An Economic Analysis of Grain Legumes Utilization and Gross Margins in Nandi County, Kenya

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL AND APPLIED ECONOMICS

UNIVERSITY OF NAIROBI

DECEMBER 2017

Declaration and Approval

I, Mercy Anyango Onyango hereby declare that this thesis is my original work and has not been presented to any other university for any award.

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Dedication

This thesis is dedicated to my mum Margaret Onyango for her love and moral support. I thank her immeasurably.

Acknowledgement

First and foremost, I thank Almighty God for granting me the energy and good health through my entire study period. Glory to Him!

I wish to acknowledge the African Economic Research Consortium (AERC) for funding my studies and research. Special thanks to Dr. John Ojiem, the Centre Director of the Kenya Agricultural and Livestock Research Organization (KALRO), Kibos for providing additional funding for my research through the McKnight Foundation-supported *Multipurpose Legume Project* (MLP) in Kenya.

Also, special thanks to my supervisors; Dr. David Jakinda and Prof. Rose Nyikal for their support and effort in bringing the best out of what I learnt in class and their guidance in research. The precious time they spent reading and providing valuable insights to this work was of great importance in completing this thesis. I also appreciate my classmates and colleagues for their positive criticisms. Lastly, I would like to thank all respondents to my field survey and all those who assisted in its success.

Abstract

Grain legumes have great potential for improving smallholder farmers' productivity in Sub-Saharan Africa (SSA). However, this has not been fully exploited due to critical problems such as high insect pests and disease infestation. As part of addressing these challenges, Kenya Agricultural and Livestock Research Organization (KALRO) in collaboration with Cornell University and supported by the Collaborative Crop Research Program (CCRP) introduced crop and soil enhancing strategies in Western Kenya. One of the strategies included use of multipurpose grain legumes species in Nandi County. Through this initiative, various legume species including common bean, cowpea, groundnuts, dolichos lablab and soybean are being promoted at the farm level. However, the extent of their utilization and the actual benefit is not known precisely as it is not comprehensively documented. Furthermore, no empirical study has delved in the assessment of the economic benefits that farmers are likely to obtain if they adopt the legume species. In order to address the aforementioned knowledge gaps, the present study sought to analyze utilization and evaluate gross margins of grain legumes. Data was collected from a random sample of 163 farmers from three study sites in Nandi County (*Koibem*, *Kapkerer* and *Kiptaruswo* sites). Descriptive statistics on frequencies and percentages on utilization and legume attributes were presented in graphs and tables. Further, gross margins were computed from farm-level data while multiple regression model was applied to determine factors influencing the gross margins obtained. Results showed that farmers' priorities for use of legume included; food dishes, income generation, forage and soil fertility improvement. This indicates that farmers value legumes for home consumption purposes and also for income. Descriptive statistics revealed that about 56 percent of the households had positive gross margins while the rest incured losses in the production of grain. Further, beans, groundnuts, cowpeas and soybean had positive gross margins while dolichos lablab gross margin was negative. This indicates that

generally legumes farming is feasible. Groundnuts and beans accounted for about 49 percent and 36 percent, respectively of the total legume gross margins. Farm labour cost was the largest component of cost, accounting for about 68 percent of the total variable production cost of legumes. An analysis of variance (ANOVA) showed that there was no statistical difference at 95 percent in the mean gross margins for the legumes studied. Further, the multiple regressions indicated that area under grain legumes, age of the farmer, access to extension services and access to credit had significant influence on gross margin. As such, different interventions are needed so as to promote the production and diversify utilization patterns of the legumes. For instance, interventions geared towards increasing diversification of utilization of legumes through processing and value addition by for instance processor village groups for soybean or any other legume through provision of processing equipment and training on the usage by the project is necessary. Also, there is need to minimize labour cost for instance through provision of seeds with less labour requirements to farmers. Further, there is the need for appraisals of extension services in order to improve the delivery to farmers. Similarly, policies and interventions which can promote credit access would enhance gains from legumes.

Key words: Legumes, utilization, gross margins, Kenya.

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List of Acronyms

ANOVA	Analysis of Variance
ASDS	Agricultural Sector Development Strategy (Kenya)
CAPI	Canadian Agri-Food Policy Institute
CBA	Cost Benefit Analysis
CCRP	Collaborative Crop Research Program
CIAT	Centro Internacional de agricultura tropical (International Centre for Tropical Agriculture)
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GM	Gross Margin
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IITA	International Institute of Tropical Agriculture
IRR	Internal Rate of Return
KALRO	Kenya Agricultural and Livestock Research Organization
OLS	Ordinary Least Squares
MLP	Multi-purpose Legume Project
SPSS	Statistical Package for Social Sciences
SSA	Sub-Saharan Africa

CHAPTER ONE
INTRODUCTION

1.1 Background to Legume Diversity and Livelihoods

Grain legumes are not only a source of protein and other minerals but are also considered to play important roles in the nutritional and health of many rural smallholder farmers in Sub Saharan Africa (SSA). They form a major diet for the rural households who cannot afford the relatively more expensive animal proteins. In addition, because of the health risk of consuming some or excess animal proteins, the demand for legume-based products is expected to increase (Daryanto et al., 2015). Legumes are multipurpose crops and are consumed either directly as food or in various processed forms or used as feed in many animal farming systems (Gowda et al., 1997).

According to Mafongoya et al. (2006), the main challenge to improving agricultural productivity is building and maintaining soil fertility. Farmers are faced with many challenges such as limited resources and inadequate skills that negatively affect agricultural productivity. Grain legumes have the potential to improve soil fertility and often they are intercropped with cereals, mostly maize. By improving soil fertility through biological nutrient fixation, legumes also play an important role in conservation agriculture by reducing amount of chemical fertilizer used. For instance results by *Ojiem et al*., (2006) indicated that *Lablab purpureus* produced high grain yield on small holder farms in Western Kenya while significantly improving soil nitrogen fertility i.e.net soil input 42 – 131 kg N/ha.

However, legume production in SSA (Kenya included) is very low due to poor soil fertility, and incidences of pest and diseases, (Odendo et al. 2006). Kosura (2013) states that the yields of grain legumes in much of Africa are low (typically less than 1 ton per hectare) despite their

economic and food security importance. Even with their importance many studies observe a yield gap. Mutegi and Zingore (2014) state that the average grain legume yields have stagnated to about 0.7 tons per hectare against a potential of 3 tons per hectare, resulting into increased food insecurity in most parts of SSA.

Kenya has a rich diversity of grain legumes. Common bean is the most important species with over 100 cultivars having been identified in the country (Wambugu and Muthamia, 2009). Groundnuts are mostly grown in western Kenya while soya bean (*Glycine max*) is grown only on a very limited scale. Farmers' choices to grow grain legumes are influenced by socio-economic and biophysical factors. This is because smallholder systems differ in terms of rainfall, temperature, soil fertility, pests and diseases, land and labor availability, income, market availability, and farmer preferences (Ojiem et al., 2006). The various production enhancing options availed by incorporating multipurpose grain legumes into the farming systems, must therefore be well adapted to specific contexts.

1.2 Opportunities for Boosting Grain Legume Production in Kenya

Grain legumes have the economic importance in the provision of food to humans and at the same time are used as feeds for animals. They have high calorie and protein content. Grain legumes are the most important source of proteins especially in the developing countries because they are relatively inexpensive compared to other sources of protein. In the urban Kenya, many people rely on protein from animal products, but which is relatively more expensive than protein from plant sources.

According to Eskola (2005) grain legumes contain as much protein as animal sources and are therefore the most practical means of reducing protein malnutrition. Increase in population in

western Kenya has decreased land sizes leading to intensive cultivation of the available crop land without replacing nutrients taken up by the crop. This has resulted into degraded soils and low crop yield (Onyango, 2010). Similarly a study by Conelly and Chaiken (2000) in western Kenya found that intense population pressure resulted in small land holdings, and that diet quality and food security were at a risk. It is in this regard that the Multipurpose Legume Project (MLP) initiated by KALRO in 2008 introduced promising grain legumes of diverse varieties including beans, groundnuts, lablab, cowpea and soybean that to address assortments of farmers' needs.

These legumes have been used as an entry point to improve productivity, food security in terms of nutrition and availability aspect and income for the smallholder farmers in Nandi County. Economic evaluation of a technology is necessary as it is an important dimension on the sustainability of a given technology.

1.3 Statement of the Research Problem

Grain legumes play important roles in smallholder farmers' livelihood. From a producer's point of view, integration of legumes in the farm enhances soil fertility and broadens the amount and stability of household income streams (Mhango, 2011). To consumers, legumes are considered to be among the least expensive sources of protein in a vegetarian's diet and supplement mineral and vitamin requirements (Joshi et al., 2000). Some of the challenges towards optimum benefits from grain legumes include inadequate access to farm support services and insufficient attention by researchers to multi-functionality of legumes (Kerr et al., 2007).

For initiatives such MLP to succeed, the beneficiaries must fully contextualize the technologies within their farming systems and resource limits, and accept and own them, especially when they are introduced by external organizations. However, ever since the introduction of these legume

varieties, their utilization and respective benefits are not yet adequately established; no study has been done to assess their gross margins and the extent to which farmers are utilizing them.

1.4 Objectives of the Study

The purpose of this study was to assess the utilization and the contribution of grain legume species in smallholder farming systems in Nandi County. The specific objectives were to:

1. Characterize the utilization of the grain legumes
2. Analyze the gross margins of the grain legumes
3. Assess factors influencing the gross margins of the respective grain legumes

1.5 Justification of the Study

The United Nations (UN) Sustainable Development Goals (SDGs) numbers one and two aim at reducing poverty and hunger to zero levels by 2030. Even though production of grain legumes has not been mentioned as one of the targets in achieving the goals, adoption of the improved varieties of grain legume species by smallholder farmers can be the starting point towards achieving these goals. Conducting an economic analysis of the grain legumes is important for proper acceptability of a technology. Farmers will easily adopt crops that they perceive to have more benefits. Information on the profitable grain legume species to farmers will lead to more farmers incorporating them into their farming and hence inform farmers on profitable cultivation practices and help them make decisions on effective changes for higher income and better nutrition.

The contribution of both farmers and scientists are important for successful technology development (Onyango, 2010). Understanding the extent of utilization and farmers' opinions about grain legumes will provide information for breeders to develop varieties taking into

account farmers' views. The scientific community will also gain information which will enable them to modify on how to approach the technology innovatively. Also, the findings will inform the CCRP whether the farmers are utilizing the grain legumes innovatively or not and inform them based on the results on better ways that will improve the utilization of legumes at household level.

The findings of this study provide insights on the patterns of utilization of the legumes studied. This information will improve the way farmers utilize legumes both in their diet and as non-food by learning how other farmers utilize the legumes. Understanding of better utilization ways particularly in their diet will not only improve their health due to provision of vitamins from legumes but also will prevent use of expensive interventions such as fortification and pure supplements which have low coverage in rural areas (Xiao et al., 2007). Therefore improving their welfare and nutrition.

1.7 Study Area

This study was undertaken in Nandi county that is located in the Rift Valley region of Kenya. It occupies a total area of 2884.5 square kilometers, with arable land of 206,959 hectares. Temperatures range from 15^0C to 26^0C and rainfall of between 1200mm and 2000mm per annum. Nandi county has two rainy seasons; the long rains between March and June and the short rains between October and early December and the dry spell usually experienced from end of December to March. With an estimated population of about 753,000 (Kenya National Bureau of Statistics, 2009), the area is mainly characterized by subsistence agriculture and livestock rearing. The main staple food crops are maize and beans,finger millet, sorghum, sweet potatoes, bananas and vegetables, while the chief cash income earners are tea, sugarcane and coffee. Western Kenya, (Nandi County inclusive) has highest rural population which has led to farm

fragmentation, resulting in continuous cropping in an effort to ensure household food security. This has resulted in the reduction of soil fertility and decrease in productivity increasing poverty levels in the County. It is for this reason that MLP implemented its activities in Nandi County in order to rejuvenate the system health and improve productivity.

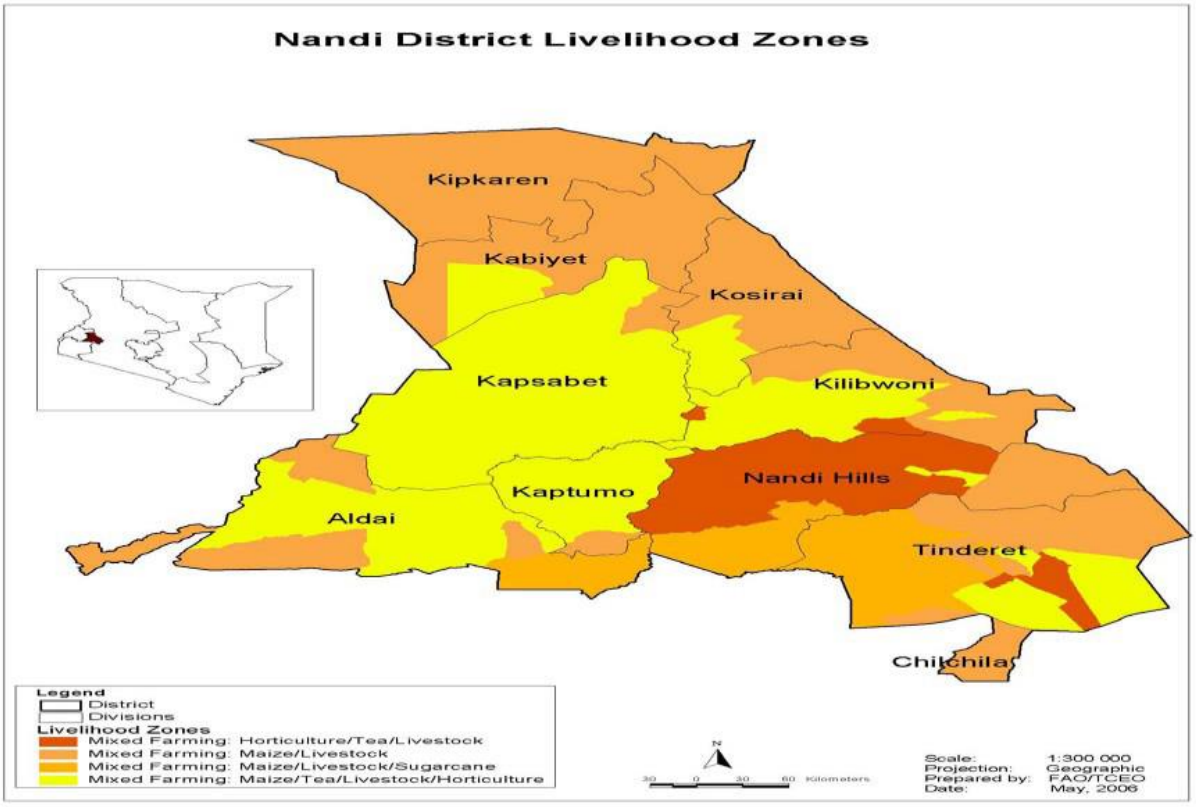

Figure 1: Map of Nandi County

Source: Republic of Kenya (2013).

1.8 Thesis Outline

This thesis has five chapters as follows: chapter one provides an overview of the diversity and the role of grain legumes in smallholder farming livelihoods. It also provides an insight on various opportunities towards increasing the production of grain legumes in Kenya. The problem being investigated, objectives to be achieved and importance of the study are also discussed here. Chapter two entails a review of literature on utilization and diversification of legumes, knowledge gaps and methods for conducting farm profitability. Chapter three includes a detailed discussion of framework on which the study is based on, sampling, data collection and analysis methods. Results of the study are presented in chapter four while the final chapter concludes the study by making some recommendations that would improve legume gross margin.

CHAPTER TWO
LITERATURE REVIEW

2.1 A Review of Insights on Legume Utilization and Diversification

Malnutrition is a serious challenge to poor households in the SSA region and thus increasing the rate of food insecurity in the region. For instance, Abdulkadir et al. (2009) showed that stunting and emaciation as a result of malnutrition affected up to 70 percent of children in Western Kenya. Regular consumption of grain legumes such as beans have the potential in reducing risk of diseases including cancer and coronary heart diseases (Winham et al., 2007; Lanza et al., 2006).

Grain legumes play an important role as food security crop for smallholder farming households in Africa. Cowpea, soybean, groundnut and common bean are the most important grain legumes in SSA (Odendo et al., 2006). They are mostly regarded as women crops since in many cases the women are the ones involved in the production and even marketing. These crops provide multiple benefits including food, fodder, weed control and water conservation (Kiptot et al., 2007). Odendo et al. (2006) also noted that grain legumes are particularly important human food as they are rich in protein and sometimes sold for cash income. In addition, herbaceous legumes such as dolichos lablab have the ability to improve soil fertility because of their high biomass production. A study by Ngwira et al. (2012) pointed out that groundnuts enrich the soil with nitrogen through biological fixation; and its husks can be used as fodder and fuel. In addition, Erskine (2001) highlighted that legumes may be a useful protein and energy source for ruminant and monograstric animals.

Farmers have multiple reasons for growing legumes depending on priorities. The various reasons include for home consumption, income generation, green manure and forage. These reasons are

often influenced by socioeconomic and biophysical factors. Snapp and Silim (2002) showed that farmers in Eastern and Southern Africa are concerned with factors such as ability to adapt to local conditions, tolerance to low soil fertility, effect on soil fertility, maturity period, yield, food security, grain quality, marketability and non-food benefits such as forage, fuel wood, or less labor demands. Separately, Freeman et al. (2002) found that high yield, drought resistance, good taste and short cooking time influenced choice of groundnut varieties.

Despite the multiple benefits stated above, utilization of grain legumes in smallholder farming systems is still low. In many parts of Eastern and Southern Africa, the perception that beans, cowpeas, and other pulses are 'poor man's food' has been the main obstacle to broader consumption of these grains. Mwenye (2003) noted lack of knowledge on the utilization of legumes for human consumption and stock feed as one of the shortcomings in the promotion of legumes that were studied. Similarly, Nhemachena et al. (2003) noted that the potential for expanding legume production has not been realized due to shortage of knowledge among other factors. The author further stated that there is need to explain the benefits of legumes to farmers. Rowe and Giller (2003) further stated that underutilization of legumes may be due to poor market development.

The diversity of varieties within the legume species and the knowledge about their utilization is currently on the decline among many communities. For instance, cowpea has been classified under neglected and underutilized crop species due to limited research done on the crop (Chivenge et al, 2015). This leads to weak demand and depressed economic value of grain legumes which in turn results to limited incentive to invest in grain legume production and utilization.

Proper utilization of crops has the ability to significantly promote economic development because legumes have the ability to contribute to food and nutritional security, income and sustainable production systems (Ebert, 2014). This illustrates the need to evaluate utilization of grain legumes that were introduced in Nandi.

2.2 A Review of Knowledge Gaps on Legumes

Literature on the utilization of legumes have mainly focused on the grain taking less account on other legume parts such as pods, leaves and other non-food aspects of legumes which also play significant roles. Wanjekeche et al. (2003) assessed utilization methods of new legumes that were introduced in North Western Kenya. The authors focused on the food value with less attention on other parts such as the leaves that are also consumed as vegetable. Other studies, for instance Ojiewo et al. (2015), acknowledge that research gaps and other areas of emphasis along the value chains in the process of mainstreaming the legumes into production and utilization systems for improved livelihoods have also been highlighted with emphasis on nutrition security.

CCRP in its development efforts has carried some studies on grain legumes that were introduced, but has been silent on the economic benefit of the legumes. One of the studies (Ojiem et al., 2013) focused on benefits of various leguminous crops when intercropped with other food crops. It demonstrated that crop production can be improved with integration of grain legumes; for example it was found that up to 53 percent reduction in *striga* population was achieved through rotation of maize with the grain legumes. In another study, Omondi (2011) focused on dolichos lablab and assessed the benefits of the legume in improving consumption adequacy for protein, iron and zinc intake in Nandi County.

Results obtained from the various previous project research activities indicated that the new legume species introduced in Nandi (bean, lablab, groundnut, cowpea and soybean) are suitable for integration into the smallholder farming systems to provide ecological benefits and improve system productivity (Njeru et al. 2007). Within the Agro-Ecological Intensification (AEI) domain, multipurpose grain legumes are capable of diversifying the production systems achieve biological control of pests and diseases (Abang et al., 2014). Also, large amounts of high quality biomass produced, e.g. by dolichos lablab can facilitate nutrient recycling, thus allowing farmers to improve legume productivity with the limited resources available to them (Mugambi, 2013).

Whereas previous CCRP studies elicited important insights on issues on grain legume sector as a whole, these aspects only guarantee farmers against agronomic related constrains. Agronomic results alone do not provide complete picture when assessing a given technology (Onyango, 2010). It needs to be supplemented by insights from economic analysis and understanding of farmer perceptions (Odendo et al., 2006). Other aspects of legumes such as preferences, prices and production objectives are also of importance (Ojiem et al., 2006).

It is against the aforementioned background that the present study sought to assess the extent and forms of utilization of grain legume and farmers' opinions on the suitability of the legumes introduced. Further, this study assessed economic gross margins of grain legume and investigated factors that explain the level of profits generated from the grain legumes. The results can be useful for better understanding of the economic potential of legume as well as important for the county government and other NGOs interested in legume production to provide better policies for instance, that could lower labour costs and increase returns..

2.3. Review of Methods Used in Economic Returns Analysis

In analyzing farm profitability, gross margin has been suggested as the best method due to its simplicity and accuracy (Ahmad, 2004). According to Chisoni (2012) gross margin is the simplest and most practical method of assessing enterprise profitability and it is widely used in farm management economics. Gross margin has been defined as total income less total variable costs. It serves as the unit of analysis in evaluating the economic performance of an enterprise and gives an indicator of the feasibility of an enterprise and its potential contributing to household income (Masvongo et al., 2013). Gross margins are usually computed per year or per cropping season (Zulu, 2011). Gross margin approach as a proxy for profitability of agricultural enterprises has been applied severally in the literature (see for example, Tschering, 2002; Erbaugh et al., 2010; Sulumbe et al., 2010). In addition, it has been argued that most farmers use farm management techniques like gross margin and partial budgeting in making farm decisions (Longworth and Kenneth, 1980).

Computation of gross margin only takes into account variable costs and hence does not misjudge the economic value of each enterprise which tends to be undervalued when fixed costs are included. Gross margin was used in the current study because it is a relatively accurate indicator of the performance of an individual farm and it allows a comparison of the performance of different farms (Nemes, 2009) as used by Kraybil and Kidoido (2009) to calculate the profitability of Ugandan agricultural enterprises.

Conversely, gross margin has limitations as it does not quantify net profit of an enterprise and only considers variable costs in its calculation. However, in most smallholder assessments fixed costs such as land and permanent labour will not necessarily be included in computation of the gross margin. The gross profit margin is appropriate for this study since when using the net profit

margin, the costs farmers incur are extremely high and do not illustrate any efficiency on the use of land and profitability.

Other methods that have also been used in evaluating benefits and costs include; internal rate of return (IRR), cost-benefit analysis (CBA), partial budgeting analysis (PBA), and return on investment (ROI), and all these are anchored on gross margin analysis. PBA and CBA include fixed costs of the whole farm. The strength of such techniques is that they help to identify all costs involved in a particular enterprise. However, full cost techniques (PBA and CBA) have difficulties and sometimes arbitrary decisions have to be made concerning the allocation of overhead expenses between enterprises (Firth, 2002). As such gross margin is not the same as profit since it does not consider overhead costs, permanent costs and capital costs (interest). It is appropriate in analyzing small scale farm enterprises since these enterprises require negligible fixed costs. The gross margin analysis was used with the assumption that fixed costs of production are negligible (Olukosi and Erhabor, 1988 and Samboko, 2011).Net profit estimates per enterprise tend to ignore the interrelated nature of enterprises and are thus less useful for most farm enterprises (Firth and Lennartsson, 1999). The return on investment is similar to CBA, since it also measures benefits and costs in monetary terms.

CHAPTER THREE
METHODOLOGY

3.1 Conceptual Framework

The driving force of economics of agricultural production at the micro level is to help farmers to meet their objectives through efficient farm allocation of resources over a specified period of time. Hence this study assumes that producers attempt to maximize some objective function subject to a set of constraints determined by institutional set up and socio-economic characteristics. In this case, maximizing returns from production factors as described from the production theory. Literature suggests that farmers may be motivated to produce on the basis of the utility derived from production; and for profit reasons (Knight 1923; Bioca 1997). Following this, the current study conceptualizes returns status as an outcome of farm and household characteristics, volume of production, price received per enterprise and cost associated with the production of the commodity. The study adopted and modified conceptual framework developed by Engel (2010) as shown in Figure 2. It illustrates that different farm and physical characteristics among farmers influence profits by having effect on the volume of production, price received per unit of enterprise and the cost structure.

Different factors influence legumes gross margins. This is because individuals in a community often vary in terms of age, education, gender, wealth and access to credit. As such, farmer attributes like age, gender, education, income, family size, group membership, primary economic activity, resource endowments, have been shown to influence farmer decisions. Furthermore, such variables may influence the costs of production, volume of production which also influence the revenues and one's ability to comprehend technologies. For instance, farm and farmer characterisctics such as access to credit, distance to input and output market, size of the farm

and group membership directly or indirectly influence volume of production, price of enterprise and eventually the gross margins they accrue. Mwaura et al. (2013) and Jimoh and Onimisi (2013) has shown that socio-demographic factors and geographical location influence production practices of farmers.

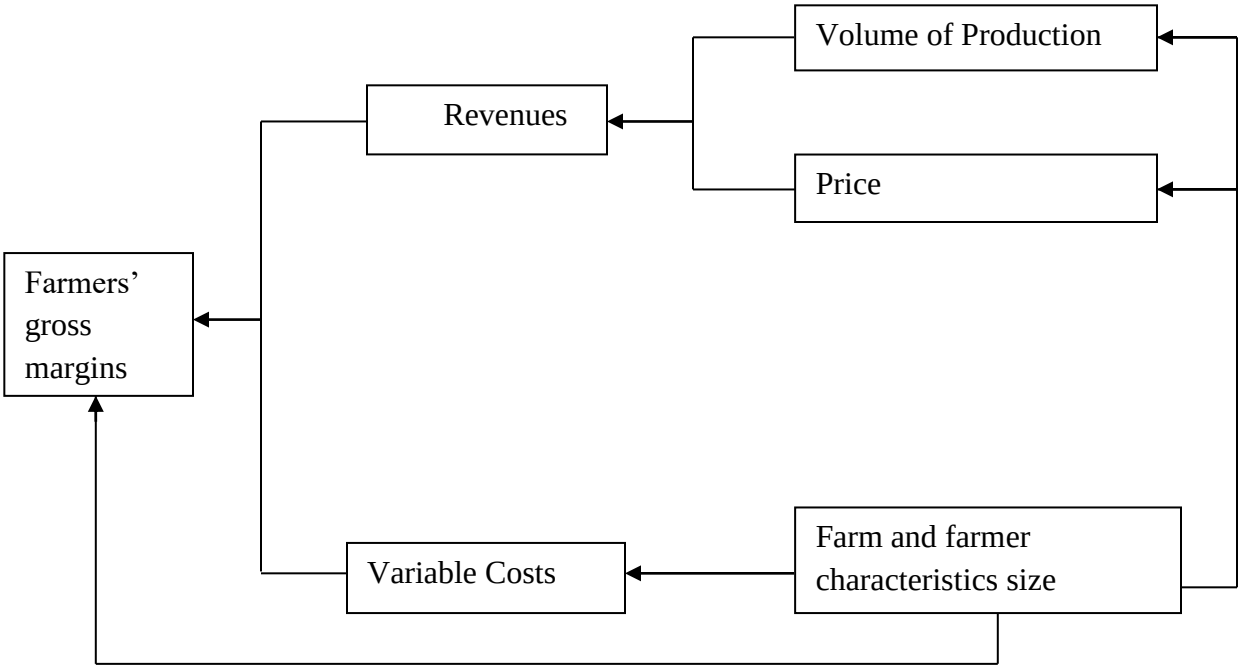

Figure 2: Profitability Conceptual Analysis

Source: Adapted From Engel E. (2000).

3.2 Theoretical framework

A farmer decides what to grow, how much of the chosen crop to grow and amount of inputs to use depending on the market prices of input and output. This can be answered through culture or technical solution as stated by Upton (1974). Some of the reasons that have been advocated towards farm production are; profit maximization, utility maximization and risk aversion theory (Mendola, 2007). However, profit maximization is limited in that it considers the farmer as one entity in decision making with profit maximization as the only one objective; hence ignoring

consumption (Ellis, 1992). Due to the limitations of profit maximization theory, household decision making theory was suggested. The theory states that a farmer makes two decisions simultaneously that is: production and consumption decisions which has impact on household utility

On the other hand, one of the stated flaws in the utility maximization theory is absence of consideration of the risk aspect of farmers. Explanations that have refuted this theory are such as those of Nyikal and Kosura, (2005) who indicated that farmers want to exclusively spread production risk by planting a number of crops in the farm in order to meet the household subsistence needs.

Therefore, based on the above discussion, the current study adopted producer theory and utility maximizing households. In producer theory, firms are described by fixed and exogenously given technologies that allow them to convert inputs (land, labor, capital and raw materials) into outputs (Levin and Milgrom 2004). Hence, legume farmers expect yields which are output from the production which involves use of input. Further, from the fact that legumes will be expected to meet household food requirements brings about utility maximization. Levin and Milgrom (2004) further states that producers take both input and output prices as given, and choose a production plan (a technologically feasible set of inputs and outputs) to maximize profits. In this study, grain legume farmers are conceptualized to be maximizing returns so as to achieve their subsistence and/or income goals.

Gardner, (1995) states that improvement of farm incomes is one of the ways of solving the farm problem. The output is a function of the inputs which the farmer uses as indicated below.

$$Y = f(x_1, x_2, x_3, \ldots x_n) \quad \ldots\ldots 1$$

where Y represents the output and x_i represents the factors of production. Therefore the producer theory is suitable in this case since farmers use inputs in the production of legumes.

3.3 Sampling and Data Collection

Household survey data were collected through face-to-face interviews for long ans short rain seasons in 2015. Face-to-face interviews guarantee high response rates besides enabling clarification of survey questions in interviews (Bennett and Birol, 2010). Three focus group discussions (FGDs) were held with an average of eight participants in each of the three study sites to obtain general information on farmers' perspectives on grain legumes. Participants of the FGDs were farmers who have participated in the project activities for a long period of time and were well conversant with the study sites and the project.

Semi-structured questionnaires used in the survey captured information on input costs, yields per acre, market price and data on socioeconomic characteristics. The current study used multi stage sampling technique because it greatly reduces the variation of the estimate while collecting less data (Allen et al., 2002). Selection of the study sites was purposive; focusing on sites where the CCRP activities were being implemented. The three study sites are Kiptaruswo (medium fertility site), Kapkerer (low fertility) and Koibem (high fertility site) which falls into different sub counties within Nandi County. Each of the sub counties are demarcated into Divisions which are administrative units. The sampling was done in three stages, first, in each Sub county, the Divisions where CCRP activities are concentrated were identified. The second stage involved selecting farmers who participated in th MLP project. Finally a random selection was made to determine the farmers to participate in the interview.

In determining the sample size, a list of 487 farmers who have participated in the project was made and employing probability proportionate to size sampling technique a sample of 163 farmers was chosen. Probability proportional to size is where by larger clusters have bigger probability of being selected. Stratification is done to ensure proper representation of important sub-population groups without biasing the selection operation (Turner, 2003).

3.4 Empirical Data Analysis

3.4.1 Calculation of Gross Margins

Gross margins were calculated for each respondent using Microsoft Excel spread sheet to estimate costs and returns of the smallholder grain legume farmers. Gross Margin in this study was calculated as shown in Equation 2.

$GM = TR - TVC$ 2

where GM is the gross margin,

TR is total revenue, and TVC is total variable costs.

The formula can further be written as;

$$GM = P_q Q - \sum_{i=0}^{n} PiXi \quad \ldots\ldots 3$$

where, GM is gross margin in Kenya shillings per acre for the selected grain legumes species; P_q is the average price of the grain legume per kg; Q is the quantity of crop output per acre in kg; P_i is the price of the i^{th} variable input used in the production of the grain legume; and X_i is the quantity of the i^{th} variable input per acre.

In this study average quantity and costs of different inputs (such as seed, fertilizer, fungicides, herbicides and insecticides) used per acre were computed for each of the grain legume. In addition labour use (man hours per acre) and the cost involved per acre for each activity carried

out during legume production were computed. Appropriate labor equivalences according to Abdulahi (1990) were used to adjust for man hours in cases where children and women worked even though there is possibility of exceptions in activities where women are faster, like in weeding of legumes. Family labor was valued at its opportunity cost according to the prevailing market rates. All the analyses were done on the basis of per acre because of the ease of computation and availability and nature of data (Onyango, 2010).

Revenue was calculated by multiplying output in kilograms (kg) per acre for each household by the price per unit (kg) at which a household sold the grain legume as computed by Ahmad et al., (2005). Total output included output harvested, consumed, paid in kind or kept for future use. The prevailing market price was used to estimate the cost of farm inputs and value of outputs as used by Mutuma et al., (2014). Non market transactions were valued at the average market price.

In order to analyze factors influencing gross margins of the selected grain legume species, multiple regression models (Gujarati, 2003) were used in this study. Computed gross margin for each household was regressed on the hypothesized variables. The subsequent step involved multiple regression estimation to investigate possible determinants of the gross margins for each legume.

Annual gross margin for each legume was used as a dependent variable (Y) and explanatory variables (X) include; socioeconomic and institutional characteristics (Age of the respondent, number of years of education, household size, distance in kilometers to the market, experience in farming, site, group membership, extension services and access to credit). Categorical variable such as gender was converted into dummy variable so that it could be included into the regression model.

Multiple regression model is still the widely used for empirical analysis and social sciences (Wooldridge, 2004). The author further states that multiple regression models accommodate many regressors which may be correlated hence one can infer causality where simple regression could mislead. Multiple regressions was used in this study because it gives opportunity to explicitly control for many other factors which simultaneously affect the dependent variable and also incorporates fairly general functional form relationships (Samboko, 2011).

The multiple regression with *n* independent variables was stated as;

$$y=\beta_0 +\beta_1 X_1+ \beta_2 X_2+ \beta_3 X_3 \ldots\ldots\ldots\ldots \beta_n X_n + e \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

Where y is the dependent variable, X_i are the independent variable, β_i are the coefficients, and e is the error term.

The model was specified as:

$$GM = \beta_0 + \beta_1 \text{Access to credit} + \beta_2 \text{Distance to the market in kilometres?} + \beta_3 \text{Household size} + \beta_4 \text{Group membership} + \beta_5 \text{Education in years} + \beta_6 \text{Site (Dummy)} + \beta_7 \text{Log area under grain legume production in acres} + \beta_8 \text{Age of the farmer in years} + \beta_9 \text{Undertake value addition} + B_{10} \text{Access to extension services} + e \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 5$$

The head of a household is assumed to be responsible for the co-ordination of the household activities and as such, it is important to include attributes such as gender, age and education of the household head in the specification of the model for factors influencing profitability (Makhura, 2001).

Legume is mostly considered to be women's crop as they are major sources of income for smallholder farmers especially women (Muimui, 2010). However, women are faced with a

couple of challanges including lack of access to productive resources and lower mobility owing to their cultural roles and responsibilities. On the other hand, Marenya and Barrett (2007) stated that men have more access to production resources, hence stand at a better position to use quality and more inputs. Hence the inclusion of gender.

Distance to the nearest market has been found to significantly influence market participation (Otieno et al., 2009), and gross margin. This is because households that are located near the markets incur lesser transport costs hence they can easily access inputs and outputs needed for production. Kamara (2004), illustrated that market access improves farmers' productivity. Therefore distance to market was expected to have an inverse relationship with gross margin.

In addition, the age of the household head can often be indicative of farming experience as well as the ability to comprehend new technologies (Matungul et al., 2001). The age of the head of the household is also important since it determines whether the household benefits from the experience of an older person, or has to base its decisions on the risk-taking attitude of a younger farmer (Makhura, 2001).

The larger the family size the more the provision of family labour needed in the production of legumes. On the other hand, Otieno et al. (2009) findings indicated that household size had a negative significant effect on participation in markets since larger family size will less likely participate in market due to lesser market surplus. The inconsistency of the influence of household size on gross margins prompted the need to include it in this analysis.

Group membership was anticipated to have influence in the legumes gross margin. This is because group membership increases farmers bargaining power interms of credit and market

access. Ngugi et al., (2007) show that groups increase the bargaining power of smallholder farmers thus shielding them from over exploitation.

Mwaura et al. (2013) found that including resource endowment, access to credit and information influenced gross margins from production of African Indigenous Vegetables (AIVs). Access to credit has been indicated to positively affect gross margins in that the farmer can not only afford more but also high quality inputs which can increase yields. According to Nyoro (2002), lack of access to credit facilities has been highlighted a key constraint to farmers investment. In this study, access to credit was measured by determining whether the farmer had any collateral, ability of the farmer to meet basic loan requirements by financial institutions and interest on loans which hinders farmer's access to credit.

Descriptive statistics on socio-demographic characteristics of the household, utilization of legumes and preferred legume attributes were analyzed, and results were presented in tables and bar graphs. Analysis of Variance was used to test any statistical differences within the categories for continuous variables. For proportional data within the categories, column proportions comparison (z-test) using bonferroni method at ($p < 0.05$) was done. Significance results were identified using an APA-style notation with subscript letter. Data were analyzed using the STATA version 13 software. Results from the analysis are presented in the next section.

3.4.2 Diagnostic Tests

To ensure the regression model was in line with assumptions and requirements of Ordinary Least Squares (OLS) a number of tests were performed. Multicollinearity, heteroskedasticity, normality test and the Ramsey's test for omitted-variable problems was carried out. None of these tests exhibited significance. To test heteroskedasticity Breusch Pagan test was used. A chi

square value of 15.88 and a *p*-value of 0.1970 was evidence that the null hypothesis of homoscedasticity was not rejected hence error term had constant variance. Further, Ramsey test (Ramsey 1969) was used to test for any omitted variable in the model. The results showed that there was no omitted variable since the *F*-value and *p*-value were 2.33 and 0.0770 respectively.

Multicollinearity exists in a model when there is one or more than one linear relationship among the explanatory variables. The presence of multicollinearity results in coefficients of independent variables to have high standard errors and low significant levels. According to Gujarati (2003), VIF of the independent variables shouldn't be more than 10 and should not be greater than one. The mean VIF in this study was 1.47 and none of the variable had VIF of more than 10 and less than one. Therefore the multicollinearity test indicated that the assumption of no multicollinearity was not violated as shown in Table 1. The coefficient of determination (R^2) of the model was found to be 0.4311. This means that the model fits the data considerably well.

Table 1: Test for Multicollinearity

Variable	**VIF**	**1/VIF**
Credit access	4.16	0.2406
Farming experience	1.29	0.7726
Access to extension services	1.13	0.8845
Household size	1.13	0.8867
Ln Area under grain legumes	1.12	0.8894
Group membership	1.12	0.8964
Years of education	1.11	0.9002
Undertake value addition	1.09	0.9151
Ln age	1.07	0.9386
Distance to market	1.05	0.9529
Mean VIF	**1.47**	

Source: Computed from Survey Data (2015)

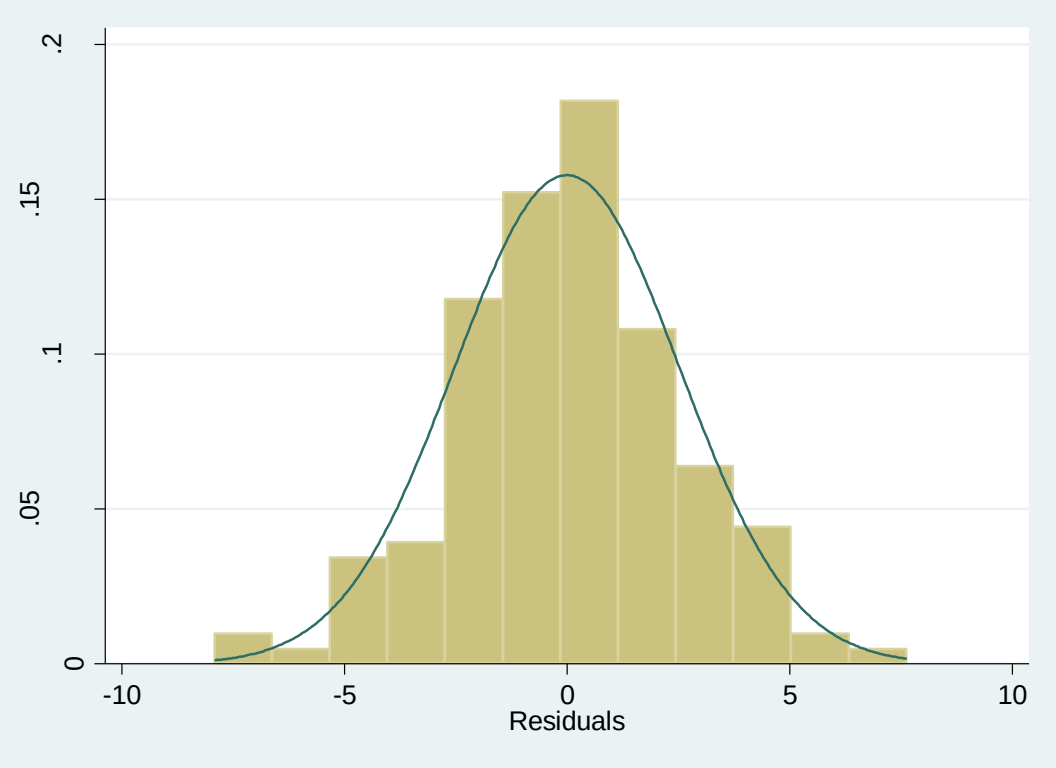

Figure 3: Distribution of the Error Term

Source: Computed from Survey Data (2015).

One of the assumptions of the OLS is that the error term should be normally distributed. Normality test shown in Figure 3 above indicated that the error term of the overall regression was normally distributed.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1. Sample Farmers' Socio-Economic Characteristics

Table 2 presents the sample characteristics for grain legume farmers in Nandi County. The mean age of the farmers interviewed was 49 years. On average, the household size in the entire study site was seven. Further, results in Table 2 shows that nearly three quarters (72 percent) of the households were headed by male persons.

Table 2: Sample characteristics for grain legume farmers in Nandi County, Kenya

Variable	Kiptaruswo (n=62)	Koibem (n=37)	Kapkerer (n=64)	Pooled (n=163)
Respondent's average age	47.0[a]	48.1[ab]	53.7[b]	49.9
Average years of formal education	9.9[a]	9.5[ab]	8.0[b]	9.1
Average farming experience (years)	20.0[a]	20.5[a]	21.9[a]	20.8
Average household size	6.3[a]	8.1[b]	6.6[a]	6.7
Average distance to the input and output market (Km)	7.0[a]	6.9[a]	2.2[b]	5.1
Average land size owned (acres)	2.4[a]	2.4[b]	1.7[a]	2.1
Average area under grain legumes intercrop and pure (acres)	0.3[a]	0.3[a]	0.3[a]	0.3
Gender (% male-headed households)	74.2[a]	83.8[a]	64.1[a]	72.4
Awareness of value addition on legumes (% households)	54.8[a]	56.3[a]	62.5[a]	57.9
Undertake value addition on legumes (% households)	11.7[a]	18.9[b]	19.6[a]	16.7
Sell legumes (% households)	85.5[a]	66.7[a]	82.8[a]	80.2
Institutional and policy factors				
Group membership (% households)	53.9[ab]	51.4[a]	64.5[b]	56.6
Access to credit (% households)	52.3[a]	71.0[b]	73.5[a]	65.6
Use of credit on legume production (% households)	24.5[a]	22.5[a]	18.8[b]	21.9
Extension contact over the last 12 months (% households)	62.1[a]	31.7[b]	66.1[a]	53.3

Note. Values in the same row not sharing the same subscript are significantly different at $p < .05$ in the two-sided test of equality for column proportions.

However, in Kapkerer more households are headed by females and this could indicate low profits of grain legumes in Kapkerer because women lack resources for market access as opposed to men. This could also bring out a difference in the way legumes are utilized across the three sites because households headed by men would utilize legumes differently from households headed by women.

The mean land size owned by the sampled farmers was about 2 acres, but only 5 percent of the land size owned was dedicated to grain legumes production. Land ownership influences agricultural productivity, hence gross margins, since farmers who do not own land can be unwilling to develop and maintain the land (Randela, et al. 2000). The small land sizes is attributed to intense population pressure in the region (Conelly and Chaiken, 2000). This therefore results in small sizes of land devoted to farming.

The mean year of formal education of household heads was approximately 9 years (varying from 0 to 18), indicating many respondents completed at least the primary level and got into high schools. Education is important in agriculture because it affects the ability to read and write extension information on various farming technologies (Mhango, 2011). Therefore, respondents with more years of education are expected to utilize legumes innovatively and have higher profits since education should translate to increased information for better agricultural practices. Also years of formal education is assumed to increase the probability of understanding new technologies. Better educated farmers can be expected to be more aware of the positive benefits associated with new technologies.

Distance to the main market was used as a proxy of access to input and output market for grain legumes. The average distance in this study was 5.1 kilometers. Closer markets reduce

transportation costs hence motivate the farmers to improve production (Masuku and Xaba, 2013). The authors further state that the far away the production area is to the market, the lesser would be the probability to participate in commercial agricultural production, hence poor profits because of high transport costs.

In general, more than half (58 percent) of the farmers were aware of value addition in legumes. However, only 17 percent of these farmers were undertaking value addition on their legumes. This could be attributed to inadequate knowledge of farmers on some of the value addition processes on legumes. This may illustrate poor and non-innovative utilization trends of legumes.

Also, farmers were asked if they sold grain legumes after harvest. About 80 percent of farmers sold the legumes for income purposes and this reaffirmed the multiple benefits of legumes. In fact, more than 90 percent of farmers perceived production of grain legumes as a profitable enterprise. Farmers used proceeds from the sale of legumes mainly for school fees payment, purchase farm input, payment of loan, purchase food and farm labour expenses as shown in Figure 4 below. Therefore, farmers saving money that could have otherwise been used in those responsibilities.

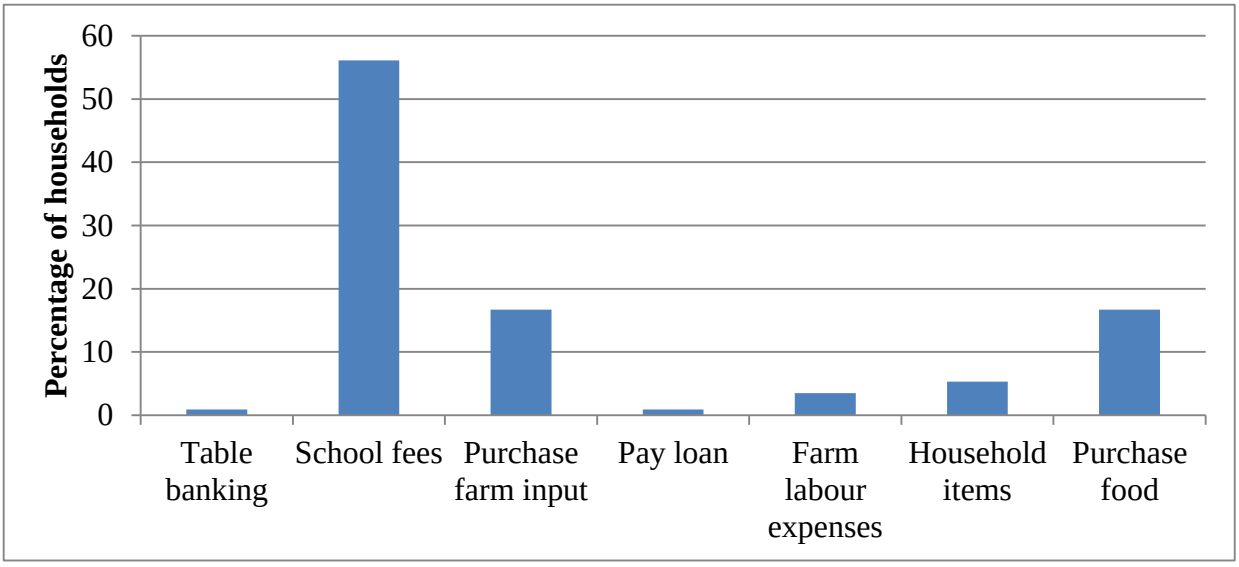

Figure 4 : Use of Proceeds from Grain Legume Sales

Source: Computed from Survey Data (2015)

On average, slightly more than half (57 percent) of farmers were members of farmer groups. Farmers belonging to farmer groups are expected to utilize legumes diversely. This could be because farmers share information and learn from their colleagues in groups or adopt something that they have seen to be successful with neighbors or friends (Conley and Udry, 2010). Also, gross margins of farmers in group membership could be higher because farmer groups provide readily available farm inputs at a lower cost than non-members (Tolno et al., 2015). Ngugi et al. (2007) further state that farmers who were organized into groups earned greater income compared to those who were not. Membership to farmer groups can be attributed to benefits farmers perceive to gain as illustrated in Figure 5.

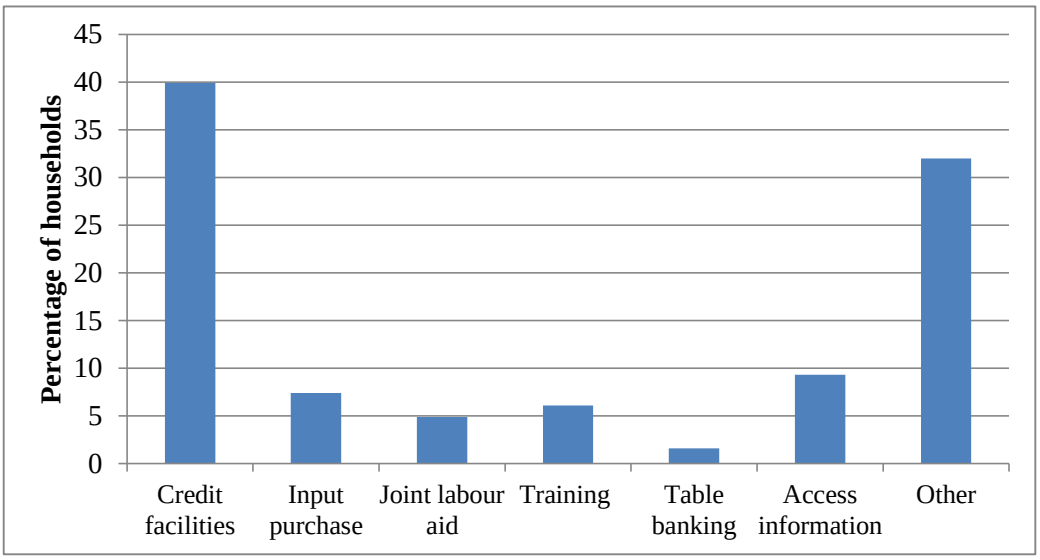

Figure 5 : Reasons for Group Membership

Source: Computed from Survey Data (2015)

Further results in Table 2 revealed that slightly more than half (53 percent) of the sampled farmers had access to extension services over the past 12 months from the date when the survey was done. Access to extension services provides a platform for learning and exchange of knowledge translating to better profits because of better agricultural practices gained from training.

Focusing on access to credit for the last twelve months, results indicate that about 67 percent of farmers generally had access to credit. However, as expected a very small percentage (22 percent) of farmers used the credit on legume production. This is likely because most farmers prioritize the use of credit on other duties such as school fees payment and used to start small commercial businesses.

4.2. Patterns of Utilization of the Grain Legumes

Figure 6 shows the main pattern of utilization of grain legumes in Nandi County. Consumption of legumes is predominantly as food with minimal value addition through processing done. These findings are similar to those of Mhango, (2011) who found that high value attached to food reasons may be a plausible explanation as to why farmers grew grain legumes for home consumption. Overall, about 74 percent of legume production was for home consumption and only 10 percent was used for seed. This may indicate that only a few farmers keep a small portion of the harvest for seed.

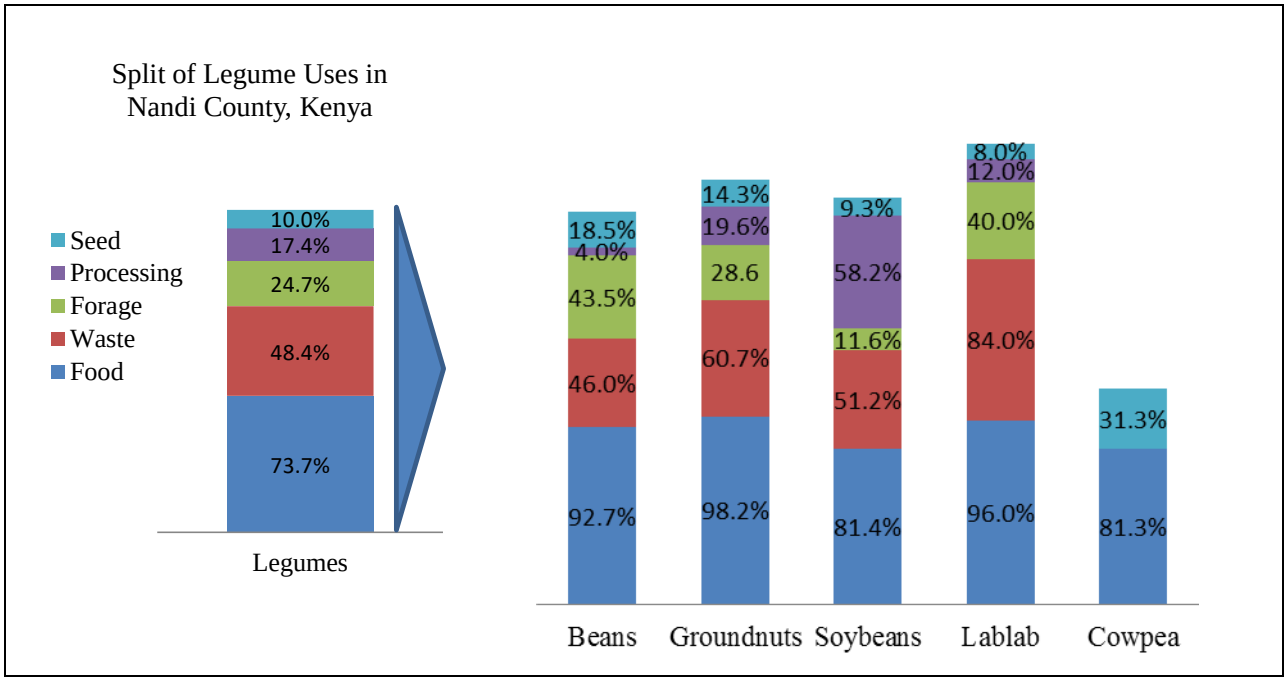

Figure 6: Main Patterns of Utilization of Legumes Grown
NB: The figures do not add to 100 percent because farmers gave multiple uses

Source: Survey Data (2015).

Splitting the trend in the use per legume indicated that cowpea had limited use as an additional vegetable and for seeds compared to the other legumes. This results are consistent with Mwangi and Wanjekeche (1997) who found that cowpea leaves was mainly utilized as compared to their

grains. This suggests that cowpea grain is underutilized and this is because in Western Keny cowpeas is mainly grown for its leaves and utilized as vegetable eaten with *ugali*. The species they grow for leaf do not produce much of seed, but eventually they do and the households use them in a mixture with maize (*githeri*) due to inadequate knowledge on other ways of utilization of cowpea grains.

Results in Figure 6 indicate that soybean was the most processed legume. About 58 percent of soybean farmers processed soybean grain with other cereals such as maize, millet and sorghum to make porridge flour mostly for the young ones. Also, few farmers processed soybean to powders and soy milk by soaking it in water and later grinding and sieving used as beverage. These results suggest that majority of farmers perceive soybean to be more nutritious to children than other legumes. More than 90 percent of farmers who grew groundnuts and beans mainly used them for home consumption and income generation. Groundnuts were roasted and consumed as snacks at home while beans were mainly mixed with maize and boiled to make githeri. Results in figure 6 further show that dolichos lablab was mainly utilized for meals and as waste to make manure.

Other uses cited included traditional seed preservative and vegetable softener. For instance, for the case of beans, 12 percent of farmers indicated they burned the dried foliage and soaked the ash in water, and the resulting sieved liquid used as vegetable tenderizer.

Further analysis was done to assess preferred legume attributes as shown in Tables 3 and 4. Common beans was the most popular legume grown by about 81 percent of the farmers while cowpeas was only grown by about 10 percent of the farmers interviewed. Farmers were also asked to rank legumes based on the legume attributes they desired. Table 3 shows that more than

half of the respondnts ranked beans as the best legume and cowpeas was the least preferred legume with only about 3 percent of farmers ranking it as the best.

Table 3: Percentage of Farmers Ranking Legume Species

	Percentage of farmers	
Legume type	1st rank	2nd rank
Beans	51.6	23.7
Soybeans	12.4	24.7
Groundnuts	22.4	24.0
Cowpeas	2.9	9.1
Lablab	11.2	14.1

Source: Survey Data (2015).

Legume characteristics influence their choice by farmers (Mhango, 2011). Percentages were computed for each characteristic and specific legume within preferred traits shown in table 4.

Table 4: Summary of Preferred Characteristics for Each Legume (Percentage of farmers)

Trait	Beans (n=124)	Groundnuts (n=56)	Soybeans (n=43)	Cowpeas (n=16)	Lablab (n=25)
High yield	39.5	21.4	23.3	24.0	6.3
High nutritional value	8.9	14.2	11.6	16.0	0.0
Improve soil fertility	6.5	12.5	7.0	52.0	0.0
Early maturing	28.2	3.6	9.3	24.0	12.5
Ability to provide fodder	4.0	1.8	2.3	0.0	0.0
Food value	45.2	42.9	30.2	48.0	18.8
Marketability	29.0	39.3	11.6	20.0	18.8
Large seed size	0.8	0.0	0.0	0.0	0.0
Easy to cook	1.6	1.8	2.3	0.0	0.0
Field pest resistant	15.3	7.2	14.0	4.0	0.0
Tasty	2.4	14.2	7.0	16.0	6.3
Easy to store	1.6	1.8	2.3	0.0	0.0

Source: Survey Data (2015).

The results in Table 4 indicate that beans was preferred for its food value attributes by nearly half of the farmers, high yield by about 40 percent and its ability to mature early preferred by less than 30 percent of the farmers. On the other hand, results on groundnuts indicate that it was preferred for home consumption and marketability by slightly greater than two fifth of the farmers and less than a quarter of the farmers preferred it because its tasty. Soybean on the other hand was mostly preferred for its nutrition value, high yield and for home consumption.

4.3 Analysis of Gross Margins from Various Legumes

Results on gross margin analysis evaluated are shown in Figure 7. About 56 percent of respondents had positive gross margins while the rest incurred losses in the production of grain legumes. The mean gross margin for all the five grain legumes was Kenya Shillings (Kshs) 18,794 per acre. Out of the five species of the legumes studied, four had positive gross margins and one had negative gross margin. Groundnuts and common beans accounted for 49 percent and 35 percent of the total gross margins for legumes respectively. High gross margins from groundnuts could be due to its huge market in Kenya and it can also perform well in poor soils hence high production. Also, common bean dominates the legume market in Kenya since it is the most consumed, increasing its demand. Hence they have readily available market due to high demand.

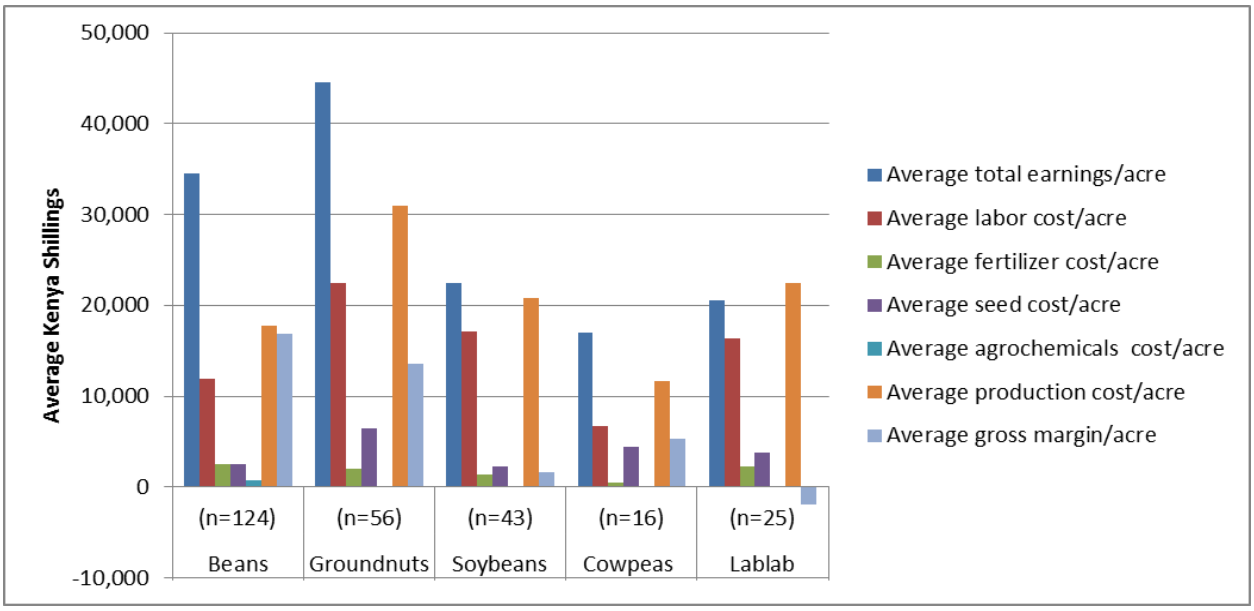

Figure 7: Comparison of Legume Annual Gross Margins Analysis in Kenya shillings/acre

Source: Survey Data (2015).

However, losses from dolichos lablab production could be attributed to the fact that first, it is one of the underutilized crops in Kenya and currently it is limited by inadequate adaptable varieties

in wide agro-ecological zones. The current dolichos lablab varieties that farmers grow have low yields, as they are susceptible to diseases and drought. Also, poor gross margins from dolichos lablab could be explained by its low acceptance by smallholder farmers in Kenya as stated by (Shivachi et al. 2012) hence have lower market value compared to other legumes. The findings in this study on the average gross margins are similar to findings in other studies (Zulu, 2011; Samboko, 2011). The results generally show that production of grain legume species is viable in smallholder farming systems.

Results in Table 5 show cost and return structure of grain legumes production in the study area. Among the variable costs included in the study, expenditure on labour operational activities for land preparation, sowing, weeding, harvesting and post-harvest activities formed the largest cost item. Table 5 illustrate that averagely for all the grain legumes 67 percent of the total variable cost was spent on labour. High labour costs in legume production has been observed in previous cost benefit analysis for legumes for instance in beans (Katungi et al; 2011).

Groundnuts showed the highest labour cost representing about 76 percent of the total variable cost used in the production. High groundnuts labour costs can be attributed to additional activities needed such as plucking and shelling that is, physical removal of the husks. Also, groundnuts require more management skills than other legumes. Generally, labour cost was the highest cost in grain legume production.

Table 5: Costs and Returns Analysis per acre from the Grain Legumes

Legume	**Beans**		**Groundnuts**		**Soybean**		**Cowpeas**		**Lablab**	
Cost item	**Amount /acre**	**% of TVC/acre**	**Amount /acre**	**% of TVC/acre**	**Amount /acre**	**% of TVC/acre**	**Amount /acre**	**% of TVC/acre**	**Amount /acre**	**% of TVC/acre**
Total revenue	**76050**		**131,223**		**59959**		**17,002**		**46749**	
Variable costs										
Labour	30791	62.3	71543	75.6	40658	75.5	6,653	56.9	31895	68.0
Fertilizer	8422	17.0	8170	8.6	6934	12.9	546	4.7	8235	17.6
Seed	7826	15.8	14910	15.7	6203	11.7	4,489	38.4	6702	14.3
Agrochemicals	2413	4.9	71	0.1	Nil	0.0	Nil	0.0	68	0.1
Average total variable cost (TVC)	**49452**		**94694**		**53795**		**11,688**		**46900**	
GMs (Gross margins)	**26,598**	**53.8**	**36,529**	**38.6**	**6,164**	**11.5**	**5,313**	**45.5**	**-1,51**	**-0.3**
Ave. gross margin/unit labour	**115**		**539**		**104**		**306**		**-279**	

Source: Survey Data (2015).

However, costs of fertilizer and agrochemicals were minimal across all the legumes studied. This demonstrated low use of agrochemicals and fertilizer in the production of legumes in the study area. The results further illustrated that the total revenue of the legumes were higher than the total variable costs used in their production except for the case of lablab. This means that legume cultivation in the study area was profitable. Thus it is desirable that more farmers should be encouraged to engage in legume production as a source of income to the households.

Table 6 represents comparisons of the means of some stated variables for the respective legumes for any significant statistical difference in costs, returns and gross margins. The letters represent ANOVA comparisons where a, b, c show significant difference in the means and a similar letter in any of the legumes means that the means are not significantly different at 5 percent level of significance. Different letters mean that the means are different across the regions whereas a combination and or similarity of any letters across any variable means the means are not statistically different. There was no statistical differences in the gross margins means across the five legume types and therefore multiple regression determining the factors influencing gross margins for each legume type was not analyzed.

Table 6: Comparison of Gross Margins from Various Legumes (in '0000 Kshs)

Variable	Beans	Groundnuts	Soybeans	Cowpeas	Lablab
Ave. total earnings/acre	7.60 ± 0.60^{a}	13.1 ± 1.70^{b}	6.00 ± 0.50^{a}	1.70 ± 1.00^{ab}	4.70 ± 0.90^{a}
Average labor cost/acre	3.10 ± 0.40^{a}	7.20 ± 0.60^{ac}	4.10 ± 0.30^{ac}	0.70 ± 0.20^{b}	3.02 ± 030^{c}
Average fertilizer cost/acre	0.84 ± 0.12^{a}	0.82 ± 0.08^{a}	0.69 ± 0.07^{a}	0.05 ± 0.05^{a}	0.82 ± 0.08^{a}
Average seed cost/acre	0.78 ± 0.07^{a}	1.49 ± 0.14^{b}	0.62 ± 0.06^{a}	0.45 ± 0.21^{a}	0.67 ± 0.07^{a}
Ave. gross margin/acre	2.66 ± 1.34^{ab}	3.65 ± 1.26^{ab}	0.62 ± 0.32^{ab}	0.53 ± 0.46^{ab}	0.02 ± 0.66^{ab}

Note: Anova Results
Source: Survey Data (2015).

Again, disaggregating legume costs and returns by gender is shown in Figure 8. Some of the outstanding differences were demonstrated in the use of agrochemicals. None of the female headed households incurred costs from the use of agro chemicals. Contrary, in male headed households, groundnut accounted for 37 percent of the total legume agro chemical costs. However, none of the female and male headed households used agrochemicals in the production of soybeans and cowpeas.

However, Figure 8 indicates that there was fair representation of allocation of seed, fertilizer and labour costs across all the legumes among the male and female headed households. Female headed households benefited more in groundnut production. On the other hand the male headed households benefited more on beans production accounting for 38 percent of the total gross margins from all the legumes and benefited less on the production of soybeans and cowpeas.

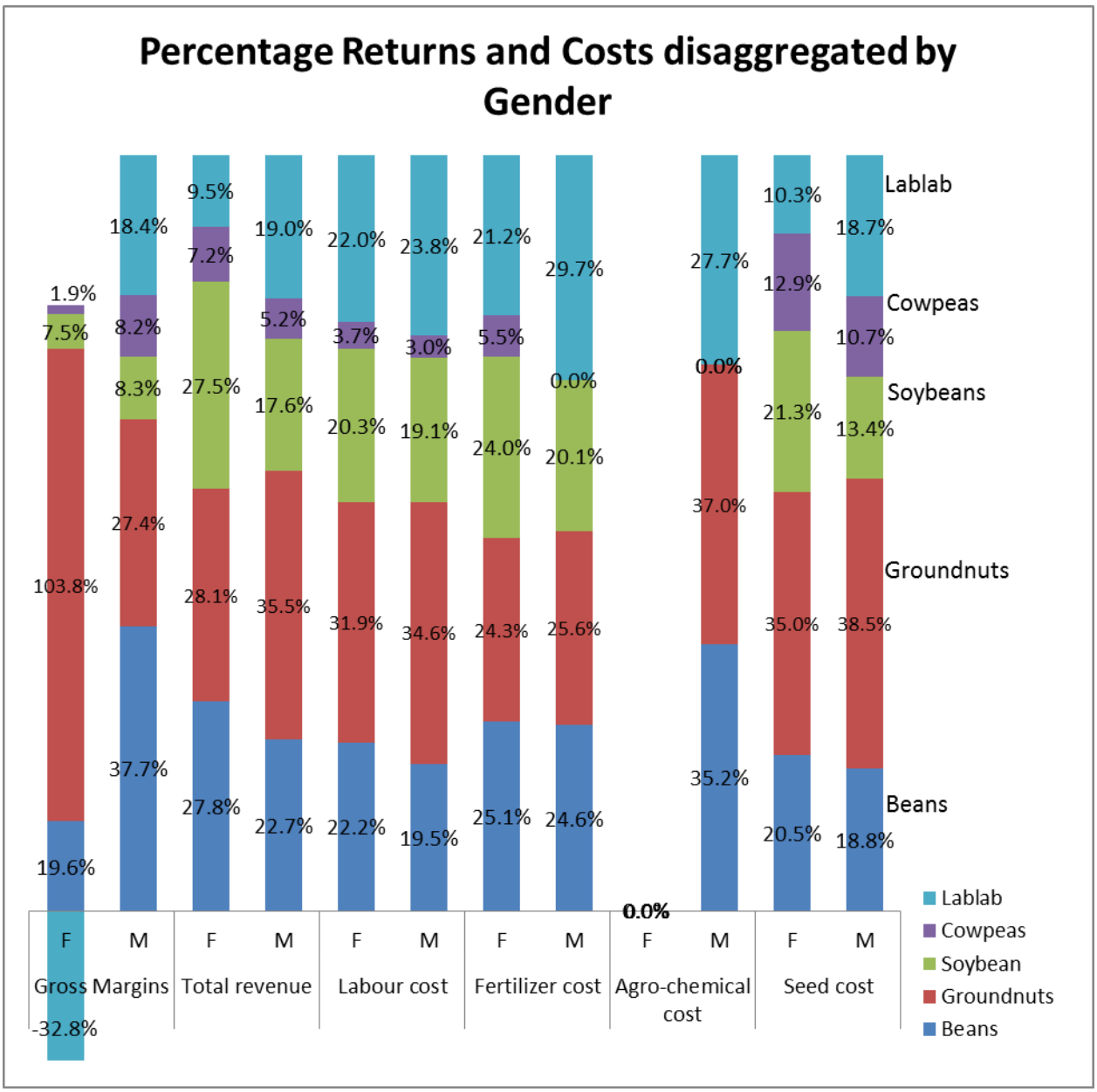

Figure 8: Percentage Returns and Costs Disaggregated by Gender. F = female and M = male.

Source: Survey Data (2015).

4.4 Determinants of Gross Margins of Grain Legumes

Results in Table 7 indicate that area under grain legumes and access to credit was significant in explaining gross margins at 1 percent level while group membership was significant at 5 percent. Age and access to extension services were also significant at 10 percent level.

Table 7: Determinants of Gross Margins of Grain Legumes in Nandi County

	Coefficient	**Std error**	**p-value**
Socio-economic variables			
Constant	9.9850	4.8307	0.041**
Ln area under grain legume	-0.5334	0.1546	0.001***
Ln age of farmer (years)	1.6839	0.9487	0.078*
Household size	-0.1025	0.0881	0.246
Undertake value addition	-0.2922	0.4996	0.559
Formal education of farmer (years completed)	-0.0577	0.0655	0.380
Distance to the input and output market for grain legume	-0.0534	0.0564	0.346
Site1	-0.9195	0.8232	0.266
Site2	0.0100	1.0030	0.992
Institutional and policy variables			
Credit access	3.0135	0.8610	0.001***
Extension contact	0.8217	0.4542	0.073*
Group membership	1.1168	0.5132	0.031**

Multiple regression results
Note: Dependent variable is gross margin; N = 163; R-squared =43%; F (12,151) = 9.09; Prob > F=0.000.
Statistical significance levels: *10%, **5% and *** 1%, respectively.
Source: Analyzed from survey data (2015).

The negative relationship between area under grain legumes and gross margin in this study is consistent with Hazell and Hangbladde (2010); Birachi et al., (2013) findings that big farms have a tendency to yield low returns per hectare of land compared to small farms. The inverse relationship between farm size and returns may be attributed to the productivity of the land, amount of input requirement and market failures (Barret et al., 2010). The outcome of the inverse productivity relationship of legumes with land dictate a proportionate increase in inputs required

for the production of the legumes for farmers to gain proportionately from the land increase (Boughton et al., 2010).

However, age was positively related to gross margin, which is consistent with the findings of the study by Ugwumba (2010) which indicated that higher age among farmers had a positive impact on profitability of the farms. This could be attributed to the fact that older farmers have many years of farming experience and therefore have gained better skills and knowledge over time. In contrast, the results by Mishra et al. (1999) and Muhammad-Laval et al. (2012), which showed that higher age among farmers, had a negative impact on profitability of the farms.

The coefficient of access to credit was significant ($p < 0.01$) and positively related to gross margin. Access to credit only generally increases liquidity. The results suggest that when access to credit increased by one unit, all else equal, the gross margins of grain legumes would increase by 3.09 Kenya shillings per acre. Further, profitability studies for instance (Fischer and Qaim, 2012) illustrated the importance of credit access to farmers could lead to higher returns. The results further suggest that access to extension services increased the gross margins. This could be attributed to farmers with access to extension services receiving trainings on best practices on crop productions hence improving their skills about the crop. Results on extension services is consistent with the findings of Sulumbe, et al., (2010).

Also, site was included in the regression model to determine whether it influenced profits generated. Results indicated that the site where the legumes are grown did not have any influence on gross margins of the legumes studied. Since the variable site was not significant in determining the level of profits from the grain legumes, it was not important to compare factors influencing gross margins per site.

Group membership had a positive relationship with grain legume gross margin i.e group membership would increase gross margin. This was expected because farmers in groups could have readily available farm inputs at a lower cost than non-members. As explained by Tolno et al. (2015) that this could be due to bulk purchasing of farm inputs by the group members.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Summary

This study aimed to explore utilization and gross margin of grain legumes in smallholder rural in Nandi county. In order for farmers to accept and adopt new technologies presented to them, it is important to determine whether farmers are benefiting from the new crop strategies or not. Therefore, this study aimed at adding limited information on the extent of utilization patterns as well as the actual benefits of the legumes introduced in Nandi County. The specific objectives were: (1) assessment of utilization patterns and perceptions of farmers on grain legume attributes. (2) economic analysis of legume gross margin (3) determinants of grain legume gross margin. To achieve these objectives, a survey was conducted on 163 randomly selected participants in three sites in Nandi county; Kapkerer, Koibem and Kiptaruswo, the sites where MLP initiated the project. The survey procedure comprised of FGD; the pre-test survey and the actual survey. Frequencies and percentages presented in tables and graphs were used to assess extent of utilization of the legumes while gross margin analysis and multiple regression analysis were used to evaluate the level of gross margin and determinants of gross margin respectively.

The first objective explored priorities for the use of the legumes that were introduced. In addition, farmers' opinion on the attributes of the grain legume species was assessed. The main legume grown by most of the farmers was beans while the least was cowpeas. The results showed that there is a broad diversity in the utilization of the legumes ranging from food to non-food uses. Also legume wastes were used to make compost manure. Results showed farmers preferred high yield, nutritional value, food value, early maturity and high market potential traits of legume as opposed ease of storage and seed size characteristics which were not highly valued

by farmers. Therefore, the results showed that farmers preferred legumes that are high yielding, early nutritious grain that could be eaten or sold and also legumes that have the ability to improve soil fertility.

The second objective assessed the gross margin of the legume species. The gross margin results indicated that the highest monetary returns from legume production were accrued in groundnuts, beans, soybean and cowpeas whereas dolichos lablab was negative. Groundnut was found to have the highest annual gross margin. Even though the gross margin of dolichos lablab was found to be negative, it provided many other benefits, probably not given value in money terms, such as shown from the results. A comparison of revenue from legumes, gross margin and production costs across the five legumes exhibited similarities in all the legumes except lablab. Further, labour was found to be more productive in groundnuts and cowpeas production as compared to beans and soybeans (gross margin per unit labour was negative for lablab). Labour costs contributed highest in terms of the total costs in the production of legumes. Cost on agrochemicals was minimal.

The study also found out different factors to be influencing the gross margins of legumes. Results on multiple regression showed credit, group membership, access to extension services and age of the farmer were positive and significant in determining gross margins of legumes while age was negative and significant.

5.2 Conclusions and Policy Recommendations

This study has examined trends in the of legumes utilization and the attributes that farmers valued in legumes. The results suggest that the production of legumes is lucrative as it does not only provide food to the household but it also a source of income not only for women but also to

men. Also results have suggested that legumes are crops that require a lot of labour input during the production.

There is high diversity of legumes utilization among farmers as shown from the results. The priorities for the use of legumes were mainly for income generation and home consumption as opposed to other benefits such as for provision of fodder. This study has also shown that the utilization of legumes depends on the type of legume.For groundnuts, farmers utilize it more for income generation as much as for home consumption. Cowpeas was kept for seed and its leaves were eaten as vegetables. This imply that cowpeas grain is underutilized. It was evident that other uses other than income generation and food provision for dolichos lablab were valued. The findings suggest that dolichos lablab was mostly used in making green manure as it has high biomass provison. Moreover, soybean was preferred in making porridge as most farmers believe that it has nutritious benefits. Farmers mainly utilize the grain of the legumes to make various dishes as opposed to other parts such as leaves. Other non-food uses included; income generation, medicinal purposes.

Generally, it was noted that there has been minimal grain legume processing undertaken. There is need to enhance and diversify legume utilization trends for instance soybeans which has been cited to take longer cooking hours through establishment of simple processing technologies. This can be achieved through partnership with interested agencies in provision of simple processors to farmers and collaboration in coaching on the use of the processing equipment. Also looking market for produce and value addition may increase the diversification of utilization of legumes.

The choice of legume depends mainly on food value, yield potential, early maturity and market potential. The results imply that farmers value high yielding, early maturing and marketable

legumes, for both home consumption and for the market. Breeders and scientific community should take into account farmers' opinions on a given technology for successful adoption. Therefore farmer's tradeoff legumes with the benefits they value most. For instance a farmer that values fodder would prefer to grow lablab and tradeoff other legumes that would have provided other benefits.

From the results, it is evident that legumes that were utilized mostly for income generation and for home consumption such as groundnuts, beans and soybeans had higher gross margins as compared to the others that were utilized for green manure and fodder. In addition, Credit, group membership, access to extension services, area under legumes and age of the farmer play a major role in enhancing economic returns from legumes.

Based on these findings, the following recommendation were made: Firstly, the low level of gross margins may be attributed to high labour costs involved during the production, therefore there is need to reduce labour requirements for instance through labour saving mechanical technologies to offset rising labour costs for instance, adoption of labour saving processing techniques like the simple shelling equipments for groundnuts. In addition increased mechanization for ploughing and weeding and also less labor-demanding legume varieties should be developed. There is need to introduce and develop high yielding, disease resistant new varieties of lablab. Also, better extension service delivery to the farmers should also be put in place through appraisal of the extension service activities by the county government. Another feasible recommendation is organizing farmers into co-operative society into membership group as it can improve access to facilities such as credit and also markets.

5.3 Contributions to Knowledge

This study focused on the utilization pattern, gross margin and factors affecting legumes gross margins in Nandi County. Beans, soybeans, groundnuts, cowpeas and dolichos lablab were introduced in Nandi County to improve the livelihood of farmers in the area through increased nutrition and improved health benefits. This study revealed the trend of legumes utilization mainly for home consumption as primary source of food.

In Kenya, grain legumes are known to be subsistence crops.The study reveals that smallholder farmers of grain legumes are currently perceiving legume as an income generating crop. However, the income generating ability of legumes depends on the type of legume grown. At the same time, farmers are beginning to practise minimal value addition on legumes for instance for the case of soybeans.

The study reveals that farmers are not only keen on the yields from the grain legumes, but they want legumes that could also improve their nutritional status, health and incomes. Generally, farmers prefer legumes that can meet their daily needs. The study emphasizes the importance of strengthening the institutional framework especially extension service delivery through appraisals at the county levels.

5.4 Suggestions for Further Research

The current study was limited valuing only tangible benefits. Therefore, researchers interested in conducting research on legumes need to value other benefits derived from grain legumes such as environmental, medicinal and non monetary benefits since the other uses are important too for instance for environmental sustainability. Also, this study focused on total output after harvest

and did not include post harvest losses of grain legumes. Further research on consumer preferences for various forms of value addition in legumes.

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APPENDICES

Appendix 1: Checklist for conducting Focus Group Discussions Multipurpose Legume Project farmers in Nandi County 2015

SECTION A: LOCATION INFORMATION

County_____ District

Division _____ Location

Sub-Location _____ Village

SECTION B: GENERAL INFORMATION

1. What is the average household size in the area?

2. On average how many children per household are in school?

3. Are there households with children of school going age who are not enrolled in school? If yes why? Ratio of household with such children

4. What are the major crops grown in the area? Average land allocation to each (Help understand the importance of legumes)

5. Name some of the common grain legumes grown in the village?

6. What do you know about the multipurpose grain legumes?

7. Are you growing improved varieties of grain legumes or local varieties?

8. What is the average farm size under grain legumes in the area?

9. Has the farm size under MPL grains increasing or decreasing over the last five years? Give some of the reasons for increasing or decreasing?

10. What are the main sources of cash income in the area? Rank the four most important.

11. What are some of the purposes/benefits of growing MPL grains as compared to other crops in the area? Rank the three most important purposes for which farmers grow MPL.

12. Which of the grain legumes are used for cash income? Rank them

13. Which of the grain legumes are used for household consumption? Rank them

14. Rank the grain legumes in terms of taste?

15. Would you like to grow more legumes? Estimate the proportion of farmers for whom this is true. If no, why not?

16. What do farmers do with the legumes residues (feed, leave on field, burn)

17. Which are the most important criteria/attributes in determining the choice of grain legume to grow? (Marketability, yield, income, utilization)

18. Name different methods of preparing MPL grains for consumption?

19. What are the constraints in growing MPL grains? Rank the five most important?

Appendix 2: Survey Questionnaire Used for Data Collection

AN ASSESSEMENT OF PROFITABILITY AND UTILIZATION OF GRAIN LEGUME SPECIES IN NANDI COUNTY

Household survey

Background information

This survey is being conducted collaboratively by The University of Nairobi and Kenya Agricultural and Livestock Research Organization (KALRO). The purpose of the survey is to assess the acceptability, utilization and profitability of the grain legume species in Nandi County. Respondents for this survey shall be smallholder farmers who participated or who are participating in the MPL project since its inception in 2008. You have been randomly selected from Nandi County and your participation is voluntary. The information that you will provide will be treated with uttermost confidentiality and will only be used for academic and policy formulation purposes. Results of this study will help smallholders to improve their productivity and improve their food security.

Screening

Which of the following grain legumes do you grow? (Beans, Groundnuts, Soybean, Lablab, Cowpeas). If yes, please proceed to the subsequent sections.

QUESTIONNAIRE NO. ☐

1. **General information**

1.1 Enumerator name	1.5 Village
1.2 District	1.6 Cluster
1.3 Division	1.7 Interview date
1.4 Location	1.8 HH phone number

1.9 Household GPS coordinates

Latitude: (S)		Longitude: (E)	
Altitude (m.a.s.l)			

2. Household characteristics

2.1 Name of the household head (HH)		
2.2 Name of respondent (if different from the HH)		
2.3 Gender of the (HH)	1=male	0=female
2.4 Age of the (HH)(years)		

2.5 What is the number of years spent in school (HH)			
2.6 What is the main occupation of the HH	1=formal employment	2=casual employment	
	3=business man	4=full time farmer	
	5=others (specify) ……		
2.7 Marital status of the HH	1=single	2=married	3=separated
	4=divorced	5=widow	
2.8 Average household size (total members)			

3. **Farm characteristics**

3.1 What is your total owned land size (acres)? …….

3.2 How many acres do you rent (if any)? .....

3.3 Do you grow your grain legume on rented land, if so, what is the cost that you pay per season or per year in Kenyan shillings……

3.4What are the types and number of livestock in the farm?

Livestock	**Number**

3.5 Experience in agriculture (years)……

3.6 Production systems in the **long** season

Legume codes 1=beans 4=lablab 2=soybeans 5=cowpeas 3=groundnuts	**Variety**	**Mode of production 0=no intercrop** **1=one intercrop** **2= two intercrops** **3=other (specify)**	**Area under cultivation in acres**

3.7 Production systems in the **last short** season, legume(s) grown **last short** season

Legume codes 1=beans 4=lablab 2=soybeans 5=cowpeas 3=groundnuts	**Variety**	**Mode of production 0=no intercrop** **1=one intercrop** **2= two intercrops** **3=other (specify)**	**No of intercrops**	**Area under cultivation in acres**

4. Households uses, knowledge and perceptions for the grain legumes

4.1 List three main uses of the grain legume and why its use is important

Name of legume	List three main uses	Rank the uses	Importance/benefits of the use	How is it used
Beans				
Groundnuts				
lablab				
soybeans				
cowpeas				

Codes for uses		**Codes for importance**
1=porridge	6=medicine	1=source of vitamins
2=relish/food	7=weed control	2=nutritious
3= livestock bedding	8= fuel wood	3=Cheaper source of fuel
4=soil fertility(manure)	9= income generation	4=increases soil productivity
5= livestock feeding	10=other (specify)	5= Other (specify)

4.2 Do you sell your grain legumes? (1=yes, 2=no). If yes proceed to the next question

4.2.1 Is the sales from grain legumes profitable? (1=yes, 2=no)

If yes, how do you use the profits you get from sales of grain legumes?

……

…….....

…….....

…….....

4.3 Rank the legumes starting with the most preferred and give the reasons?

Legume (codes)	Reasons in order of importance			
	Reason 1	Reason 2	Reason 3	Reason 4

Legume codes	**Codes for traits (Reason you prefer growing it?)**		
1=beans	1= High yield	6= Food	11= Resistant to field pests
2=soybeans	2= High nutritional value	7= Marketable	and/or diseases
3=groundnuts	3= Improve soil fertility	8= Large seed size	12= Tasty
4=lablab	4= Early maturing	9=Soft texture	13=Easy to store
5=cowpeas	5= livestock feed	10=Easy to cook	14=Other specify

4.4 Who is responsible for the following activities on your farm?

List legume grown (beans, soybeans, groundnuts, lablab, cowpeas)	(1=man, 2=woman,3=children, 4=other (specify)				
	Production	Marketing	Fertilizer purchase	Fertilizer application	Preparation of organic manure

5. Input used

5.1 This section requires the farmers to provide information on the inputs used in production of the grain legumes in the last **long** season

Legume grown	Variety	Input used	Type	Quantity	Units	Area spread (Acres)	Price per unit in Ksh	Cost in season in Ksh	

Legumes	List	Only for fertilizer	**Units**
1. Beans 2. Cowpeas 3. Groundnuts 4. Soybeans 5. Lablab	1=Fertilizer 2=Pesticide	1=TSP, 2=DAP 3=animal manure, 4=compost manure, 5=other (specify)	1 = Kg 2 =50 Kg Bags 3 =Milliliters 4 = Litres 5 = debe 6 = gorogoro 7 = bottle top 8=others(specify)

5.2 This section requires the farmers to provide information on the inputs used in production of the grain legumes in the **last short** season

Legume grown	Variety	Input used	Type	Quantity	Units	Area spread (Acres)	Price per unit in Ksh	Cost in season in Ksh	

<u>Legumes</u>
1. Beans
2. Cowpeas
3. Groundnuts
4. Soybeans
5. Lablab

<u>List</u>
Fertilizer
Pesticide

<u>Only for fertilizer</u>
1=TSP,
2=DAP
3=animal manure,
4=compost manure,
5=other (specify)

Units
1 = Kg
2 =50 Kg Bags
3 =Milliliters
4 = Litres
5 = debe
6 = gorogoro
7 = bottle top
8=others(specify)

5.3. Seeds used in **long season**

Grain legume	Quantity used	Units	Price per unit inKsh	Total cost in Ksh	Area spread(Acres)	Source of seeds

Legumes	**Units**	**Source of seeds**
1. Beans 2. Cowpeas 3. Groundnuts 4. Soybeans 5. Lablab	1 = Bottle top 2=kgs 3=gorogoro 4=grams	1 = open market 2= Agro vets 3 = Organizations (NGO) 4 = Government 5 = Wild 6 = Other sources (specify) 7=Own stock

5.4. Seeds used in the **last short** season

Grain legume	Quantity used	Units	Price per unit inKsh	Total cost in Ksh	Area spread(Acres)	Source of seeds

Legumes
1. Beans
2. Cowpeas
3. Groundnuts
4. Soybeans
5. Lablab

Units
1 = Bottle top
2=kgs
3=gorogoro
4=grams

Source of seeds
1 = open market
2= Agro vets
3 = Organizations (NGO)
4 = Government
5 = Wild
6 = Other sources (specify)
7=Own stock

5.5. Labor use during the last **long season**

Legume grown	**Activity**	**Area in acres**	**Type of labour 1= family 2=hired 3= Both hired and family**	**Adult male**					**Adult female**					**Children**				
				hiring mode 1=perday 2=piece work(contract)	**No. of people**	**No. of days**	**Cost per day**	**Total cost if payed per piece**	**hiring mode 1=perday 2=piece**	**No. of people**	**No. of days**	**Cost per day**	**Total cost if payed per piece**	**hiring mode 1=per day 2=piece**	**No. of people**	**No. of days**	**Cost per day**	**Total cost if payed per piece**
	Land preparation																	
	Planting																	
	Weeding																	
	Fertilizer application																	
	Spraying																	
	Harvesting																	
	Threshing																	
	Other(specify)																	

Legume name (second legume grown if any)	Activity	Area in (acres)	Type of labour 1= family 2=hired 3=Both hired and family	Adult male					Adult female					Children				
				hiring mode 1=perday 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece	hiring mode 1=perday 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece	hiring mode 1=per day 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece
	Land preparation																	
	Planting																	
	Weeding																	
	Fertilizer application																	
	Spraying																	
	Harvesting																	
	Threshing																	
	Other(specify)																	

Legume name (third legume grown if any)	Activity	Area in (acres)	Type of labour 1= family 2=hired 3=Both hired and family	Adult male					Adult female					Children				
				hiring mode 1=perday 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece	hiring mode 1=perday 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece	hiring mode 1=per day 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece
	Land preparation																	
	Planting																	
	Weeding																	
	Fertilizer application																	
	Spraying																	
	Harvesting																	
	Threshing																	
	Other(specify)																	

Legume name (forth legume grown if any)	Activity	Area in (acres)	Type of labour 1= family 2=hired 3=Both hired and family	Adult male					Adult female					Children				
				hiring mode 1=perday 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece	hiring mode 1=perday 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece	hiring mode 1=per day 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece
	Land preparation																	
	Planting																	
	Weeding																	
	Fertilizer application																	
	Spraying																	
	Harvesting																	
	Threshing																	
	Other(specify)																	

Legume name (fifth legume grown if any)	**Activity**	**Area in (acres)**	**Type of labour 1= family 2=hired 3=Both hired and family**	**Adult male**					**Adult female**					**Children**				
				hiring mode 1=perday 2=piece	**No. of people**	**No. of days**	**Cost per day**	**Total cost if payed per piece**	**hiring mode 1=perday 2=piece**	**No. of people**	**No. of days**	**Cost per day**	**Total cost if payed per piece**	**hiring mode 1=per day 2=piece**	**No. of people**	**No. of days**	**Cost per day**	**Total cost if payed per piece**
	Land preparation																	
	Planting																	
	Weeding																	
	Fertilizer application																	
	Spraying																	
	Harvesting																	
	Threshing																	
	Other(specify)																	

5.6. Labor use during the last **short season**

Legume grown	**Activity**	**Area in acres**	**Type of labour 1= family 2=hired 3= Both hired and family**	**Adult male**					**Adult female**					**Children**				
				hiring mode 1=perday 2=piece work(contract)	**No. of people**	**No. of days**	**Cost per day**	**Total cost if payed per piece**	**hiring mode 1=perday 2=piece**	**No. of people**	**No. of days**	**Cost per day**	**Total cost if payed per piece**	**hiring mode 1=per day 2=piece**	**No. of people**	**No. of days**	**Cost per day**	**Total cost if payed per piece**
	Land preparation																	
	Planting																	
	Weeding																	
	Fertilizer application																	
	Spraying																	
	Harvesting																	
	Threshing																	
	Drying (or any other activity)																	

Legume name (second legume grown if any)	**Activity**	**Area in (acres)**	**Type of labour 1= family 2=hired 3=Both hired and family**	**Adult male**					**Adult female**					**Children**				
				hiring mode 1=perday 2=piece	**No. of people**	**No. of days**	**Cost per day**	**Total cost if payed per piece**	**hiring mode 1=perday 2=piece**	**No. of people**	**No. of days**	**Cost per day**	**Total cost if payed per piece**	**hiring mode 1=per day 2=piece**	**No. of people**	**No. of days**	**Cost per day**	**Total cost if payed per piece**
	Land preparation																	
	Planting																	
	Weeding																	
	Fertilizer application																	
	Spraying																	
	Harvesting																	
	Threshing																	
	Drying																	

Legume name (third legume grown if any)	Activity	Area in (acres)	Type of labour 1= family 2=hired 3=Both hired and family	Adult male					Adult female					Children				
				hiring mode 1=perday 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece	hiring mode 1=perday 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece	hiring mode 1=per day 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece
	Land preparation																	
	Planting																	
	Weeding																	
	Fertilizer application																	
	Spraying																	
	Harvesting																	
	Threshing																	
	Drying																	

Legume name (forth legume grown if any)	Activity	Area in (acres)	Type of labour 1= family 2=hired 3=Both hired and family	Adult male					Adult female					Children				
				hiring mode 1=perday 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece	hiring mode 1=perday 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece	hiring mode 1=per day 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece
	Land preparation																	
	Planting																	
	Weeding																	
	Fertilizer application																	
	Spraying																	
	Harvesting																	
	Threshing																	
	Drying																	

Legume name (fifth legume grown if any)	Activity	Area in (acres)	Type of labour 1= family 2=hired 3=Both hired and family	Adult male					Adult female					Children				
				hiring mode 1=perday 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece	hiring mode 1=perday 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece	hiring mode 1=per day 2=piece	No. of people	No. of days	Cost per day	Total cost if payed per piece
	Land preparation																	
	Planting																	
	Weeding																	
	Fertilizer application																	
	Spraying																	
	Harvesting																	
	Threshing																	
	Drying																	

5.7 Please provide the following information for the **last long** rain season

Grain legume 1=Beans 2=Groundnuts 3=Soybean 4=Lablab 5=Cowpeas	**Total area harvested (acre)**	**Total harvested quantity please indicate units**	**Quantity consumed please indicate units**	**Quantity sold please indicate units**	**Selling price /unit**	**Total value in season**	**Selling place for legume (market)**

Codes main type of market

1 = neighbor
2 = schools
3 = hospitals
4 = Local urban market
5=Brokers

Codes for units

1=kg
2=tin
3=gorogoro
4=20kg sack
5=90kg sack
6=other (specify)

5.8 Please provide the following information for the **last short** rain season

Grain legume 1=Beans 2=Groundnuts 3=Soybean 4=Lablab 5=Cowpeas	**Total area harvested (acre)**	**Total harvested quantity please indicate units**	**Quantity consumed please indicate units**	**Quantity sold please indicate units**	**Selling price /unit**	**Total value in season**	**Selling place for legume (market)**

Codes main type of market

1 = neighbor
2 = schools
3 = hospitals
4 = Local urban market
5=Brokers

Codes for units

1=kg
2=tin
3=gorogoro
4=20kg sack
5=90kg sack
6=other (specify)

5.9 Do you normally have prior information on possible markets and prices before selling your grain legumes?

(1= Yes 2 = No)

If Yes

Where do you get information on possible markets and prices for your produce?

(1= Neighbor 2 = Television 3=Radio 4 = Internet 5 = Newspapers/magazines 6= Buyers 7 = NGO'S 8=Extension officers 9 = Other (Specify)

……

7. Membership of organization7.1 Do you or any of your household members belong to any farmer group? …….. (1 = yes; 0 = No)

7.2 If yes, which one (s)? (1=cooperative society, 2=KFA, 3=women group, 4=NGO, 5=others (specify)

7.3. What services/benefits do you get from the organization you belong to? (1 = Credit/loan 2 = Input purchases 3 = Joint extension services 4 = Market/ price information 5 = Training 6 = Ready marketing of produce 7 = Higher prices for produce 8 = Other (Specify)

…….

8. Access to credit

8.1 Have you accessed any credit in the last 12 months? (0=no, 1=yes)

8.2 Did you use the credit on production of grain legumes? (0=no, 1=yes)

9. Access to extension services

9.1 Did you have contact with extension services for assistance in the last one year? (1=yes, 2=no)

9.2 If yes,

Type of the extension information given (1=Pulse crop production, 2=fertilizer use, 3=pesticide use, 4=manure use, 5=improved seed use, 6=livestock husbandry, 7=soil fertility management, 8=others (specify)

10. Value addition

10.1**.** Are you aware of any value addition for the grain legumes ……. (1 = yes; 0 = No)

10.2. Do you undertake any value addition activity on your grain legumes? ……. (1 = yes; 0 = No) **(if yes proceed to the table below)**

What are the value added products	How are the products prepared (processes)	How often do you produce per season	Ingredients involved	How much do you produce (please indicate units)	Total Cost of ingredients (kshs)	Total cost of labour involved (kshs)	Quantity sold indicate units	Price sold per unit
			Codes for processes involved 1=sorting 5=grinding 2=grading 6=packaging 3=drying 7=roasting 4=threshing, 8=other (specify)					

10.3 Do you transport your legumes to the market …… (1 = yes; 2 = No)

10.4 If yes, what means do you use ……

10.5 What is the approximate total cost incurred in transporting the legumes in Kenyan shillings……

11. Access to infrastructure services

11.1 Distance from home to nearest market/ trading centre……..Km.

11.2 Status of main road to the nearest trading centre…….. (1=mud road, 2=murram, 3=tarmac, 4=other …….……..)

11.3. Distance from home to nearest extension services office…….Km

Thank you very much for your time