.

The following information was obtained: Respondents who kept cows had enough maize, beans, potatoes and milk as illustrated by their corresponding chi-square value of 10.6, 7.3, 2.7 and 35.8 respectively. Indeed, the chi value of milk and cow was 35.5 showing a

strong relationship between keeping cows and milk production. Farmers used maize waste to feed cows and in turn used cow manure to grow maize and beans. This is one system that is interrelated.

The corresponding chi-value of vegetables and goats which was 9.9 and the P value of 0.002 was a pointer of food security for farmers who had integrated the two activities just like the chi value of goats and beans (11.162) and the P value of 0.00. The relationship in this case was that goat manure could be used to grow beans, vegetables and potatoes. However, the P value of cow and milk was higher than that of goat and milk. This was attributed to the fact that farmers in Suwerwa did not keep high quality goats for dairy purposes. There is no demand for goat milk and neither do farmers have knowledge of modern ways of keeping goats.

There is also strong relationship between integrated donkey, maize, vegetables, potatoes and milk production. Farmers use donkeys to transport maize, vegetables and potatoes to the markets as well as carrying animal feeds.

There was a relationship between Sukuma wiki and Maize as shown by their Chi Value of 8.71 and the p value of 0.003. Farmers grew both crops. They were supplementary crops. Farmers use Sukuma Wiki was an accompaniment for Ugali. Similarly, there was a strong relationship between sukuma wiki, beans, other vegetables, potatoes and milk. They all took three months to mature. Owing to small size of land, farmers chose to grow crops that took a short period to mature. They also intercropped them.

In addition, farmers used sukuma wiki and cabbage waste to feed cows and at the same time used animal (cow) manure to enrich their farms to grow cabbages and sukuma wiki. This was a clear integrated system in which farmers relied more on internal farm inputs. However the system could be made better if farmers were to keep cows under zero grazing structures next to sukumawiki and cabbage gardens to ease collection of manure. This is labor saving.

Also observed was the relationship between tomato and maize. Their chi value of 9.5 and P value of 0.002 represented a strong case of integration. Farmers planted tomatoes in maize farms when maize was ripe and about to be cleared from the farm. They did not wait until they had harvested. This was necessitated by the need to make maximum use of their small parcels of land. They also intercropped beans, tomatoes and vegetables in the same parcel of land. Sweet potatoes, beans, vegetables, potato farming had also resulted to food security as seen in their corresponding chi and P value.

The chi value of sugarcane and potato that is 18.15 represented a strong case of integration. In this case, sugarcane was grown in rows in potato gardens. However there was little integration between donkey keeping and sugarcane farming. Donkeys were not used to transport sugarcane because it was cumbersome.

However, there was little relationship between fruit farming and beans, vegetables, potatoes and milk as seen in their chi values of 8.333, 8.754, 3.088 and 7.592 respectively. Fruit farming was not popular in Suwerwa location because of a number of factors such as unfavorable weather and that they took longer to grow compared to other crops. Thus, farmers preferred growing other crops that took a shorter time on the farm.

Table 4.30. Chi square test on Integration and Food security.

		Maize	beans	vegetables	potatoes	Milk
Cows	Chi-square	10.643	7.392	.861	2.714	35.582
	Df	1	1	1	1	1
	Sig.	.001*	.007*	.353	.099	.000*
Goats	Chi-square	1.471	11.162	9.953	7.210	2.527
	Df	1	1	1	1	1
	Sig.	.225	.001*	.002*	.007*	.112
Chickens	Chi-square	.253	.995	7.733	2.222	.362
	Df	1	1	1	1	1
	Sig.	.615	.318	.005*	.136 ^a	.548
Donkeys	Chi-square	3.263	.494	4.399	4.773	14.141
	Df	1	1	1	1	1
	Sig.	.071	.482	.036*	.029*	.000*
Maize	Chi-square	.570	1.493	1.620	.521	1.653
	Df	1	1	1	1	1
	Sig.	.450 ^{a,b}	.222 ^{a,b}	.203 ^{a,b}	.470 ^{a,b}	.199 ^{a,b}
Beans	Chi-square	.252	.636	.745	1.870	.791
	Df	1	1	1	1	1
	Sig.	.616 ^a	.425 ^a	.388 ^a	.171 ^a	.374 ^a
sweet potatoes	Chi-square	2.205	6.595	5.073	33.869	1.493
	Df	1	1	1	1	1

	Sig.	.138	.010*	.024*	.000*	.222
sukuma	Chi-square	8.710	23.135	36.942	13.299	13.537
wiki	Df	1	1	1	1	1
	Sig.	.003*	.000*	.000*	.000*	.000*
Cabbage	Chi-square	7.836	16.676	20.955	17.476	10.675
	Df	1	1	1	1	1
	Sig.	.005*	.000*	.000*	.000*	.001*
	Chi-square	9.589	15.716	18.575	21.155	8.670
	Df	1	1	1	1	1
	Sig.	.002*	.000*	.000*	.000*	.003*
sugar	Chi-square	2.178	7.250	4.162	18.152	6.226
cane	Df	1	1	1	1	1
	Sig.	.140	.007*	.041*	.000*	.013*
Fruits	Chi-square	1.390	8.333	8.754	3.088	7.592
	Df	1	1	1	1	1
	Sig.	.238	.004*	.003*	.079	.006*

Key:

Df - Degree of Freedom

Sig - Level of significance

Source: Field survey (2017)

Hypothesis2. There is relationship between challenges that farmers face and food security

Challenges were cross tabulated against food security. The researcher used chi-square to test the relationship. It emerged that lack of reliable market was a major challenge to farmers. The P-value of 0.000 for maize and beans, 0.030 and 0.001 for vegetable and potatoes were indicators of market as a major problem to farmers.

The researcher tested whether drought and inability to irrigate was a problem. The P-value of 0.000 for milk showed that there was a great relationship between drought and potatoes, that is, potatoes were affected by drought significantly leading to low production. The same case applied to milk production which had P-value of 0.032.

Farmers lack pasture during drought seasons and therefore low milk production. The researcher tested the impact of inability to irrigate land on food security. The chi-square revealed that this had contributed to food insecurity. The P-value for vegetables was 0.000. This implied that indeed, inability to irrigate land had contributed to insufficient vegetables for the respondents. This had also contributed to insecurity in maize foodstuff as seen in the chi-square P-value of 0.002.

Lastly, access to loans was confirmed as a challenge to the respondents especially in relation to potatoes farming. The P-value of 0.035 confirmed this. The challenges faced by the farmers in Suwerwa location needed to be addressed by all the concerned stakeholders if food security is to be realized. This is addressed under recommendations.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATION.

5.1 Summary:

Integrated Small Scale Agricultural Production As Practiced in Suwerwa Location

Elementary or traditional integrated farming system prevailed in Suwerewa location. Farmers kept traditional chicken, goats and sheep as well as poor breeds of cows. In addition to this they had not evolved integrated farming into distinct modern farm systems that are characterized by strong interdependence.

There was no modern integration of farming activities such as fish- chicken- maize farming. Thus farmers had not reaped full benefits of integrated farming. This would be possible if farming activities were to evolve to embrace more modern methods of integrated agriculture practices.

It emerged that integrated small scale agricultural practices was beneficial to most of those who had adopted it: Low cost of production, sufficient and nutritious food throughout the year and reduced risk of monoculture.

Even those farmers who practiced this kind of farming had not transformed their activities into farm systems in which waste products from one system could be used as input in other farm activities. This had forced the farmers to rely on external farm inputs (such as chemical fertilizer) that were costly.

Evaluation of the Capacity of Integrated Small Scale Agricultural Production in Ensuring Food Security.

Where there is proper integration of farm activities, there is food, security- 59% of the respondents are food secure. However, it was possible to attain food security for all via integration of small scale farm activities if farmers were to evolve their farming activities to embrace modern integrated farm systems.

Challenges Facing Integrated Small Scale Agricultural Production

There were a myriad of challenges or risks that small scale farmers faced and which impeded their effort to integrate farming activities, for example, unfavorable weather conditions (storms, frosts and droughts)

Drought in particular, was a great obstacle to farmers most of who did not have tools (equipment), which might enable them to irrigate their farms. Thus they did not grow food throughout the year. This had resulted to food shortage. Farmers fetched little money from their produce due to poor markets.

Loans

To revamp agriculture there should be credit facilities for farmers. They should be made aware of the sources, terms and conditions of the credit.

Extension service

Majority of the respondents did not get extension services and even some farmers did know that such services existed. In this regard, farmers should be sensitized on the need and benefits of these support services that are very crucial to them. At the same time extension services must be aligned to the needs of the farmers; in this way the services would add value to farming practices

Scarcity of labor had made it hard for farmers to practice integrated farming owing to multiple activities which took place concurrently in the farm. To overcome this challenge farmers should evolve farm system which are labor saving.

Farmers used old\ obsolete technology in their activities. The use of Jembe, panga (machete) was prevalent. There was need to evolve agriculture and adopt modern ways of agriculture.

Storage facilities

Farmers did not have constant supply of milk, vegetables, potatoes and other perishable foodstuffs. This was attributed to the fact that there were no storage facilities for perishable produces.

Seeds

Most farmers planted certified seeds. However, the few (14%) attributed their failure to plant certified seeds to lack of finance, availability of certified seeds or ignorance. Those who planted certified seeds were more secure than those who did not. However, there was need to ensure that seeds were available during planting season. The government needs to streamline distribution chain for farmers' easy access. Majority of the respondent used chemical fertilizer- an external input instead of farm manure. However, about 7% of those who use chemical fertilizers did not know the right usage (quantity).

5.2. Conclusion

The researcher set out to evaluate the capacity of integrated small scale agricultural production to ensure food security. A sample size of 200 small scale farmers from Suwerwa location was picked.

The study adopted 4 objectives, 4 research questions and 2 hypotheses which were tested using chi-square test at 0.05 level of significance. The researcher drew the following conclusions from the study.

Integrated small scale agricultural production as practiced in Suwerwa location had ensured food security for only 59% of the population. However this system of farming could ensure food self-sufficiency for all, if farmers were to re-orient their farming activities to embrace modern technology, evolve better farm systems characterized by high-quality animals, certified seeds, better farm tools and improved storage facilities even for perishable farm produces. In the same breath, the ministry of agriculture should assist farmers to change and adopt better integrated agricultural practices.

Lastly, farmers must ensure that they reap full benefit of integrated agriculture by adopting more modern farm systems. They must be sensitized on the need for extension services. At the same time extension services providers must realign the services to meet farmers needs. Furthermore, credit facilities must be provided to farmers to empower them to begin projects. They must be sensitized on the sources of the loans, terms and conditions.

5.3 Recommendations

i) In view of the fact that land size is ever dwindling , it is important to lay emphasis on the need to integrate farming activities on tiny land holdings in order to ensure that Kenya's population is food secure. This is the way to go.

ii) Farmers should be taught different systems of integration, for example, chicken-fish farming, trees-fruits-bee keeping, keeping cow- farming maize- chicken keeping and fish farming among others. They should come up with farm system in their tiny land holdings. The ministry of agriculture should come up with demonstration farms and training centers to make it easy for farmers to learn novel ways of integrated farming.

iii) There is need for agricultural extension services to educate farmers on better methods of farm systems. As demonstrated in the findings, only 44% had access to these services and that it had contributed to poor productivity and hunger. Farmers should be made aware that they can be assisted free of charge.

iv) Farmers should be encouraged to embrace irrigation to ensure that they grow food all the year round and at the same time enable them to grow other crops apart from maize. By so doing, they would not only cushion themselves from the attendant risks of monoculture but also ensure that they have constant income throughout the year. This can only be done if they are able to acquire equipment. It is there fore important for the government to come up with tools that are affordable, simple to operate and repair.

v) If farmers were to realize benefits of farming, markets must be built and the existing ones streamlined in order to be farmer friendly. In this regard, NCPB should be

flexible and efficient to accommodate small scale farmers. Payment should be prompt to attract small scale farmers and at the same time discourage them from selling by the roadside and to the middle men.

vi) Farmers should form cooperative associations in order to strengthen their bargaining powers such that they can also be able to penetrate foreign markets. The government should assist farmers in this regard.

vii) Farmers should also be sensitized on the existence of credit facilities: sources, location, terms and conditions and interest.

viii) To overcome challenges associated with labor, farmers should be taught better ways of integrating farming activities to make sure that farming is not labor intensive.

ix) The government should streamline seed distribution chain to make seeds available to the farmers during planting seasons. In deed, more seed distribution points should be established across the counties.

x) Chemical companies should have field days with farmers to demonstrate the right usage of fertilizers and other chemicals.

5.4 Suggestions for further study

This study exclusively dwelt on integrated small scale agriculture. It would be advisable for future researchers to study different systems of integrated agricultural production, their costs, benefits and pitfalls.

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My names are John Kimingi Mwangi, a post graduate student in Moi University, pursuing a Masters of Philosophy Degree in Development Studies. As a part of the requirements for the course, I am carrying out research on the capacity of integrated small scale agricultural production in realization of food security in rural Kenya. This research will explore ways of making integrated small scale agricultural production sustainable and beneficial to farmers. Any information provided will remain confidential and be used only for the purpose of this research.

Thanks in advance for your co-operation.

Section A

(Instructions: Tick the correct answer)

Respondent's Profile

Name	
Age	
Education Level	
Marital Status	

1. Do you own land?

Yes No

2. What is the size of your land?

a. Between 0.1 – 1 acre b. Between 1 – 2 acres c. Between 2 – 3 acres

b. What is the size of your land under cultivation?

a. Between 0.1 – 1 acre b. Between 1 – 2 acres c. Between 2 – 3 acres

3. Do you lease land?

Yes No

b. How much land do you lease?

a. Between 0.1 – 1 acre b. Between 1 – 2 acres c. Between 2 – 3 acres

4. What is /are your other sources of income?

a. Farming

b. Formal employment/ office work

c. Transport business

d. Casual labourer

e. Broker

If others state

.....

5. Do you keep the following animals in your farm?

- a. Cows Yes
- b. Goats Yes
- c. Chicken Yes
- d. Ducks Yes
- e. Fish Yes
- d. Bees Yes
- e. Donkeys Yes
- f. Others

.....

6. Do you grow the following crops in your farm? Tick

- a. Maize
- b. Beans
- c. Sweet Potatoes
- d. Sukuma Wiki
- e. Cabbage
- f. Tomatoes
- g. Sugar cane
- h. Fruits
- i. Others

.....

7. Do you have enough of the following foodstuff to last you through out the year? Tick

- a. Maize
- b. Beans
- c. Vegetables

Sukuma Wiki								
Cabbages								
Tomatoes								
Sugar cane								
Fruits								
Milk								
Eggs								
Cows								
Goats								
Chicken								
Sheep								
Sunflower								
Others								

Income from Sales

9. How is the farming activities interconnected / interrelated?

- a. Animal manure (cows and goat dropping) is used to fertilize soil and therefore increase productivity
- b. Waste from the crops is used as animal feeds
- c. Waste from crops is used as compost to make organic manure that is used in the farm.
- d. Chicken dropping is used to grow algae as fish feed
- e. All of the above
- f. Others

.....

Section B (Benefits)

Tick the correct answer

10. a) What benefits do you get by integrating small scale farming?

- a. Increased productivity.
- b. Sufficient food throughout the year
- c. Constant income
- d. Low cost of production
- e. Variety of food
- f. Reduced risks of monoculture
- g. All of the above

b) If there are other benefits, state.....

Section C (Challenges)

Tick the correct answer

11 a) What are the risks of integrating small scale agricultural production?

- a. Unfavorable weather conditions e.g. droughts and floods
- b. Pests and diseases
- c. Market fluctuation
- d. Land tenure system
- e. All of the above

b) Have the above risks made it impossible to integrate farming activities?

Yes No

12. Has lack of labour made it hard for you to integrate agricultural activities?

Yes No

If yes, say how

.....

13 What tools / machines do you use in your farm?

- a. Jembe b. Panga c. Sickle d. Shovel e. Water
- Pump
- f. Refuse Tractor g. Fork Jembe g. Slasher

Others

.....
 If none, say why

14. Do you have knowledge of mixed farming?

Yes No

b. If no, has it made it difficult for you to integrate farming activities?

Yes No

15. Do you get agricultural extension services?

Yes No

b. If yes, how often?

Weekly Monthly Quarterly Annually

Other

.....
 c. If no, would you like to be provided with the same?

Yes No

16. Do you have a reliable market for your produce?

Yes No

b. Where / to whom do you sell?

a. NCPB b. Municipal Market c. Export Market

d. Middlemen e. Neighbours

f. Others

.....
 17. Do you experience the following extreme weather conditions that affect farming activities?

a. Prolonged droughts Yes No

b. Frost Yes No

c. Floods Yes No

d. Wind storm Yes No

e. Others.....

18. Do you irrigate your farms during dry seasons?

Yes No

If no, say why

.....

19. Do you have access to loans and other credit facilities?

Yes No

b. If yes, from which of the following institutions?

i. Banks

ii. Agricultural Finance Corporation

iii. Micro-finance Institutions

iv. Co-operative Sacco

v. Others

.....

If no, say why

Have other sources e.g help from relatives

Have no security

Afraid to take risks

Have enough capital

Not interested

Do not know the source

Get help from relatives

Others

.....

20. Do you use chemicals fertilizers in your farm?

Yes No

b. If yes, what quantity per acre.....

a. 25 Kgs b. 50 Kgs c. 75 Kgs d. 100 Kgs

e. 150 Kgs

c. If no, say why

.....

21. a) Do you use animal and organic manure?

Yes No

b. If yes, do you know the quantity?

Yes No

c. If yes, what quantity per acre

.....
.....

d. If you don't use organic manure, say why

.....
.....

22. Do you use pesticides?

Yes No

If no, say why

.....

23. How do you store your produce?

a. Grain granary b. Silos c. Gunny bags d. None of the above

e. If other, state

.....
.....

24 .a) Do you plant certified seeds?

Yes No

b. If no, why

a. Lack of finance

b. Unavailability of seeds

c. Lack of knowledge of their existence

d. Preference to indigenous seeds

If for other reasons,

state.....

.....