FACTORS INFLUENCING THE PRODUCTIVITY OF GROUNDNUTS AMONG SMALLHOLDER FARMERS IN ZAMBIA'S EASTERN PROVINCE

A Research Report presented to the Department of Agricultural Economics and Extension Education of the University of Zambia

By

Eustensia Munsaka

In Partial Fulfillment of the Requirements for the Degree of Bachelor of Agricultural Sciences

ACKNOWLEDGEMENTS

My sincere thanks go to my supervisor Dr. Thomson Kalinda and Dr. Gelson Tembo for all the guidance and assistance that have significantly contributed to the completion of this study as well as their contribution to my professional development.

I am very grateful to Mr. Stephen Kabwe for the help rendered during the data analysis and IAPRI for the data they provided.

Finally would like to extend my gratitude to my loving and supportive family and all the people that assisted me in one way or another.

Table of Contents

List of Tables

List of Figures

List of Acronyms

CSO	Central Statistical Office
IAPRI	Indaba Agricultural Policy Research Institute
RALS	Rural Agricultural Livelihoods Survey (2012)
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
VIF	Variance Inflation Factor

ABSTRACT

Factors Influencing the Productivity of Groundnuts among Smallholder Farmers in Zambia's Eastern Province

Eustensia Munsaka
University of Zambia

Supervisor:
Dr. T. Kalinda

Groundnut is one of the dominant crops in Zambia that enable most of smallholder farmers earn both food and income. Despite the overall importance of the crop amongst smallholder farmers in the country; its productivity countrywide is often hampered by a number of limitations. The objective of this study was to determine the factors that affect the productivity of groundnuts in order to provide more information on groundnut productivity by providing a more comprehensive understanding of the causes of the difference between actual and expected groundnut yields. This study used secondary data from the 2012 Rural Agricultural Livelihoods Survey which was collected by Indaba Agricultural Policy Research Institute and Central Statistical Office to carry out both descriptive and multiple regression analysis. 1323 household that grow groundnuts in Chipata were analyzed in this study. STATA was used to analyze the data. The comparison of the average actual yield with the average expected yield revealed that the actual groundnut yield (502kg/ha) is a lot less than the average expected yield (1500kg/ha). The results of regression analysis revealed that the groundnut yield in Eastern province is significantly affected by: number of household members ($p= 0.043$); educational attainment of household head ($p=0.014$); the number of complete weedings ($p=0.042$); field type (monocropped or mixed) ($p=0.074$) and groundnut variety planted (hybrid or local) ($p=0.030$). All these factors were found to be positively related to yield. In order to increase the current groundnut yields and considering that the number of weedings during groundnut production and the variety of seed used affect groundnut productivity, the study recommends the need for governments and players in the private sector to put in place mechanisms for smallholder farmers to access and use good quality seed and support agricultural extension to be more efficient and effective in transferring the recommended improved technologies particularly weed control products as well as other recommended crop management practices.

CHAPTER 1
INTRODUCTION

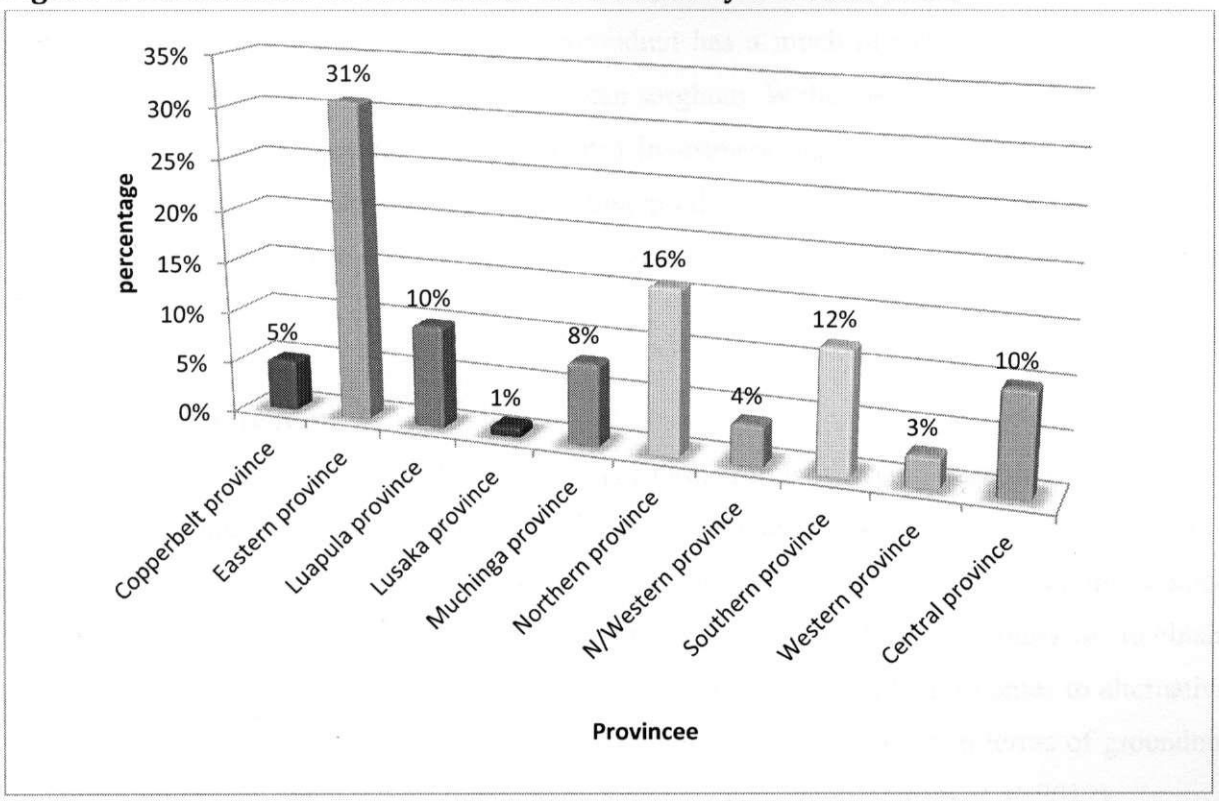
1.1 Background

Groundnuts (*Arachishypogaea*) are species in the legume or bean family, they are very good source of food nutrients not only for human beings but also for soil.Groundnuts contain a high value of energy as they contain approximately 25% protein, 50% edible oil and diverse vitamins, they are cholesterol free and have a low salt status (Minde et al, 2008). They are an important source of food because they provide a cheap source of protein. They are used for oil especially in India but most Zambian households consume groundnuts in the raw, boiled or roasted form, pounded and mixed into their maize porridge or vegetable relish or as peanut butter. After oil extraction, the residues are good sources of protein useful in bakeries and in the manufacture of livestock feeds. (Adinya ,2009)

The groundnut crop is an excellent cash crop and is also very useful for crop rotation as it can fix atmospheric Nitrogen with the help of nodule bacteria and thereby improves soil fertility as well as providing a good green manure for the succeeding crop. It can withstand drought and hence is suitable for dry land farming. The shell, skin and hulm, from groundnut crops are good as fodder; and the plant stalks are fed to cattle in the green form, dried or as silage. (Jenkins *et al*, 2009).

Most of Zambia's groundnuts are grown in the Eastern (31%), Northern (16%), Southern (12%), Central (10%), and Luapula (10%) provinces of Zambia (ACF, 2013). Although all these provinces produce groundnuts, Eastern and Northern provinces produce about half (47%) of the groundnuts produced in Zambia, generating 31% and 16% of the country's production respectively. (Ross *et al* ,2012). Figure 1 shows this.

Figure 1: Distribution of Groundnuts Production by Province 2012



Source: Ross *et al* ,2012.

The demand for groundnuts has been increasing in Zambia, unfortunately groundnuts have registered a decline in productivity and expected production which has consequently led a to serious shortfall, this is reflected by reduced exports, a negligible supply for processors and the high prices charged for the commodity especially in urban areas (CSO 2011). High increases in prices from one year to the next have also been seen in the last three years. In 2009 prices did not rise above 2500 ZK/kg, whereas in 2010 they reached 4000 ZK/kg, and in 2011, 5500 ZK/kg. Therefore, in spite of the slight production increases over the same period, demand still exceeds supply (Ross *et al*, 2012). Zambia's groundnut yields vary from anywhere between 0.3 and 0.6 MT/ha with occasional highs of 0.7 (CSO 2011).

In some areas of Zambia that are semi-arid, crop diversification through the production of crops such as groundnuts may generate a significantly a high value of output for a given bundle of inputs. However, Zambian smallholder farmers continue to dedicate more than 70 percent of

their cropped land to food grains. This is especially ironic for the areas that are semiarid (Agro-ecological region 1) because a crop like groundnut has a much higher resistance for drought compared to most grain crops like maize or even sorghum. While there are several constraints to the expansion of cash cropping including, lumpy investment requirement and poor seed delivery system for smallholder farmers. The groundnut productivity challenge that exists in Zambia demands more attention in order to provide farmers with the knowledge to get the most out of their inputs.

1.2 Problem Statement

In Zambia, The loss of maize's attractiveness as a cash crop is worrying because of the fact that the Zambian population has continued its dependency on maize as a staple crop. There is a lot of literature that has been written on Maize but many farmers do not have adequate information about how profitable crops like groundnuts are or what is required to grow groundnuts to obtain a very good yield, hence farmers cannot make informed decisions when it comes to alternative crops to grow. The information that is available and much talked about in terms of groundnut production is mostly about the different varieties available in Zambia.(Ross *et al*, 2012)

The production of any crops has a percentage of risk associated to it and this means for a farmer to start producing a crop such as groundnut especially if it will become the main source of income for his/her family, they need to have a good approximation of the expected yield and to have a good understanding of the most significant factors that influence the process of producing the crop in order for them to be able to do what is necessary to maximize yield. For example nearly all groundnuts grown in Zambia are produced from farmer retained seed recycled over several generations. In this case if farmers that grow these groundnuts were sure that the seed variety they use is a major factor that contributes to the yield and consequently the income they would generate from producing groundnuts, they would try to change to using improved varieties in an attempt to gain more from the enterprise. It is important to realize that the groundnut production/growing process involves several factors that may be overlooked but may have a significant effect on the potential yield and consequently returns obtained. From the farmers' point of view, it is very important to gain insight into factors which limit most significantly the yield from groundnuts production so that decisions can be made on how much to produce compared to other crops or if a farmer should produce groundnuts for sell, home consumption or

other reasons such as food security. Therefore the gap that exists in this case is that farmers are not as informed as they should be about the potential to increase groundnut productivity from the current low levels and exactly the role that they as farmers can play to enhance groundnut productivity. Hence there is need to provide this information so that the most significant factors that affect productivity are identified and necessary modifications can be made by farmers in an attempt to increase/maximize profit from farm groundnut production.

Traditional methods of growing groundnuts still continue to be used hence yield have persistently remained low. Chipoto (2010) clearly stated that "the challenge of improving farm productivity appears to have a straight forward solution of providing small scale farmers with the knowledge to get the most out of their input". Evidently, an insight to help farmers appreciate growing groundnuts is required and being rational producers, knowing exactly what could help them increase their groundnut yield would be of interest to them. There are a lot of factors that are involved in the process of growing groundnuts but there is no literature or empirical research in Zambia that has been done to specifically determine the factors that affect the productivity of groundnut, some of the factors are external factors that the farmer cannot change (Unfavorable weather conditions such as erratic rainfall, droughts, floods etc), however there are some factors that are within the farmers' control and this study will bring out some of these factors and identify the most significant ones so that farmers become more aware of this and concentrate more on changing them in order to not only increase productivity but also use the scarce resources on the farm more efficiently.

1.3 Objectives

General objective

Determine the significant factors that affect productivity of groundnuts among small holder farmers in the Eastern Province (Zambia).

Specific objectives

To determine average yield of groundnut produced in Eastern province.

To compare the average yield to the average expected yield.

To identify the factors that affect groundnut yield.

1.4 Rationale

Carrying out a study like this one will provide a more comprehensive understanding of the causes of the difference between average and potential groundnut yields by identifying the demographic factors, crop management practices and other factors that are significant to attain high groundnut yields because small holder producers in Zambia urgently need sustainable improvements in groundnut productivity and profitability. Improvement in productivity is required for higher output as well as income and food security while avoiding significant expansion of croplands (Ross *et al*, 2012). Yields per hectare of groundnuts planted are currently extremely low due to a variety of constraints, therefore it would be wise to tackle these constraints in order to enable farmers to produce more from the area of land cultivated before encouraging the plantation of larger groundnut plots (Ross *et al* ,2012). Groundnuts production in Zambia has increased but not as much as it should increase compared to the national demand. The relatively low groundnut supply has led to the market buying groundnuts of any variety as long as the nuts are clean and dry (Ross *et al* , 2012) . As it is at the moment in Zambia, there is insufficient stimulation of the agricultural potential hence there exists a possibility to achieve substantially higher yields per hectare (ACF, 2013). A lot of households in Zambia actually grow groundnuts for home consumption and not as a cash crop because most households especially in the rural area are not aware of the possibility of increasing productivity to the level where they can gain profits from groundnut production (ACF, 2013).

There is a growing body of evidence around sub-Saharan African countries including Zambia that argues for the pursuit of a strategy of food security that is based on diversification of smallholder agriculture into high-valued cash crops like groundnuts (Jayne, 1994). Small-scale farming systems in Zambia are overwhelmingly dominated by a single crop: Maize. In 2009/10, 81.72% of all smallholders grew maize (Sitko *et al*, 2011). However, with the growing demand for food because of the rapid growth of the population, the country will need to increase agricultural production performance and food production and this can be done by diversification to start focusing not only on maize production but try to also develop farmers' interest in growing crops like groundnuts and increasing their productivity with the aim of enhancing food

security and ultimately reduce poverty in the country. Empirical records suggest that in many semiarid areas crops such as groundnuts have the potential to provide higher returns to land and labor than food grains and therefore present opportunities to promote small holder income growth, national foreign exchange generation (Jayne, 1994). The understanding of the factors that affect groundnut production productivity will also enable famers to determine the influence of possible changes of significant variables upon productivity and will be able to know how their yield will be affected in the absence of certain factors. With adequate information about groundnuts productivity, farmers that suffer many constraints as growers of maize can easily switch to other more easily cashable crops like groundnuts. Identification of these factors will hence facilitate production and marketing decisions/strategies to maximize profit and productivity or increase income from farm production and policy makers can be advised on ensuring that farming remains a profitable venture despite uncertainties in the farming process. However, if such factors are not seriously addressed, the contribution of groundnut production to poverty reduction and food security in the Zambia might ultimately get compromised.

1.5 Organization of the Report

The report is organized into five chapters; Chapter one provides a background on the subject matter of the study. It also gives the details of the problem statement, study objectives and rationale of the study. Chapter two presents a review of the relevant literature to the study. Chapter three is a discussion of the research methods and procedures that were used, specifically looking at the data analysis procedure used. It also presents an empirical model for determining the factors that affect the productivity of groundnuts among smallholder farmers in Zambia's Eastern province. In chapter four the study findings are presented, interpreted and discussed. Finally, chapter five covers the recommendations and conclusions of the study.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of relevant literature to the study, literature that has been done on agricultural productivity in general as well as literature specifically on groundnut productivity. Productivity is a very important measure of the efficiency of factors of production which ultimately has an effect on the profitability of any crop and livestock enterprise.

There is a lot of literature on agricultural productivity in general as well as groundnut productivity in particular.

2.2 Productivity and Production

The terms "crop productivity" and "crop production" though related are two different concepts and hence carry different meanings. Crop production refers to the total output produced within a specific period while Productivity of a crop is the ratio of the quantity of output to the quantity of input used in producing the crop (Lipsey *et al*, 2001). There are various measures of productivity depending on the resource being considered i.e. labor productivity, machine or capital productivity, material productivity and land productivity (www.enotes.com). In this study will focus on land productivity - production per hectare (the amount of groundnuts produced per hectare i.e. kg/ha).

2.3 Factors that affect Agricultural Productivity

Bruce (1992) conducted experiments to validate theoretical estimates and determine the factors that limit crop productivity in optimal environments. This study focused on climatic and environmental factors like temperature and CO_2 as well as photosynthetic radiation. The study was too scientific and the factors that were studies are factors that cannot be controlled by small scale farmers with the resources they have hence the results cannot help the small scale farmers being targeted here.

An article by David *et al* (2009) determined the yield gaps (difference between actual and potential yield) for the major cereals (maize, wheat and rice) in their major growing reasons and the causes of these gaps. This article revealed that sizeable differences in the actual and potential yield are actually required to maintain yield growth because yields begin to plateau once they near the yield potential ceiling. This study also emphasized the need for the knowledge of factors that contribute to the yield gap is useful for efficiency targeting efforts to increase production.
A study on the Constraints, Challenges, and Opportunities in Groundnut Production and Marketing in Malawi by Minde *et al* (2008) attributes the changes in groundnut productivity to: groundnut varieties; poor pricing structure and lack of lucrative export markets. While Kumwenda *et al* (2005) identified low yielding materials, declining soil fertility through poor crop management and low nutrient application, inadequate support services such as extension services and credit facilities, pests and diseases, and a clash in labor demand as major factors that affect groundnut productivity.

(Rearden, *et al.,* 1997) observed that smallholder farmers had very low yields compared to commercial farmers in his study on productivity determinants in Africa, other factors that were found to be important agricultural productivity determinants were: seed type and fertilizer usage, the two were seen to positively affect; farm size and land tenure; incomes through their effects on farm input acquisition and investments; well-functioning input and output markets were seen to also be an indirect determinant of productivity as they affect profitability of farming outlets and input access.

2.4 Methods used to Determine Factors that Influence Productivity

In the 1970s, On-farm controlled experiments were conducted as part of the International Rice Agro economic Network to research factors that influence yields. Farmers ran these experiments side by side with their normal practices then the management aspects that varied in the experiments on a site-by-site basis by researchers, who field most likely to improve yields. The study concluded that crop productivity could be determined by biophysical factors such as soil quality of field, specific factors related to management practices particularly fertilizer application and insect pest management as well as other management practices not included in the study.

Calvin & Saders (2004) carried out an empirical study of yield heterogeneity. This method documented yields for more than 50 fields within a small region to study yield variation and thereafter determine the causes of this variation. This method however required detailed information on the specific soil and management factors likely to affect yields making it not only very expensive but also time consuming.

David et al (2009) additionally mentioned that factors that affect yield can be identified even without management and soil measurements by analyzing the pattern of yield in space and time and comparing these patterns to those expected for different factors. The relative amount of variability observed provides an indicator of the importance of a set of factors relative to another set of factors even though this method cannot specify the exact factors causing the variation.
From the reviewed literature, It is very clear that several methods or models and productivity of crops in general can be analyzed from different angles. The factors that affect groundnut productivity in other countries/ areas may not apply to Zambia and looking at the literature reviewed, some factors that may be important in groundnuts productivity have not been considered for example the effect of weeds on groundnut productivity.

CHAPTER 3
METHODS AND PROCEEDURES

3.1 Introduction

This chapter presents a description of the methods and procedures used in achieving the stated objectives, and the data used in the analysis as well as the actual empirical models used. A descriptive analysis was carried out which included a comparison of the average actual yield to the average expected yield, then a multiple regression model was run to identify factors influencing the productivity of groundnuts.

3.2 Methods

Analytical Techniques

The analytical framework for this study included descriptive analysis and as well as regression analysis. Both the descriptive analysis and multiple regression analysis were carried out in a statistical package, STATA.

Descriptive Analysis

The descriptive analysis encompassed frequency distribution, mean, standard deviation as well as maximum and maximum variables.

Multiple Regression Analysis

The multiple linear regression model is one of the most widely used vehicle for empirical analysis and the social sciences (Wooldridge 2004). Multiple regression analysis is more amenable to ceteris paribus analysis because it allows us to explicitly control for many other factors which simultaneously affect the dependent variable. Wooldridge (2004) also contends that multiple regression models can accommodate many regressors which may be correlated thus helping us infer causality where simple regression analysis would be misleading. Multiple regression analysis can also incorporate fairly general functional form relationships. Generally, multiple regression with k independent variables can be stated as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_k X_k + u$$

Where the x's are the explanatory variables and the betas are the effects

Empirical Model Specification

The empirical model specification is :

Y = f(gender, eduhead, HHsize, age, net_off_farm, gnutvar, gnutpurch, weednu, rlstock, accessinfo)

Where:

Y = the groundnut yield (in Kilograms per hectare) realized by the household

Gender = Dummy variable for the gender of the household head (1=male 2=female)

Eduhead = Educational attainment of household head

HHsize = The number of household members

Age = The age of household head (years)

Net_off_farm = Off farm income received by the household (ZMK)

Gnutvar = Dummy variable for groundnut Variety planted (1=hybrid 2= local)

Gnutpurch = Source of groundnut seeds (1=purchased 2=owned)

Weednu = Number of complete weedings

Rlstock = Dummy variable for livestock ownership (1=yes 2=no)

Accessinfo = Dummy variable for access to agricultural commodity price information (1=yes 2=no)

Gnutfldtyp = Dummy variable for field type (1=monocropped 2=mixed)

To identify the significant factors affecting the productivity of groundnut production, the yield was regressed on the variables above by running the regression in STATA.

According to Ross *et al*, 2013 yield in Eastern Province is Significantly constrained by the continuous recycling of seed (seed quality), the varieties planted, limited availability of improved varieties, rainfall pattern, , agronomy practices employed (late planting), pest attacks and weed pressure.

3.3 Regression Diagnostics

A number of regression diagnostics were conducted on the regression mode. Heteroskedasticity is a violation of one of the assumptions of OLS, in which the error variance is non-constant; consequences of which the estimated coefficients are unbiased but inefficient leading to erroneous conclusions. The results of the Breusch-Pagan/Cook-Weisberg test revealed the presence of heteroskedasticity; the data was thus corrected using White's heteroskedasticity corrected standard errors for OLS estimators to avoid drawing erroneous conclusions (Gujarati 2003).

The model was also checked for adequacy to ensure it assumed the correct functional form and that there were no more variables required. A multicollinearity test was also done to ensure that the assumption of no correlation between variables was not violated. The results indicated that multicollinearity was not a problem.

3.4 Data collection and Data Analysis

This study used secondary data that was collected by Indiba Agriculture Policy Research Institute (IAPRI). The data was from the 2012 Rural Agricultural Livelihoods Survey (RALS12).

Only data for Small holder farmers from Eastern province was used in this study because most of the groundnuts in Zambia are produced in Eastern province hence there is a lot of investment in groundnut production in the area. The Eastern Province is dominated by small to medium scale farmers with 69% growing groundnuts and 22.56% of all farms being less than 1 ha in size (Ross *et al* ,2012).. 2000 farmers in Eastern province participated in the RALS survey but only 1323 planted groundnuts. Therefore only the 1322 farmers were used in the analysis.

.

CHAPTER 4
RESULTS AND INTERPRETATION

4.1 Introduction

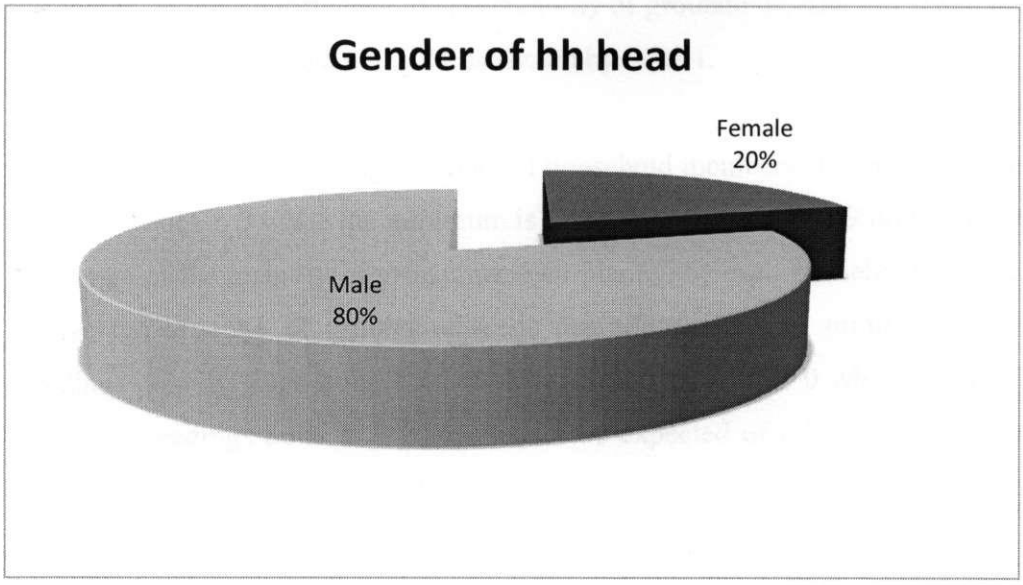
This Chapter presents a discussion of the study findings, starting with a description of demographic characteristics followed by the results of the regression analysis,. The chapter ends with a discussion on the factors influencing groundnut productivity.

4.2 Descriptive Analysis

Demographic Characteristics

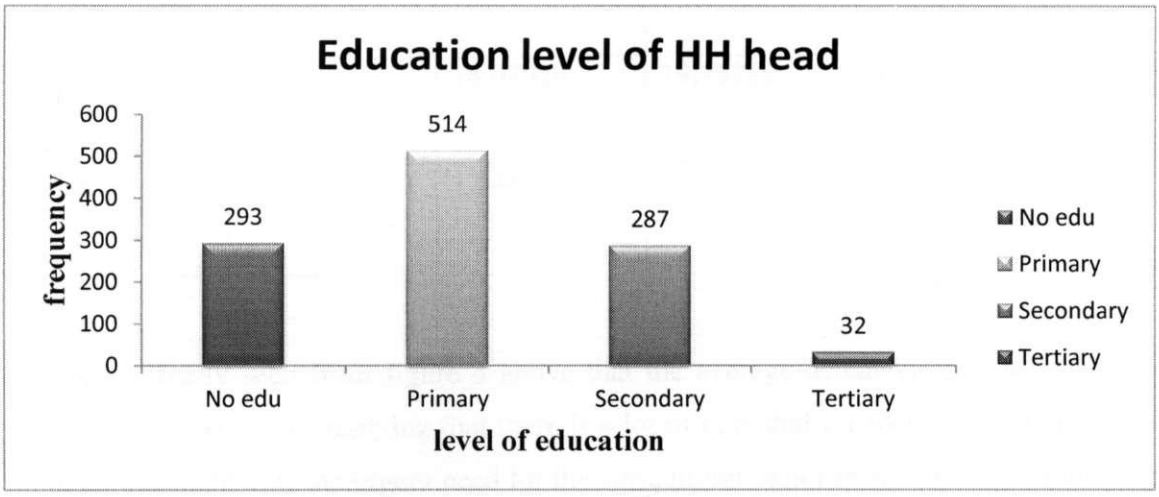
The following are the demographic characteristics of groundnut growers in Eastern province. The majority (79.66%) of the households that grow groundnuts in Eastern province are male headed household while only 20.33% are female headed households. However the responsibility of growing groundnuts is usually given to women even in the male headed households. Women are primarily responsible for the planting, weeding, and harvesting of groundnuts. In terms of marketing, women tend to dominate the small-scale informal groundnut trade in rural and urban markets. Gender of the household head may have an effect on groundnut productivity in the sense that gender of a farmer may affect one's access to credit for input purchase which, in turn affects productivity levels. (figure 2)

Figure 2: Gender of Household head



Only 32 out of 1323 (2.4%) of the household heads attained tertiary education with the majority just having gone up to primary school and 293 (22.1%) with no education. The attainment of higher education may have a bearing on productivity because it may imply that one understands the theoretical aspect of agriculture more than a farmer with low educational attainment. (figure below)

Figure 3: Level of Education of Household head



Generally older famers have more practical farming experience compared to younger farmers; this means age could influence the productivity of groundnuts. The age range of the household is 20 – 19 with the mean age being 46 as shown by table 1.

Table 1 also shows the average number of household members. The average number of people in each household is 5 while the minimum is 1 and the maximum is 19 household members.
The range of the quantity of groundnut seed planted by each household is 0.6 kg – 384 kg with an average of 46kg of groundnut seeds per household. The minimum number of complete weedings done by each household in their groundnut field is 0 while the maximum number of complete weedings done is 5 which would be expected of a household that uses family labor which the farmer does not consider as a cost.

Table 1: Table of Descriptive Statistics for Continuous Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Yield ((kg/ha)	1323	502.3732	424.5778	0	3800
Num_Members	1323	5.78458	2.594304	1	19
Eduhead	1323	5.051398	3.840081	0	15
Agehead (yrs)	1323	46.3099	14.89299	20	93
Gnutseed (kgs)	1323	18.07926	19.75289	.6	384
Weednu	1323	1.548753	.632937	0	5

It can be clearly seen from figure 4 above that the average actual yield is a lot less than the average expected yield implying that there is a lot of potential for increasing productivity. Ross *et al* (2012) highlights the urgent need for the agricultural sector in Zambia to be more organized

and requirement for considerable investment of effort in improving yields and product quality via extension input, seed multiplication, breeding initiatives, labor-saving technology transfer and aflatoxin control mechanisms.

Figure 4: Comparison of Actual with Expected Groundnut Yield

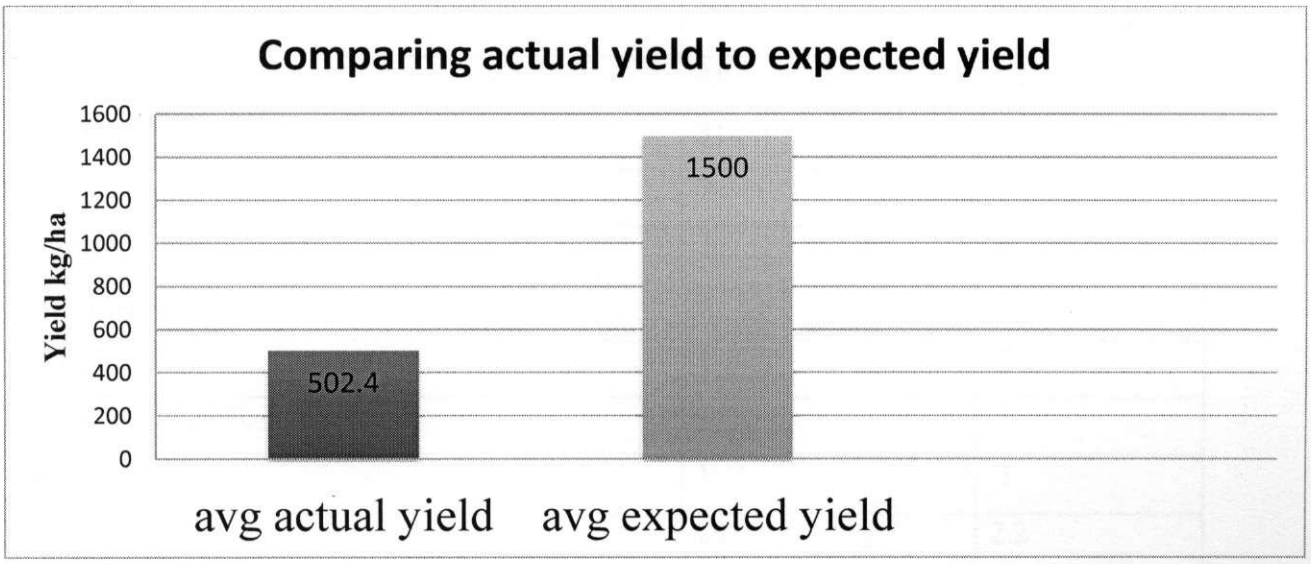


Table 2 presents the different groundnut varieties planted in Eastern Province and indicates the majority (55.2%) of the households that grew groundnuts planted local varieties. Chalimbana was the single most planted variety with 286 households using it which represents 21.6% of the households that grew groundnuts. 10% of the households planted Kanjute variety while very small percentages of the other varieties were grown with Makuru Red, MGV-4, Chishango, Chipego, Nyanda, OPV Groundnuts, MGV-5, Katete - ICG 12991, Flamingo and Other Hybrid having 3.8%, 3.1%, 2.3%, 0.5%, 0.3%, 0.2%, 0.2%, 0.1%, 0.1% and 2,2% respectively.

Table 2: Seed Varieties used in Eastern Province

Seed Variety	Number	Percentage
Chalimbana	286	21.6
Kanjute	139	10.5
Makuru Red	50	3.8
MGV-4	41	3.1
Chishango	31	2.3
Chipego	7	.5
Nyanda	4	.3
OPV Groundnuts	3	.2
MGV-5	2	.2
Katete - ICG 12991	1	.1
Flamingo	1	.1
Other Hybrid	29	2.2
Local Groundnuts	730	55.2
Total	1324	100.0

4.3 Regression Analysis

From the multiple regression results, the regression model was statistically significant in explaining the relationship between the regressors and the observed yield, 12.17% (R=0.1217) of the variation in yield could be explained by the regressors at 95% confidence level (Appendix 1). The p-value associated with the F value was very small (0.0001) is compared to the alpha level (0.05), this means the independent variables in the regression model reliably predicted the dependent variable (Yield) (Appendix 1). The regression results also show that the household size, groundnut variety planted, field type (whether the field was purely a groundnut field or not), number of weedings completed and educational attainment of the household head were significant.

The household size is significant (p=0.0373) and has a positive relationship with yield. Having a large number of family members could translate into having more family labor as

revealed by a survey that was carried out by Minde *et al* (2008), the survey demonstrated that households with more labor realized higher yields. This means more people are available to contribute to labor in the groundnut production process and this is likely to increase productivity.

Educational attainment of the household head which refers to the highest level of education that the household head has completed is significant (p=0.014) and the positive coefficient suggests that the higher the educational attainment of the household head, the higher the yield obtained by the household. The technology diffusion theory suggest that uptake of new technology is expected to be high when educational levels are high, and this may result in improved productivity. Educated farmers are generally in a better position to understand technology adoption procedures, agricultural instructions and extension services (Minde *et al*, 2008)

The dummy variable for field type (whether the field was purely a groundnut field or not) was significant. Groundnuts are sometimes grown intercropped with Maize but more often as a monocrop because groundnut crops require a lot of sunshine and the shading effect from the maize reduces yields. . The coefficient for this variable shows that higher yields are obtained from monocropped groundnut fields compared to mixed crop fields. This is supported by a study carried out by (Thwala, 2004) to determine the effect of crop mixtures on individual crop yield, the results shows that pure groundnut fields yielded significantly higher than intercropped groundnuts

Similarly, the presence of weeds in a groundnut field has a negative impact on the growth of the groundnut crop, this is because weeds compete with crops for soil moisture, nutrients and light hence negatively affecting the growth of the groundnut plant and consequently the yield obtained from it (Vilas *et al,* 2012). Therefore the higher the number of completed weedings in a field, the higher the yield obtained as shown by table 3. The loss in yield of groundnut pods due to weed competition range from 24 to 70% (Jhala, 2005).
The groundnut variety planted in a field is statistically significant and the positive sign on the coefficient (48.834) implies that using hybrid groundnut varieties increases groundnut

yield. Good quality seed with a high germination percentage should be used instead of using seeds that have been recycled year after year.

Table 3: Regression Output for Regression Variables

Variable	Label	Coef.	P>|t|
HHsize	Number of household members	8.037381	0.043**
Gender	Gender of household	35.97148	0.197
Eduhead	Educational attainment of household head	8.473758	0.014**
Age	Age of household head	-.1046091	0.892
Gnutfldtyp	Dummy variable for field type (monocropped or mixed)	163.7662	0.030**
Weednu	Number of complete weedings	38.53566	0.042**
Gnutvar	Dummy variable for groundnut Variety planted (hybrid or local)	48.83453	0.074**
Gnutpurch	Source of groundnut seeds	-38.78401	0.232
Net_Off_Farm	Off farm income	8.12e-07	0.546
rlstock	Livestock ownership	-33.43392	0.416
accessinfo	Access to agricultural commodity price information	-28.60601	0.444

**significant variables at 5% confidence interval

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

Groundnut yields in Eastern province are low but there is potential to increase the yield as implied by the observed large difference between the actual and expected yield. The majority of farmers use local seed varieties that have been recycled for several years.

The factors that influence the productivity of groundnuts are: the number of household members; the educational attainment of household head; the field type (monocropped or mixed); the number of complete weedings and the groundnut variety planted (hybrid or local). The regression coefficients of these variables were positive and statistically significant.

5.2 Recommendations

Based on the results obtained from this research, farmers should be encouraged to use improved groundnut varieties by putting in place mechanisms for smallholder farmers to access and use good quality seed. However this should be done together with the encouragement of using all recommended practices in groundnut production. This is because using improved groundnut seeds without following the recommended crop management practices for groundnuts will still result in low yields.

Since the education level of the household head influences the productivity of groundnuts but some farmers had no formal education at all and most of them only attained primary education, it is very important that extension agents become more efficient and effective in transferring the recommended improved technologies and also not only concentrate on the practical side of groundnuts production but find ways to try to make the farmers understand the theoretical aspect of growing groundnuts so that they can look at the process with a comprehensive view, farmers are probably not seriously applying crop management practices that would enable them improve yields.. For example the results of this study highlight the effect of weeding on productivity, this means the farmers have to be taught, the importance of weed control products, how to choose the

right products for their fields as well as how to correctly use them and the consequences of not correctly using the weed control products.

The literature review also revealed that farmers do not normally have agricultural information required to make informed decisions related to groundnut production (Ross et al, 2012). Therefore it is recommended that the government and the private should establish groundwork of identifying and characterizing farmers so that their varying needs in terms of groundnut production information can be mapped.

References

Adinya I. B. 2009. Analysis of Costs-Returns Profitability in Groundnut Marketing In Bekwarra Local Government Area, Cross River State, Nigeria. Department of Agricultural Economics and Extension, Cross River University of Technology (CRUTECH) Obubra Campus, Nigeria. The Journal of Animal & Plant Sciences 19(4): 212-216

Ahuja H.L. 2006. Advanced Economic Theory. S. Chand & Company, New Delhi.

Desai, M., 1976.Applied Econometrics, Philip Allan Publishers Ltd, Deggington, Oxford, pp: 52-60.

Dougherty, C. 2002. Introduction to Econometrics. New York: Oxford University Press

Evenson R E and Gollin D. 2003. Crop Variety Improvement and its effect on productivity: the impact of international agricultural research. Technology & Engineering. CABI Publishing.

Greene, W H. 2002. Econometric Analysis. Fifth edition. New York: Pearson Education Inc.

http://www.ats.ucla.edu

http://m.allafrica.com/stories/201301190144.html

http://mpra.ub.uni-muenchen.de/41593/

Lipsey R.G & Fraser S. 2001. What does Total Factor Productivity Measure? Study Paper Verson 02. January 18.

Maddala, G S.1992. Introduction to Econometrics. Second edition. New York: Macmillan Publishing Company,

Minde I, Madzonga O, Kantithi G, Phiri K and Pedzisa T. 2008. Constraints, Challenges, and Opportunities in Groundnut Production and Marketing in Malawi. Report No.4 ICRISAT.

Ngulube S,Subrahmanyam P, Freeman HA, van der Merwe PJA, and Chiyembekeza AJ. 2001. Economics of Groundnut Production in Malawi. ICRISAT.

Siegel PB, Alwang J. 2005. Poverty Reducing Potential of Smallholder Agriculture in Zambia: Opportunities and Constraints. Working Paper Series No. 85 World Bank.

Sitko NJ, Chapoto A, Kabwe S, Tembo S, Hichaambwa M, Lubinda R, Chiwawa H, Mataa M, Heck S, and Nthani D. April 2011. Technical Compendium: Descriptive Agricultural Statistics and Analysis for Zambiain Support of the USAID Mission's Feed the Future Strategic Review. Working Paper no. 52, Food Security Research Project.

Waddington S. R. and Karigwindi J. Productivity and profitability ofmaize+groundnut rotations compared with continuous maize on smallholder farms in Zimbabwe. Cambridge University Press.

APPENDICES

Appendix 1: Regression results

Number of obs = 1323

F(11, 1311) = 3.51

Prob > F = 0.0001

R-squared = 0.1265

Root MSE = 420.66

Yield	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
HHsize	8.037381	4.63578	1.73	0.043	-1.056977	17.13174
Eduhead	8.473758	3.435661	2.47	0.014	1.733764	15.21375
Gnutfldtyp	163.7662	75.52669	2.17	0.030	15.59983	311.9326
Weednu	38.53566	18.96209	2.03	0.042	1.336293	75.73503
Gnutvar	48.83453	27.29649	1.79	0.074	-4.715297	102.3844
Gender	35.97148	27.86533	1.29	0.197	-18.69402	90.63699
Age	-.1046091	.7706787	-0.14	0.892	-1.616507	1.407289
Gnutpurch	-38.78401	32.40208	-1.20	0.232	-102.3496	24.78158
Net_Off_Farm	8.12e-07	1.35e-06	0.60	0.546	-1.83e-06	3.45e-06
rlstock	-33.43392	41.05639	-0.81	0.416	-113.9773	47.10949
accessinfo	-28.60601	37.37128	-0.77	0.444	-101.9201	44.70804
_cons	204.6328	119.3921	1.71	0.087	-29.58764	438.8531

Source: analysis results 2013

Appendix 2: VIFs of variables

Variable	VIF	1/VIF
gender	1.19	0.840699
eduhead	1.17	0.851801
HHsize	1.12	0.894040
age	1.10	0.910532
net_off_farm	1.09	0.916871
gnutvar	1.09	0.919804
gnutpurch	1.08	0.928943
weednu	1.04	0.964339
rlstock	1.03	0.969202
accessinfo	1.03	0.974764
gnutfldtyp	1.02	0.984347
Mean VIF	1.09	

Appendix 3: Results of OV test

Ramsey RESET test using powers of the fitted values of yield

Ho: model has no omitted variables

F (3, 1308) = 0.86

Prob > F = 0.4595