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Agronomic Factors Limiting Groundnut Production: A Case of Smallholder Farming in Tabora Region

Katundu Mangasini

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ABSTRACT

Groundnut is one of the dominant crops in Tanzania that enable most of smallholder farmers earn both food and income. It is one of the biggest sources of fats, protein, carbohydrates, and vitamins for human consumption. The crop is also a source of human nutritious minerals, as well as other manufactured animal feeds. But, despite the cited overall importance of the crop amongst smallholder farmers in the country; its production countrywide, is often hampered by a number of socio-agronomic limitations. As one of the cases in point, Tabora region is not an exception from this consequence, and, it was from this viewpoint that this study was proposed. It was conducted in Tabora Region, and basically in Urambo District where household-groundnut production is becoming increasingly limited overtime. The major study-objective was to identify the key factors that are naturally agronomic, and are potentially contributing to limited agricultural expansion of the crop amongst smallholder producers in the area. A multivariate regression analysis was adopted so as to both identify and quantify such potential causal factors; whereas, the Chi-square test was used to compare levels of smallholder-income received from groundnut production over the previously past three-year harvest seasons. The sample size for the study comprised about 400 farmers for both groundnut-producers and non-producers. A semi-structured questionnaire for the Focus Group Discussion (FGD) was used to solicit data on qualitative aspects of the study, and, a Statistical Package for Social Sciences programme was used for data analysis.

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1.0 INTRODUCTION

1.1 Background

Groundnut (*Arachis hypogaea L.*) is an annual legume which bears many other local names, including: pea-nut, earthnut, monkey-nut and goobers. It is the 13th worldwide most important food-crop, and fourth important oilseed-crop (Smith, 2002). Groundnut seeds, which are known as kernels, contain 40-50% fats, 20-50% protein and 10-20 % carbohydrates (Sorrensen *et al.*, 2004). They are a nutritional source of vitamin E, and of some other minerals for human health. The latter include niacin, falacin, calcium, phosphorus, magnesium, zinc, iron, riboflavin, thiamine and potassium. Groundnut is useful in the treatment of haemophilia, and can cure *stomatitis* and prevent diarrhoea. It is beneficial for growing children, and for both pregnant and nursing mothers (Akobundu, 1998). Kernels are consumed directly as raw, or as roasted or boiled nuts. Some of the extracted oil from kernel is used as culinary oil (NIGAM, and LENNÉ, 1996). However, some of the crop-extracts are used as animal feeds. In other words, almost every part of the groundnut plant is used in some way. While kernels are used for human consumption, vines are used as fodder for cattle (Pompeu, 1980; Hong *et al.*, 1994). Sometimes raw items of the crop are used as industrial materials for producing oil-cakes and fertilizer. Literally speaking, all these multiple uses of groundnut plant make it important for both food and cash-crop for the available domestic, or worldwide external markets in several developing, and developed countries.

In Tanzania the production of groundnuts is mostly done by way of smallholder farming. Since groundnut is one of the key sources of getting major ingredients of household nutritional foods; women are mostly found as paying more labouring in producing the crop. But again, being one of the major raw materials for providing edible oils in the country; the crop is dominated by cottonseeds and sunflower production. Generally speaking, groundnut is largely used as food-crop and is consumed directly (Sibuga *et al.*, 1992) but being considered as cash-crop; is also sold for earning income, and most of it is mainly marketed by way of informal markets.

Groundnuts are mostly grown in some parts of the country that are below 1 500 m of altitude, but most of the local growers do not tend to increase their scale of production overtime. Important growing regions include Mtwara, Tabora, Shinyanga, Kigoma, Dodoma, and Mwanza. These regions receive annual rainfall varying between 500 mm and 1 200 mm (Mwenda *et al.*, 1985). Two of the main growing zones however, have different amount of rainfall distribution during growing seasons. One of the zones covers the regions of Mtwara, Ruvuma, Kigoma, Shinyanga and Mwanza; where rainfall is uni-modal, falling from October/November to May/June, with a brief dry spell of some few days to few weeks in January or February (Mwenda, 1985). The other zone covers Morogoro, central and north-eastern parts of the country. This has a bimodal rainfall distribution, with short rains in November/December, and long rains from March to May/June.

Groundnut is grown entirely under rain-fed conditions. It is generally grown as intercrop with cereals or cassava. Usually, the crop is grown without application of fertilizers. Farmers grow groundnuts on flat seedbeds on the tops of ridges, or just on the lower sides of these ridges. In part, adverse weather conditions and particularly unreliable rainfall have been recognized as one of the responsible factors leading to low yield (Sibuga *et al.*, 1992).

1.2 Problem statement and significance of the study

1.2.1 Problem statement

The production of groundnut in African countries is not evenly unvarying over years. It is greatly fluctuating. For example, records show that during the previously ended decade, its production had not exceeded 8% of the world output (ICT, 2001). Hitherto, the annual yield per hectare has not changed much, it is still low. Literally, there are obvious interplaying factors that are mostly responsible for this. As already cited, some of them include unreliable rains, and/or traditional methods of farming, that is, small-scale with little or without application of mechanization. Others include outbreak of pests and diseases, and the use of low-yielding seed varieties, or lack of improved seeds. In addition, it is sometimes evident that the situation is exacerbated by increased cultivation on marginal lands. On the other hand however, Kafiriti (1990) cites of adopting poor agronomic practices by various growers as further limiting the overall farm production.

But, despite overall cited causes for the low yield countrywide; it is still apparent that the production of this crop in Urambo district is limited by more of researchable problems; and, mostly agro-economic factors. To some greater extent, these are negatively inducing and/or influencing household producer-behaviour. It is observed that, if such factors are not seriously addressed; the contribution of groundnut production to poverty-reduction and food-security in the region might ultimately get compromised. Most of the studies have been directed towards climatic factors and improved seeds, or pests and diseases; whereas, agronomic factors that tend to limit smallholder production in the proposed area of study remain unstudied. These include factors like transportation facilities, access to credit and markets, bargaining power, and storage facilities, and the like.

1.2.2 Significance of the study

In order for Tanzania to meet stipulated objectives for adopting the National Strategy for Growth and Reduction of Poverty, as well as achieve the Millennium Development Goals (MDGs); the primacy of agriculture must receive due priority. This entails the adoption of *'kilimo-kwanza'*, as a strategy, and comprehensive approach for agricultural development of the time. The strategy is based on ten actionable pillars with clear focus to poverty-reduction. The agricultural sector in the country does not only employ the majority of Tanzanians; but also contributes significantly to overall share of the national income. Therefore, it must be primarily improved. Where

possible, there is a need to transform the agricultural sector from smallholder subsistence farming into large scale commercial farming. This study is attempting to show responsible agro-economic drawbacks that retract smallholder farmer from achieving this noble goal of the national objective. The implementation of *kilimo-kwanza* in Tabora region is one of the key strategies to address low agricultural yields that might go parallel with groundnut-production in the area. In this way, the findings of the study can partly assist in designing better agronomic policies that are suitable for smallholder production, and induce countrywide expansion of producing the crop.

1.3 Objectives

1.3.1 Main objective

To determine agro-economic factors limiting the scale of groundnut production in Tabora Region so as to improve smallholder livelihood and income earning.

1.3.2 Specific objectives

1 To identify socio-agronomic factors influencing small scale of groundnut production in Urambo district;

2 To determine the contribution of groundnut production on overall household income;

3 To determine actual contribution of groundnut-production on poverty reduction of women growers;

4 To establish income differences between groundnut growers and non-groundnut growers.

2.0 THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Theoretical Framework

The theoretical framework that underlies the proposed study, borrows insights and empirical contributions from the Farm Household Production theories, as clearly articulated and revisited by Mendola (2007). The author is evidently pointing out that, peasants are farm households with access to a piece of land, of which they mainly utilize household labour in farm production. This author maintains that, peasants are located in large dominant economic and political systems that can affect production-behaviour. In addition, this author cites of the observation by Ellis (1992) who also finds that peasants are fundamentally characterized by partial engagement in markets, which are often imperfect or incomplete. The author makes citation from Hunt's (1991) view, which identifies peasant farms as being units for both production and consumption – implying that a proportion of produce is sold to meet their cash requirements and financial obligations, and a part is consumed by them. In this context, Mendola (*ibid*) is maintaining that these units involve a variety of market and non-markets tasks such as agriculture; pastoral-ism; fishing; crafts; and gathering (e.g., fruits, nuts, fuel-wood, water, etc). In concluding, she notes that, typically peasant farms ^ work with developing markets that function sporadically and somewhat disconnectedly across locations and time.

That being the case therefore, the above described production framework for the peasantry, or smallholder agricultural production has implications upon the producer-behaviour, as well as his/her overall production-decisions. Taylor and Adelman (2003) identify the involved classic economic models that incorporate the consumption goals of household into microeconomic models of peasant households' decision-making – as 'agricultural-household' models – i.e., they identify them as 'consumption and production' units, in both perfect and incomplete market context. This being the case therefore, it does mean that the typical Cobb-Douglas production function, which assumes constant returns to scale, that are based on restrictive assumptions of perfect competition in both factor and product markets, is inadequate to explain reasons for smallholder production-behaviour. In this way, it is equally inadequate to provide answers for the study objectives.

2.2 Literature Review

2.2.1 Groundnut production

Groundnut (*Archis hypogaea L.*) is an important annual legume in the world; it is mainly grown for oilseed, food, and animal feed (Pande *et al*., 2003; Upadhyaya; *et al*., 2006). It is the chief crop rotation component in many Sub Saharan countries (Gbèhounou and Adango, 2003). Records show that the world average production of this crop was 1690 kgh^{-1} in 2006 (FAOSTAT, 2008). Further, it is revealed that at that time groundnut production in Africa was

much lower, i.e., 980 kgh^{-1} (*ibid*). This was lower than the world average groundnut yields. Researchers associate these lower yields to both biotic and socio-economic factors (Caliskan *et al*., 2008; Pande *et al*., 2003; Upadhyaya; *et al*., 2006).

According to Taru *et al.* (2008) groundnut requires 500 mm to 1 600 mm of rainfall, which may last for 70 to 200 days of a single rainy season. Groundnut also requires well-drained light coloured loosed friable sandy loam soil, with optimum moisture in pod-zone and mean daily temperature of about 30°. Rainfall should be well distributed during pre-sowing operations, that is, 100 mm to 150 mm for sowing, and for flowering and pod-development the required rainfall is about 400 mm – 500 mm. Groundnut cannot withstand frost longer, as it can do for severe drought or water stagnation. However, the crop does best in sandy-loam and loamy soils, and in black soils with good drainage. Heavy and sticky clays are not suitable for groundnut cultivation because the pod development is hampered in these soils.

The production of groundnut worldwide includes over 100 countries which grow a total estimated area of 21.8 million ha. These countries produce about 28.5 million tonnes of shelled-nuts (ICRISAT, 2009). There are 25 countries in Asia producing 71.7% of the crop. African countries follow this figure in terms of the extent of produce. There are 46 countries, Tanzania inclusive, producing 18.6% of the total produce. North-Central America produces 7.5% from a small area of 3.7% of the overall estimated area of world producers. But again, important world producers of the crop include China, India, and Indonesia in Asia; Nigeria, Senegal, and Sudan in Africa; and USA in North-Central America. Argentina in South America is another significant producer.

2.2.2 Background of groundnut production in Tanzania

The history of groundnuts in Tanzania dates back to 1946. At that time mainland Tanzania, the then Tanganyika, was a colony under British rule. Frank Samuel, the then head of the United Africa Company, a subsidiary of Unilever, came up with an idea for the colony to cultivate groundnuts, so as to produce vegetable oils. Both the idea and priority to introduce the groundnut-production scheme in the colony were exclusively based on the then interests of colonial government. Largely, the need was to have an exclusive large-scale commercial production sector that would be state-managed for export; although household smallholder-production of the crop, which could be expanded and/or improved for household food and income earning, was there. The first site for cultivation was in Kongwa in the central Tanganyika where local people had already been cultivating groundnuts for ages before. Although, the scheme could start; it had ended or abandoned during the same colonial period.

Today, groundnut production in Tanzania is done by smallholder farmers. It is one of several oilseeds produced in the country. As previously cited, edible oil production in the country is dominated by cottonseed and sunflower. Ramadhani *et al.* (2002) note that despite the groundnut importance in the country, yield is still low. For the past 10 years, groundnut production has

experienced two production plateaus with relatively high yield of about 600 and 500kgh^{-1}, respectively. It is again cited that the reasons for low yields in the country include the use of unimproved varieties, unreliable rainfall, pests and diseases, as well as lack of institutional support (BACAS, 2000). It has been noted that, due to lack of improved varieties and seed availability; farmers recycle seeds which further complicates the situation (Doss *et al.*, 2003). Countrywide observers, find that the country's sustainable agricultural production is resting on delicate balance due to certain socio-economic factors (Katinila *et al.*, 1998; Pixley *et al.*, 2006).

2.2.3 Groundnut production in Tabora region

Tabora region is one of the 21 regions of mainland Tanzania. Inhabitant farmers of the region are mainly smallholders, and are mostly depending on tobacco, maize and groundnut-production for livelihood-earning (Ramadhani *et al.*, 2002 cited by Bucheyeki *et al.*, 2008). However, crops like tobacco, maize and groundnuts production, which are the chief sources of income for majority of people of Tabora region in Tanzania, are currently experiencing a sharp yield-decline. The grown varieties are older than 10 years. *Mamboleo*, the only groundnut variety which was introduced in the 1960s has lower yield-capacity and had forced farmers to abandon it. Hence, there was need to introduce new varieties. To curb this situation; a client oriented research was conducted. Two varieties, *Pendo* and *Johari* were identified by client as high yielding, and as possessing preferred traits. These varieties were recommended to be grown by farmers in the region (Bucheyeki *et al.*, 2010). But, despite all these attempts to improve the situation in growing areas; low yields are still a problem. This calls for more research into other probable limiting factors, including agronomic practices.

3.0 METHODOLOGY AND HYPOTHESES

3.1 Justification and Location of Study Areas

The study was done in Tabora region particularly in Urambo district. All divisions of Urambo district namely Urambo, Ussoke, Songambele and Ukondamoyo were involved in the study. A total of five wards was included in the sample. They included Muungano, Vumilia, Songambele, Usisya and Ussoke. Kaliua and Ulyankulu (former divisions of Urambo District) were not involved in the sample because they were newly formed districts with Kaliua selected to form the new region of Katavi, and Ulyankulu as a new district in Tabora region. Urambo is one of the seven districts of Tabora region. Others include Tabora Municipality, Uyui, Nzega, Igunga, Sikonge and Ulyankulu. Urambo district is bordered by Uyui district to the East, Mpanda district in Katavi region in the South and Kaliua district of Katavi region to the Western side; whereas, Kahama district is in the North. The district lies between 31^0 $24^{'}$ and 32^0 $47^{'}$ Longitudes East, and 5^0 $30^{'}$ and 6^0 $20^{'}$ South. It covers an area of 25 995 km^2; with a population of 369 329, of whom 340 348 live in rural areas. This proportion comprises about 92.2% of the total population (URT, 2003). Urambo was selected for the study because it is not only the largest district in Tabora region; it also produces more groundnuts than the rest of the other districts in the region.

3.2 Research Design

This study employed a cross-sectional design, whereby the data were collected at a single point in time, by using survey methods. The reason for choosing this design was that, it is flexible and economic (Babbie, 1990).

3.3 Sampling Population, Sample Size and Sampling Techniques

The sample population for the study was all farmers in Urambo district. The sampling unit for the study was the household. At times this term was used interchangeably with farmer and smallholder. The total sample size for this study was mixture of 400 smallholder-farmers including both groundnut growers and non-growers. The choice for this figure was based on Fisher *et al.* (1991) formulation in determining the study sample size for the total population that exceed 10 000 (Appendix IA). Out of 400 households, a total of 30 households were sampled from Muungano, 27 from Vumilia, 42 from Songambele and 20 were from Usisya. Others were Ussoke (13), Uhuru (18), Usongelani (29), Sipungu (19), Kalemela A (32) and Kalemela B (47). Likewise, 17 were from Mabundulu, 20 from Itegamatwi, 31 from Katungulu and 55 from Jioneemwenyewe (Appendix IB). These figures are based on proportionate sampling. This number was thought to be appropriate and its characteristics were representative of the target population. The larger the sample is the more consistent is the outcome to estimated parameters in question. Likewise, the larger the sample the more likely it is to have representative number of the target-population from which the sample comes (Amin, 2005). The sampling procedure

adopted a combination of different approaches including Multistage, Simple Random Sampling (SRS), and Purposive sampling. Multistage sampling was used to identify areas of survey, i.e. Divisions, Wards and Villages. Purposive sampling approach was applied to get groundnut growers as well as non-growers. Using simple random sampling 400 farmers among groundnut growers and non-groundnut growers were selected.

3.4 Sources, Types and Methods of Data Collection

Both primary and secondary data were collected. Primary data were collected by way of using a conventional questionnaire. The procedure dealt much on agronomic and socio-economic factors leading to production. Factors like transportation, availability of credit, modes of crop storage and facilities in particular were captured. Also, the reasons for the farmer's choice(s) of groundnut production or (other) were exhaustively triangulated. Access and availability of markets were also captured. Farmers were not shrewd enough to bargain for their productions when demand and supply determine price. This study wanted to know if this factor contributes to low yields. The study also wanted to establish whether culture or used agricultural traditions and demographic factors influence the status of the scale of crop production today. Primary data were collected using survey methods particularly semi structured questionnaire and FGD. Secondary data consisted of annual yields and acreage and were obtained through review of secondary sources such as district annual reports, farmers' records and government reports.

3.4.1 Focus group discussion (FGD)

Two focus group discussions were conducted based on pre-determined questions. The first focus group discussion was done at Jioneemwenyewe village in Songambele division on 16 th September 2010. However, on 21 st September 2010 the second focus group discussion was done at Uhuru Village, which is located in Vumilia ward, in Ukondamoyo division. Each group discussion consisted of 15 members, with at least five female participants. Each focus group discussion was guided by one facilitator, whose concern was to moderate and guide the discussion. The focus group discussion guide consisted of general questions which tackled important aspects of the study, by exploring the basic objectives behind the implied study.

3.5 Data Analysis Techniques

The collected data were analysed using Statistical Package for Social Sciences (SPSS), as well as Microsoft office Excel 2003. Likewise, descriptive statistics was employed to determine the contribution of groundnut production on overall household income. These included the mean, mode, range, sum, frequencies, percentages, maximum, minimum, variance and standard deviations. A multivariate regression technique was applied to identify socio-agronomic factors influencing small scale groundnuts production in the district. In order to establish income differences between groundnut growers and non-groundnut growers, as well as determine the

actual contribution of groundnuts production on poverty reduction of women growers, the cross-tabulations were used.

3.5.1 Model specification

There are several ways of specifying the production function. In a general mathematical form, a production function can be expressed as:

$Y = f(X_1, X_2, X_3 ... X_n)$……..1

where,

Y = quantity of output

$X_1, X_2, X_3 ... X_n$ = factor inputs

This general form does not encompass joint production (that is a production process, which has multiple co-products) or outputs (Heathfield, 1971). The model has the left hand side which specifies the dependent variable Y for output depending on the array of factors, or explanatory variables known as independent variables *vis a vis* groundnut production. Using an equation usually implies continual variation of output with minute variation in inputs, which is simply not realistic. Fixed ratios of factors, as in the case of labourers and their tools, might imply that only discrete input combinations, and therefore, discrete maximum outputs, are of practical interest (Shephard, 1970). One formulation is like a linear function such as;

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + ... b_nX_n$ ……..…2

where,

$a, b_1 – b_n,$ = are coefficients of parameters that are quantitatively determined empirically.

From equation 2 above the model was estimated as:

$Y = a + b_1HHS + b_2FMS + b_3L\ IP + b_4SEX + b_5INC + b_6PRI + b_7AMC + b_8MRK + b_9TRS + b_{10}SRF + b_{11}BP + \mu$ ……..……3

where,

Y = Quantity of groundnut produced (in kg. per acre)
HHS = Household size (Number of people in a household)
FMS = Farm size (measured as land size cultivated in acres)
LIP = Labour input (measured as number of hours spent on farming)
SEX = Sex of farmer (dummy; 1 = male, 0 = female)
INC = Income of a farmer (Tshs)
AMC = Amount of credit (in Tsh.)

MRK = Availability of market or where does the farmer sell (dummy; 1 = cooperatives, 2 = producer market, 3 = processing industries, 4 = auctioning, 5 = individual buyers)
TRS = Transport facilities (dummy; 1 = Oxcart, 2 = bicycle, 3 = pick-up, 4 = track, 5 = head-load, 6 = train)
PRI = Price of groundnut in (Tsh per kg.)
SRF = Storage facilities (capacity to carry amount of produce in kg.)
BP = Number of times have farmers determined market price
μ = Error term
$b_1 - b_n$ = Regression coefficient to be estimated
a = constant term.

3.6 Hypotheses

It was hypothesised that:

1 Socio-agronomical factors such as access to credit, household size, availability of markets, sex of farmer, little bargaining power, storage facilities and means of transportation limit both growth and expansion of smallholder groundnut production in Tabora Region;
2 Groundnuts farming have not brought any significant increase in the household's income;
3 Groundnut production does not improve poverty situation of women growers;
4 There is no significant income difference between groundnut growers and non-groundnut growers**.**

3.7 Data Presentation

After a sound analysis both qualitative and quantitative data were obtained. Quantitative data were presented using graphs, charts, tables and figures. These were mostly accompanied by explanations to highlight the contents. If items would need further clarification, notes were added to clarify indicated figures. Oso and Onen (2008) find that this method is useful in presenting the findings because it summarises a lot of information in a small space. It is almost impossible to present qualitative information in a form of a table. The qualitative data from this study were summarised and presented in form of sentences and explanations to supplement quantitative information.

3.8 Policy Implications

The current national policy outlook puts emphasis on agriculture. For that reason, this implied study on groundnut production for both food- and cash-crop, was deliberately focused on the present strategy for agricultural development, namely, '*Kilimo-Kwanza*'. This approach, which is highly magnificent, builds upon the existing resources to make the sector a national top

priority to ensure peoples' livelihoods, as well as their socio-economic wellbeing. Its grand profile is clearly stipulated in the 'Kilimo-Kwanza' Resolution by the Tanzania Agricultural Council (TAC). It is based on ten actionable pillars. This strategic approach however, is basically intended to transform agriculture for the purpose of benefiting the majority of Tanzanians. The major thrust behind, is to revolution-alize agriculture; so as to become the major and effective contributor on social welfare *vis a vis* other poverty reduction strategies. The policy therefore, puts agriculture a topmost agenda in Tanzania's development policies. This is also in line with the 1997 Agricultural and Livestock Policy. Among other things, it aims at improving the wellbeing of the people whose principal occupation, and way of life is based on agriculture. Specifically, the policy intends to improve standard of living in the rural areas through increased income generation from agriculture and livestock production, as well as from processing and marketing. This should also be able to increase foreign exchange earnings for the nation by encouraging the production and increased exportation of cash crops, livestock products, and other agricultural surpluses including food crops, by-products and residuals. The government however, could launch the so called "*Kilimo-Kwanza*" as a strategic campaign to make sure that the above objectives are met within reasonable time. The literal translation for the acronym is "Agriculture-First", but the advocacy is basically emphasizing the primacy of agriculture to bring about significant socioeconomic development. It is asserted that: "if anything, agriculture has to largely be emphasized", because the sector provides survival to majority of Tanzanians.

4.0 RESULTS AND DISCUSSION

The objective behind this study was to determine agronomic factors that limit groundnut production in Tabora region. Primarily, it was focused on Urambo district where the casual production of the crop is persistently declining overtime. This chapter therefore, is presenting the major findings of the study. It is comprised of five major parts of discussion. Part one presents the major characteristics of the sampled smallholder groundnut farmers; whereas, part two discusses the key agronomic factors that are revealed as factors limiting the amount of production of this crop. The third part presents the analysis of groundnut contribution on overall household income; while the fourth part, indicates the observed extent of poverty reduction amongst women growers of this crop. The last part compares income differences between growers and non growers of the crop in the studied area.

4.1 Characteristics of the Sampled Smallholder Groundnut Farmer

About 400 household heads were interviewed, of which 131 or 32.8% were females, and 269 or 67.2% were males. This could obviously imply that most of households in the study area were male-headed. In the African way of life and culture, the household head is usually a male person. The study by Lacey and Sinai (1996) observed that, in sub-Saharan Africa, it is difficult to compare the levels of female-headed households; since many households report the male as head, and even when the spouse is not present on a regular basis.

While a greater percentage of the surveyed households shows that males were dominant to the sample; results are further indicating that more than three-quarters (77.6%) of the surveyed heads (males or females) were married. About 3.2%, 3.0%, and 7.7% were single, separated, or divorced, respectively. Less than a tenth (8.0%) were either widowed or widower, respectively. However, Smith (2002) remarks that marriage in contemporary African societies is a commonplace practice, even people older than 60 years, and, the divorced or widowed get re-married. The marriage system requires that a price be paid by a man for the right to marry a woman. In Swahili this price is termed as *mahari*.

Table 1 below indicates the analysis of key characteristics of smallholder groundnut farmers in the studied area. Findings suggest that the mean age of household head was 46 years, and the median age for the surveyed sample was 45 years. The results however, reveal that both the mean and median ages were higher than the national mean age of 15 years, and a general median age of 18.3 years reported by index *mund*, in 2010. The bigger range can be attributed to the fact that, the survey included only heads of households whose majority were above 18 years; while the national survey covered all people, including children and the youth; who, in most cases are aged below 18 years, and, are not heads of households. That idea considered majority of the smallholder groundnut farmers in the area as having the active working age.

Table 1: Characteristics of the sampled smallholder groundnut farmers [N = 400]

Variable	Minimun	Maximum	Mean	Mode	Median	Std. Deviatio	Variance
Age of household head in years	18.00	81.00	46.30	40.00	45.00	13.64	186.010
Household size	1.00	28.00	7.87	8.00	7.00	3.92	15.368
Number of years a household head spent in school	0.00	13.00	5.34	7.00	7.00	2.82	7.968
Average annual income of the household head in Tsh	0.00	15080000.00	1665122.61	200000.00	974000.00	2037821.0	4152714585519.69
Total land in ha.	0.00	80.00	5.20000	4.00	3.00	8.013196	160.5284
Land cultivated in ha.	0.00	12.00	1.6955	0.80	1.20	1.690776	7.1468

Source: Survey Data 2010

Furthermore, the study findings indicate that the surveyed sample had an average of 7.9 persons per household. According to the 2002 Population and Housing Census, the average size of households for Tanzania as a whole was 4.9. Atanasi (2007) observed the average household size in Urambo to be 9.6 persons per household. The fact that the national-wide household size tends to decline from, say, 5.2 persons per household in 1988 to 4.9 persons per household in 2002 (URT, 2003); the average of 7.9 persons per household, which was recorded in Urambo was still above the national average, including the Tabora region's average household size of 5.9 persons recorded in 2002 (*ibid*). Such high household sizes may be attributed to a high demand for labour, mainly the labour to work on Tobacco farms. But also it can be attributed to having high birth rates in the surveyed area; since many African families prefer having many children to create more of the household labour. Therefore, it might be the reason why this type of African agriculture (that is, groundnut farming) is dominated by smallholder farming. For small-holder farming, the family is the main source of labour (Njuki, 2001).

Apparently, the results are also showing that most of the heads of households in the studied area spent an average of 5 years for schooling. For someone to finish primary education in Tanzania, a person must spend 7 years schooling. Therefore, the average number of years the household-heads spent in schooling (i.e. five years, in the case of Urambo district was far below the national standard of 7 years. This would sometimes imply that the majority them did not even finish primary education. It was not the intension of this study to seek for the reasons as to why the majority of pupils in the District did not finish primary education. However, other studies show that, lack of tuition fees, early pregnancy, as well as early marriages and child labour – especially on farms, are the leading causes for school truancy and drop-outs (Smith, 2010).

The study also revealed that the average annual household income of the farmer was about Tsh.1 665 122.61. This was an equivalence of US$ 1 280.86 at an exchange rate of $1.00 to Tsh 1 300 basing on September rates in 2009 (BoT, 2009). When divided by twelve months each household in Urambo District, on average, would earn an average monthly income of US$ 106. 74. Assuming all what is earned is being consumed, and taking an average household size of 7.9 persons per household found in the study area, each person in the studied area would be

consuming about US$ 13.51 per month. This would also mean that a person was consuming about US$ 0.45 a day, an amount below a dollar-a-day.

It was further found that on average each household owned about 5.2 ha of land, and on average only 1.6 ha were being cultivated. This implies that availability of land was not a major problem for expanding groundnut farming in the study area, since on average, land which was owned was large enough but only few ha were being cultivated.

4.2 Socio-agronomic Factors Influencing Small-Scale Groundnut Production

In order to determine responsible socio-agronomic factors that affect groundnut production in Urambo district, two methods were used. First, groundnut farmers were asked to tick amongst the listed possible factors, by citing factors that they considered to be the major constraints to produce the crop. Data from this question was then analysed using descriptive statistics, and, the results are presented in Table 2 below. To a greater extent, results show that 13 % of the sample reported lack of market as major constraint they faced in groundnut production. This was followed by low price (12.6 %). Other major reported constraints included lack of capital. About a tenth of respondents (11.8%), reported this as a major problem. Likewise, the similar number of respondents (11.2%) said that inadequate extension services was a problem; whereas, the same percentage (11.1%) mentioned lack of credit facilities as a problem. About a tenth (9.9%) said that inadequate inputs, together with inadequate labour (8.1%), with poor transportation facilities (7.2%) were the major drawbacks. Other mentioned drawbacks included: poor soils (5.9%), lack of storage facilities (4.9%), and shortage of land (3.1%). Very few respondents reported pests (0.5%) and diseases (0.7%) as major constraints in groundnut farming.

Table 2: Major Constraint in Groundnut Production

Category label	Count	%ge of Responses	%ge of Cases
Lack of credit facilities	292	11.1	78.1
Inadequate labour	212	8.1	56.7
Inadequate extension services	294	11.2	78.6
Inadequate inputs	261	9.9	69.8
Shortage of land	82	3.1	21.9
Lack of market	341	13.0	91.2
Lack of storage facilities	130	4.9	34.8
Lack of transportation facilities	189	7.2	50.5
Poor soils	155	5.9	41.4
Lack of capital	311	11.8	83.2
Low price	332	12.6	88.8
Pests	14	.5	3.7
Diseases	19	.7	5.1
Total responses	**2632**	**100.0**	**100.0**

Source: Survey data 2010

Second, the multiple regression analysis was used to determine the effects of the mentioned predictors on small scale groundnut production in the studied area. Eleven predictors were involved in the analysis. They included the household size; cultivated land size in ha; number of times a farmer did determine price. Others included the capacity of the storage structure in terms of 'gunny-bags' measure; hours spent on farming; and farmer's annual income. The other set of variables also included the sex of farmer; amount of received credit in Tanzanian shillings; the market (implying the farmer's selling point). The type of transportation facility as well as selling price in Tanzanian shillings complemented the list of observed variables. The results for the analysis are presented in Table 3 below.

Table 3: Socio-agronomic factors influencing small scale groundnut production in Urambo district

Variables	Coefficients Beta	Std. Error	t- value	P-value	95% Confidence Interval for B
(Constant)		2.209	-1.151	.251	1.801
Household size	.020	.107	.381	.704	.251
Land size cultivated in acres	.113	.104	2.082	.038	.421
Number of times a farmer did determine price	.022	.492	.461	.645	1.196
Capacity of the storage structure 'gunny-bags'	-.008	.000	-.153	.879	.000
Hours spent farming	.098	.148	1.921	.055	.575
Farmer's annual income	.187	.000	3.278	.001	.000
Sex of the farmer	.086	.847	1.750	.081	3.148
Amount of credit in Tsh	-.085	.000	-1.610	.108	.000
Market (where does the farmer se	.005	2.147	.089	.929	4.412
Transportation facility	.068	.185	1.237	.217	.591
Price in Tsh	.170	.000	3.361	.001	.000

a. Dependent Variable: Quantity of Groundnuts harvested

4.2.1 Effect of household-size on quantity of production

The effect of household size on the quantity of the harvested groundnut was measured at a significant level of $p < 0.05$. Results in Table 3 indicate that it was not statistically significant, and coefficient b = 0.020; where t-value was equal to 0.381, and p-value = 0. 704.

As long as the coefficient b is positive; it would signify that the household size was also related to more of quantity of groundnuts harvested. This would also mean that, the larger the size of the household, the more the quantity of groundnuts would be harvested. This is so because smallholder farming, or farming under peasantry system – the household is the major source of labour (Mendola, 2007), and therefore, the larger the household size the more the labour force, and the larger the land to be cultivated. With large land cultivated, one would expect more harvest.

4.2.2 Relationship between farming acreage and harvested quantity

Interestingly, it was observed that the relationship between the cultivated land-size (// acreage), and the quantity of groundnuts harvested was statistically significant at $p < 0.05$. The results for this test are indicated in Table 3 above. They include, b = 0.113; t-value = 2.082; and p-value = 0.038. These findings denoted a positive relationship between the cultivated land-size, and the quantity of groundnuts harvested – implying that the larger the size of land cultivated, the more the quantity of groundnuts harvested – this was measured by some fixed weight of 'gunny-bag' package. The implication is that, the cultivated land-size was an important factor in determining groundnut production. However, to some extent, such findings were expected. For example, *other things being equal*; and, with large size of land cultivated – a person would expect more quantity of groundnuts to be harvested.

4.2.3 Relationship between selling price and quantity of crops produced

A test on whether the number of times a farmer determines price had had an effect on the quantity of groundnuts harvested, showed that there was a statistical insignificance ($p < 0.05$) between the two. The test outcome indicated that b = 0.022, t-value = 0.461 and p-value = 0.645, implying that: the number of times a farmer determines price of groundnuts was not associated with the quantity of groundnuts harvested.

4.2.4 Effect of household storage capacity on groundnut production level

The effect of the capacity of storage-structure (in terms of fixed gunny-bag-weight packaging) to the quantity of groundnuts harvested, was found as not statistically significant (that is, b = - 0.008, t-value = - 0.153, p-value = 0.879). The figures suggest that, the capacity of the storage-structure in terms of the number of gunny-bags does not correlate with the quantity of groundnuts harvested. In another words, it could be said that the quantity of groundnuts harvested in a particular household, was not determined by the capacity of the storage-structure of a particular household.

4.2.5 Impact of working duration on crop production level

A regression analysis was run to test as whether hours spent on farming by the particular household does influence – in any way, the quantity of groundnuts harvested. The analysis produced a statistically significant result, that is, b = 0.098, t-value = 1.921, p-value = 0.055. Literally, such result could indicate that the hours spent on farming by a particular household had correlated with the quantity of groundnuts harvest. Nevertheless, the b-coefficient is positive implying that the more the time spent by a particular household farming the more the quantity of groundnuts harvested. In other words, these results meant that farmers, who spend many hours on farming, were likely to work larger pieces of land, and harvest more than the counterparts who could spend few hours farming.

4.2.6 Effect of income on groundnut production level

The effect of farmer's annual income on the quantity of groundnuts harvested was tested at a significance level of $p < 0.05$ and yielded a highly statistically significant result. Figures in Table 3 above show that b = 0.187, t-value = 3.278, p-value = 0.001. Such results indicated that there was a relationship between farmer's annual income, and the quantity of groundnuts harvested. Besides, if the b-coefficient were positive, it could suggest that quantity of groundnuts a particular household harvested was associated to higher income levels.

In short the higher the income level of the household-head; the more the quantity of groundnuts harvested. This is so because, with higher income a farmer is able to access farming inputs like seeds, fertilizer, and sometimes the access of power-tiller. Hence, putting him in a better chance to produce and/or harvest more, when compared to one with lower income level. This outcome was similar to the study by Mpawenimana (2005) who found that the output from banana-production in Rwanda (i.e. the quantity harvested) was positively related with income, as physical capital. It was a study on the "analysis of socio-economic factors that affect the production of bananas in Rwanda".

4.2.7 Gender and credit based impact on groundnut production

Regarding the effect of sex of a farmer to the quantity of groundnuts harvested, the regression analysis shows a statistically significant result, that is, b = 0.086, t-value = 1.750, p = 0.081. However, the positive b-coefficient would suggest a positive relationship between sex of the farmer and quantity of groundnuts harvested. Additionally, it was further determined as whether the amount of credit a particular household might have received could affect, in any way, the quantity of groundnuts produced. The analysis in this indicated that the results were not statistically significant (p = 0.108) implying that, amount of credits a particular household received was not related to the quantity of groundnuts produced. Yet, the negative coefficient could still indicate a negative relationship between the amount of credit and the quantity of groundnuts harvested. This would further imply // that, credit did not always lead to higher

productivity. For instance, it might be true that: not always when farmers acquire loans use them for the intended purpose; consider, say, for groundnuts farming. A farmer may use the credit which is intended for groundnuts inputs to purchase a radio which is not necessarily resulting into increased groundnuts production.

4.2.8 The impact of market availability to quantity of crop production

The effect of availability of markets to the quantity of groundnuts harvested was tested at ($p < 0.05$) and produced a non-statistically significant results, that is, $b = 0.005$, t-value = 0.089 and $p = 0.929$, which indicate that quantity of groundnuts harvested was not influenced by the availability of markets (or buyers). This result might be true because groundnut farmers, like any other business-people, are interested in maximizing profit. A person cannot necessarily maximize profit just because buyers are many, but largely where the price is above the production and transportation costs.

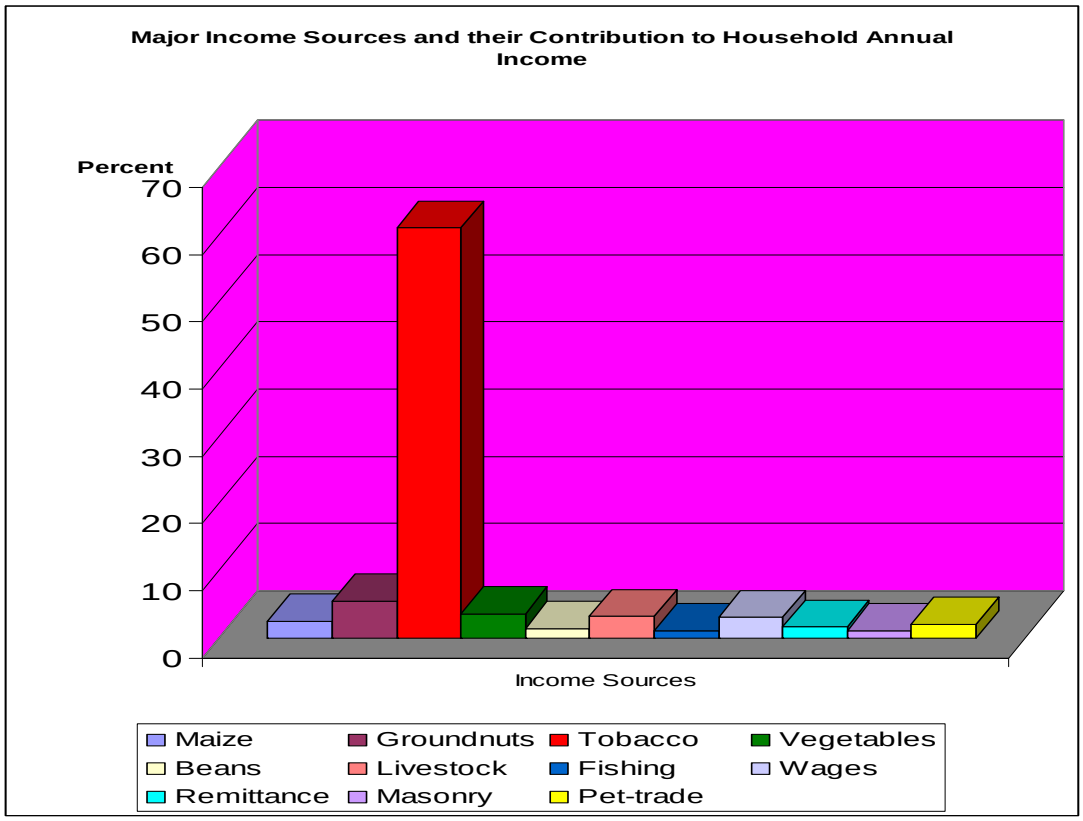
4.2.9 The impact of price on production quantity

It was interesting to note findings in Table 3 above showing that price of groundnuts was greatly associated with the quantity of groundnuts harvested, that is, $b = 0.170$, t-value = 3.361, $p = 0.001$. The results were highly statistically significant at $p < 0.05$. This indicated that the higher the price, the higher the quantity harvested. These findings depicted some economic principles which suggest that, price of a product influences the quantity supplied. This is particularly true because, when the price of a product is high sellers perceive that they are going to earn more profit, and therefore, increase production. In turn, the perceived increase in price also does affect quantity produced.

4.3 Contribution of Groundnut Production on overall Household Income

The results for contribution of groundnut production on overall household income are presented in Fig.1 below. The figure indicates that, apart from tobacco which contributes 61.00% (as the major source of household income); groundnuts production contributes 5.50%. It is second to tobacco.

Fig. 1: Major Income Source and their Contribution to Household Annual Income.



On average, groundnut contributed about Tsh 90 915.00 per household per annum. This was equivalent to US$ 69.93 per annum using an equivalence of $1.00 to Tshs 1 300.00 for the year 2009. Income from vegetable contributed only 3.62% of household income per year followed by maize and beans which contributed 2.50% and 1.35 % respectively. Other sources contributed less than 1.00% of the household income per year. The implication to that effect was that: groundnuts production was one of the important contributors of household income in the surveyed area.

4.4 Reduction of Poverty amongst Groundnut Women Growers

Actual contribution of groundnut production on poverty reduction of women growers is presented in Table 4 below. Results show that groundnuts contribute 6.3% of the total mean annual income of women growers. It is second after tobacco which contributes 52.2% to this group. Income from off-farm activities is 21.4%, without any one single activity contributed as much as that of groundnuts production.

Table 4: Contribution of groundnut-production on poverty reduction of women growers (N = 131)

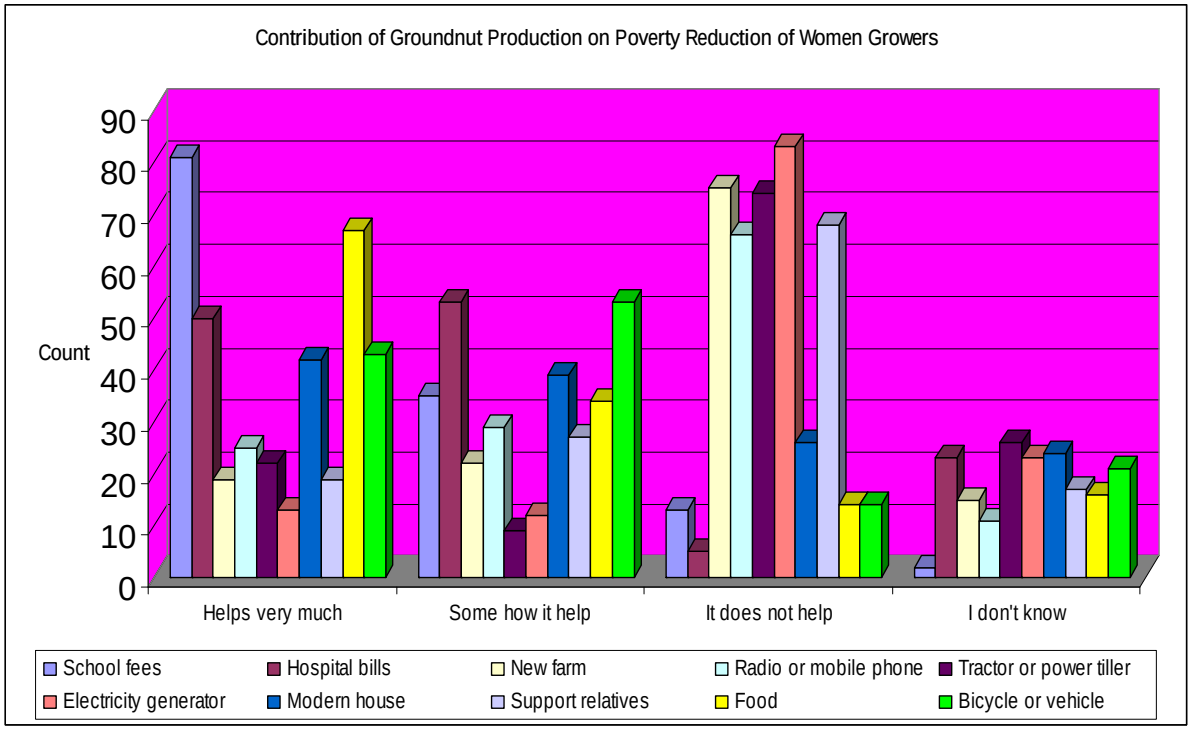
Variable	Sum	Mini.	Maxi.	Mean	Range	Std. Deviation	Variance	%age of Total mean annual income*
Livestock	2525000.0	0.00	270000.0	19274.8	270000.0	39795.1	1583650822.1	1.5
Livestock products	148000.0	0.00	50000.0	1129.8	50000.0	5258.2	27648414.1	0.1
Groundnuts	10308300.0	0.00	976800.0	78689.3	976800.0	139392.0	19430138038.8	6.3
Tobacco	85792900.0	0.00	8000000.0	654907.6	8000000.0	1145446.4	1312047496095.1	52.2
Off-farm activities	35112110.0	0.00	5400000.0	268031.4	5400000.0	750372.1	563058237870.4	21.4

Source: Survey data 2010

Off-farm income sources / activities were specified as salaries, pet-trading, and all other sources that were not agriculturally based. Figures in Table 4 indicate that off farm activities seemed to contribute more than groundnuts production because they were largely a combination of many activities, but each of them contributed *less* than one percent of the income. Even if women growers reported to earn some income from tobacco, researchers could verify that tobacco was a men's business; whereas, groundnut-production was purely subscribed to women's undertaking. It was revealed however that, although few women reported to live single; these had managed to grow tobacco as their cash crops. Other women reported tobacco business on behalf of their husbands because the latter were not available at the time of this survey. Otherwise, income from groundnut was what women own, and these could confidently report it.

Figure 2 below illustrates graphically the extent to which groundnut production supported women growers to alleviate poverty in the study area. Most women (81 respondents) reported that groundnut production have contributed much on paying school fees, while others (35 respondents) said that groundnut production had somehow helped. The rest of the remaining reported as either the production of the crop did not help at all, or as having no idea. This implies that most women in the study area believe that groundnuts farming help very much to pay school fees. (Please, the TOTAL number of women should be specified)

Fig. 2: Contribution of Groundnut Production on Poverty Reduction of Women Growers



4.4.1 Support on medical expenses by income from groundnut production

In terms of paying hospital charges, majority of women (53 respondents) admitted that groundnut farming helped to pay hospital expenses. Moreover, a significant number (that is, 50 out of 400 respondents) reported that groundnuts farming helped them very much. But, 23 respondents, on the other hand, said to have not known whether it helps or not, yet about five respondents reported that it did not help. Overall, this could entail that income from groundnut production helped women tackle poverty by enabling them (women) meet medical expenses. Very few, women (about five respondents) reported to have no meaningful support from income generated by groundnut production, which could help them meet such hospital expenses.

4.4.2 Groundnut production income spent on buying new farm

The study had also sought to know as whether income from groundnuts farming helped women to buy new farms. The majority (about 75 respondents) said that income from groundnuts farming did not help them buy any new farms. But a few of respondents (about 22 respondents) reported that such farming helped. This number had included 19 respondents who reported that groundnuts farming helped them to buy new farms. But again, a significant number (15 respondents) said they did not know whether it helped. To some extent, these findings may be correct in the sense that most women reported that household land was inherited (that their husbands inherited from their parents mostly father). Even if land law provided for women to

own land in Tanzania, like many other African countries, land is still a men's domain to decide. Women own land via their husbands.

4.4.3 Groundnut production income spent on buying new farm

As previously seen for the other variables and assets, the study had also sought to evaluate the extent of income from groundnut production that had enabled women growers purchase important assets like radio, or mobile phones, or other. It was revealed that majority of women reported that income from groundnut-farming did not help them buy important assets. This was reported by 66 respondents. Some respondents (about 29 respondents) said that the farming helped them. About 25 respondents reported to have been helped very much; while a few (11 respondents) said that they did not know. Researchers have also observed that many smallholder groundnut-farmers did not own mobile phones; because of varying reasons including the fact that for a poor person a mobile phone in surveyed area was considered a luxury and a greater priority was placed on securing food security. Nevertheless, in some areas such as Songambele Ward in Urambo district, there was no antenna or aerial facility for using mobile phone.

4.4.4 Groundnut production income spent on buying farm hardware

It was also the purpose of this study to know if income from groundnut enabled the farmers acquire farming tools and hardware like tractors; power-tillers; and other. Majority of respondents (about 74) reported that such farming did not help them to acquire such big assets and wares. Second to this number were 26 respondents who reported to have not known anything about farming hardware. Nine respondents reported to have been helped very much. But the majority had reported to access solar power and/or electricity generators. A sizeable number, that is, 83 respondents reported the farming as not helped at all to acquire such assets. The rest of the remainder reported to have no idea at all.

4.4.5 Groundnut production income spent on housing construction

Farmers were also asked if income from groundnut enabled them build permanent and modern houses. 42 respondents said that it enabled them very much; whereas, 39 respondents said it had somehow helped. Six respondents reported the farming as not helped; while 24 respondents said they did not know. This had an implication that most women considered income from groundnuts to be an important contributor to make newer and modern housings in the surveyed area.

4.4.6 Other supports by income from groundnut production

With regard to the extent to which income from groundnut helped women support relatives financially, it was reported by the majority (i.e. 68 respondents) that it did not help. But, 27 of the respondents said it somehow helped, whereas 19 said it helped very much. The remainder 17

said they did not know whether it helped or not. However, some respondents said that the extent of income from groundnut enabled them buy food items. Many of them (about 67 respondents) reported that it could help them very much; while a significant number (34) reported that it was only to some lesser extent that it could. On the other hand, a few women (16 respondents) had an opinion that: income from groundnuts farming did not help them buy food. This meant that majority of the women considered groundnuts farming as important source of income for buying food stocks. Most women (about 53 respondents) said that income from groundnuts farming did not help them purchase bicycles or motor vehicles. But on the other hand, 43 of the respondents reported that it could help them very much. Again, a sizeable number of women (21 respondents) reported to have no idea about being supported by such crop farming. This calls for further research. Very few (14 respondents) reported that groundnuts farming did not help them in any way to purchase expensive and valuable assets like vehicles.

4.5 Income Comparison between Groundnut Growers and Non-growers

This study had also established if there were income differences between groundnut growers and non-growers. Results for this analysis are presented in Table 5 below. They indicate that groundnut growers earned the mean annual income of Tsh 1 603 307.80; while non-growers could earned up to an average of Tsh 1 805 979.24 a year. This had implied that non-growers of groundnuts earned more than what groundnut-growers earned. The reasons for this could be low price offered to groundnut, compared to the price of tobacco, which was the leading crop in the district at the time of the study. Another reason might be the fact the tobacco and groundnuts are grown during the same rain season (during the months of November and December) when it is not easy for all growers opt to deal with both crops at one time. At this time most farmers, especially those growing both tobacco and groundnuts would decide to grow tobacco first, then groundnuts latter. In most cases, it is done at the end of the season. Literally speaking, this reduced produces and it lowered income from the crop as pointed out by Aziza Bakari Kurulinda a groundnuts farmer from Katunguru village of Usisya ward in Ussoke division.

Table 5: A comparative analysis of income between groundnuts growers and non groundnuts growers

Variable	N	Mean annual income	Sum	Mini.	Maxi.	Range	Std. Deviation	Variance
Groundnuts growers	278	1603307.83	445719577.00	0.00	12310000.00	12310000.00	1911038.21	3.652E + 12
Non groundnuts growers	122	1805979.24	220329467.00	0.00	15080000.00	15080000.00	2303119.96	5.304E + 12

a. Limited to first 400 cases

5.0 CONCLUSIONS AND RECOMMENDATIONS

This study survey on socio-agronomic factors that affect the level of groundnut production in Tabora region, was conducted in Urambo district. Largely, it was meant to identify limiting factors that amount to declining production of the crop overtime. A number of factors were revealed by the study as key elements leading to subsequent lesser harvest annually. For example, price was identified as one of the potential factors limiting the (would-be) expansion in growing the crop. The study finds this factor as key de-motivator towards expanding the cultivation of groundnut production at the level of smallholder farming. Some economic principles however, show that the price of a product is to a greater extent influencing the quantity that can be supplied for demand.

Secondly, it was realised that the income position of the household can likewise determine the level of production of groundnuts; despite the fact that the crop is highly attributed to women's business domain in local production systems. The implication to this finding is that, income can easily enable the crop-grower determine the level of farming inputs one requires for the greater or limited output. Therefore, it was found to be one of the dictating factors in deciding to have higher productions of the crop. The study, on the other hand, finds that there is a relationship between the size of the cultivable-land or acreage, and the amount of yield that should be harvested. In part, this factor induces a similar response to the farmer or grower, like that of the amount of income the household might command for groundnut farming. The lesser the crop acreage would definitely imply the lesser the harvest. Most of the farmers in the sampled area had an average of 1.7 ha. of cultivated land for groundnut farming. It means the amount of land which is allocated for groundnut production is indeed very little, when compared to 12.0 ha a farmer can have as cultivable land.

Thirdly, groundnut crop production in the sampled area is considered to be a women's business affair. Men's participation is quite limited. Therefore, the production of this crop is likewise secondary for the purpose supporting household income and/or expenditure. Therefore in order to make this crop a major contributor for the household income in the sampled area the following recommendations need to be addressed:

1. The market price for this product should be reasonably improved. This can be achieved through addressing key factors that might lead the production of this crop into poor pricing. For example, value addition should be highly observed when processing such crops for ultimate selling.

2. There should be special loan-schemes that are tailored towards such crop-producers so as to enable them to increase as well as improve their productions. Likewise, credit to groundnut-producers should enable them to afford necessary production inputs.

3. Basically, the production of groundnuts at household level is usually considered as secondary undertaking, in a sense that it is not a key supporter of the household's income. Therefore, in order to make it one of the key supporters of the household income it needs to address it as homestead project. This would entail investing into producing for selling or business.

4. Since groundnut production is deemed as women's business, household heads – especially men do not give this crop deserved weight for its production. This has mostly contributed to lower production. It is therefore highly recommended to reverse this trend so as make it a key determinant of household income.

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APPENDICES

Appendix I: Sample size determination

A: Based on a sample size formula by Fisher et al. (1991) as described hereunder:

When population is greater than 10,000

Sample size n of a population P is given by: $n = \frac{Z^2 Pq}{d^2}$

Where,
Z = Standard normal deviation set at 1.96 (or 2.0) corresponding to 95 confidence level
P= Percentage of target population estimated to have a particular characteristics if not known use 50%
q= 1.0-P
d=Degree of accuracy desired set at 0.05 or 0.02

Given:
P= Percentage of (groundnut and non groundnut farmers) (not known), we use 50%.
Z= 2.0
q=1.0-0.5
d=0.05

The sample size for the study is given by: $\frac{2^2 x 0.05 x 0.05}{0.05^2}$ = **400 Farmers**

B: Proportionate sampling

Using a formula: $n = \frac{p_1}{p_2} xN$

Where,
N = Total sample 400
n = Expected sub-sample
P_1 = Estimated population of the village

P_2 = Total households of all 14 sampled villages (**1,592 H/Holds)**

We get the following sub-samples:

S/No.	Village	Households	Sample	Percentage
1	Kalemela B	180	47	12
2	Muungano	120	30	7
3	Mabundulu	68	17	4
4	Songambele	168	42	10
5	Uhuru	72	18	6
6	Usisya Kati	80	20	5
7	Usoke	52	13	3
8	Usongelani	116	29	7
9	Itegamatwi	80	20	5
10	Sipungu	76	19	5
11	Vumilia	108	27	7
12	Katunguru	124	31	7
13	Kalemela A	128	32	8
14	Jionee mwenyewe	220	55	14
Total		**1592**	**400**	**100**