ROUND POTATO PRODUCTION IN SOUTHERN HIGHLANDS OF TANZANIA: MARKET PREFERENCES, FARMERS' VARIETY SELECTION, AND PROFITABILITY

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A THESIS SUBMITTED IN FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

2013

ABSTRACT

This study investigated the market orientation of round potato farmers in the southern highlands of Tanzania. A market oriented farmer, assumed to be a maximiser of short run profit, is expected to select varieties with higher profit potential and in accordance with market preferences and would allot more acreage to a more profitable crop than those needed for home consumption. Thus, this study sought to achieve the following objectives: to determine the market preferences for round potato varieties; to determine factors guiding farmers' selections for varieties they produce; to analyse the profitability by varieties; and to analyse the market orientation of the round potato farmers. A sample of 510 farmers was obtained in Njombe, Mbeya Rural and Nkasi Districts. Preferences for round potato varieties was analysed by using a mini market survey of 155 respondents. The collected data was analysed by using both quantitative and qualitative approaches. Gross margin (GM) analysis, logistic regression and ANOVA models, and commercialisation index (CI) were adopted for data analysis. The overall results showed that red-skinned round potatoes were preferred to white/purple-skinned ones whereby consumers associated colour with dry matter content. Farmers' criteria for variety selection included seed tuber availability, market demand, price, and common practices. Econometric results indicated that gender ($p<0.01$), education level ($p<0.05$), prices of previous season ($p<0.01$), location ($p<0.01$) and extension services ($p<0.01$) influenced farmers' selection of varieties. Farmers who consulted the extension officers were 2.6 times more likely to choose varieties in accordance with the market preferences than others. The ANOVA model indicated that there was significant difference in profitability among varieties. *Kagiri* was the highest profitable variety with mean GM of TZS 794 889 per acre followed by *Tigoni* (TZS 618 167), *Kikondo* (TZS 484 900), and *Arka* (TZS 377

743). The proportion of land allotted for the crop ranged from 20% of total land under cultivation at Nkasi to 67% in Mbeya Rural. Furthermore, CI of 88% showed that round potato production was highly market oriented. Based on key findings, the study recommended that plant breeders should include consumer preferences as part of their breeding programme.

DECLARATION

I, **Hosea Mpogole**, do hereby declare to the Senate of Sokoine University of Agriculture that the thesis presented here is my own original work and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.

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ACKNOWLEDGMENTS

Glory is to God, the Almighty, for the gift of life and for the continued blessings. He has made me live, move and walk, see and hear, think with my mind and work with my hands.

I wish to express my sincere gratitude to all persons and institutions that assisted me in one way or another to successfully complete this work. It is indeed difficult to mention every person here but I humbly appreciate their every single contribution. However, I would like to take this opportunity to mention and appreciate a few key contributions.

First and foremost I thank my employer, Tumaini University, Iringa University College, for giving me the opportunity and the time for this study. Along the same lines, I would like to thank the Research on Poverty Alleviation (REPOA) and the Tanzania Higher Education Students' Loans Board (HESLB) for their financial assistance.

I express my very sincere and deep appreciation to my supervisors, Prof. M. E. Mlambiti of St. Augustine University of Tanzania and Dr. R. M. J. Kadigi of the Department of Agricultural Economics and Agribusiness of Sokoine University of Agriculture for their guidance, comments, constructive challenges and close supervision from the beginning to the completion of this study. Also, I thank Dr. Mishili, Prof. Hella, Dr. Philip, Dr. Kilima, Dr. Gabagambi and the entire staff of the Department of Agricultural Economics and Agribusiness of Sokoine University of Agriculture for the assistance and cooperation that I enjoyed throughout my study at the University.

Also, I would like to thank my key research assistants Mr. Fidelis Mawona and Mr. Geofrey Matata. Together with them, I thank Ofro Sanga, Huruma Kibaja, Rehema Milamo, Pendo Ngowi, Wendey Mbeyela, Upendo Ezekiel, Angelika Kalinga, Maulid

Lyoba, Mesaka Mwamfupe, and Simon Chiboko for their help in data collection. Moreover, I would like to thank all the relevant authorities and the village officers in the study areas for giving me the permission to interview their people. I thank the officers of Uyole Agricultural Research Centre and all the respondents for their positive cooperation.

I am also indebted to my wife, Neema, my daughter, Edith, and my son, Ammi, my mother, and the rest of the family and relatives for their love, encouragement and continued support throughout my studies. In a special way, I thank the family of my uncle and aunt, Mr. and Mrs. Musokwa for taking me to school and for their continued love and care for me and for my family.

Although there have been a number of contributions in the completion of this work, all the views expressed in this thesis are mine and I remain personally responsible for any errors, omissions, inadequacy in the views and results presented or any other shortfalls herein.

Thank you very much.

DEDICATION

This thesis is dedicated to the memory of my grandfather, the late Mzee Jacob Masasi, to the memory of my father, and to the memory of my son, Elias.

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LIST OF ABBREVIATIONS AND SYMBOLS

ALP	Agricultural and Livestock Policy
AMP	Agricultural Marketing Policy
ANOVA	Analysis of Variance
ASDP	Agricultural Sector Development Programme
ASDS	Agricultural Sector Development Strategy
BoT	Bank of Tanzania
CI	Commercialisation Index
CIP	International Potato Centre
DRC	Democratic Republic of Congo
ECA	Eastern and Central Africa
FAO	Food and Agriculture Organisation of the United Nations
FAOSTAT	Food and Agriculture Organisation Statistics Division
GDP	Gross Domestic Product
GM	Gross Margin
HBS	Household Budget Survey
LPM	Linear Probability Model
MNL	Multinomial Logit
MS Word	Microsoft Word
NBS	National Bureau of Statistics
NDV	National Development Vision 2025
NSGRP	National Strategy for Growth and Reduction of Poverty
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares

SACCOS	Savings and Credit Cooperative Societies
SHT	Southern Highlands of Tanzania
SNAL	Sokoine National Agricultural Library
SPSS	Statistical Package for Social Sciences
STATA	Statistical Analyses Package
TZS	Tanzanian Shilling
UARC	Uyole Agricultural Research Centre
URT	United Republic of Tanzania
VEOs	Village Executive Officers

CHAPTER ONE

1.0 INTRODUCTION

Agriculture is by far the largest sector and the backbone of the Tanzanian economy. It accounts for about 45% of the nation's GDP with a growth rate of 4.1% and about 60% of the country's foreign earnings (United Republic of Tanzania (URT), 2006; 2009a). Farming is practiced in rural areas where over 75% of the population lives giving agricultural employment to over 70% of the entire nation's population (URT, 2008a; 2009a). Smallholder farming dominates agricultural production, and a large proportion is for subsistence (URT, 2008a). These subsistence farmers usually farm on small and fragmented plots of about 0.9 to 3 hectares (Sokoni, 2008; Wolter, 2008a).

Over the past years, subsistence farming had neither improved the livelihoods of the rural population nor guaranteed food security. As a result, smallholder agricultural production has become a policy priority for the United Republic of Tanzania (URT, 1997; 2008a; 2008b). The government has focused on major staples namely, maize and rice, for which subsidised fertilisers are given but also there are sporadic restrictions on sales and export (Gabagambi, 2009). While such restrictions lower the potentiality of maize and rice as commercial engagement, opportunities do exist in other sub-staples, such as round potato (*Solanum tuberosum*). Round potato has a potential for food as well as for income in areas of favourable climatic conditions (Kelly, 2006). The crop grows fast, it is adaptable, high yielding and responsive to low inputs. It provides nutritious food per unit land in less time and often under adverse conditions than other food crops (FAO, 2006).

Round potato is more profitable than many other food crops as it matures earlier, has higher yield per unit of land, and provides a larger income (Blanken *et al*., 1994; Uyole Agricultural Research Centre (UARC), 1990; Goossens, 2002; International Potato Centre (CIP), 2008). The maturity period of round potato is about 3 months as compared to maize, which takes about 8 to10 months to be ready for harvest (UARC, 1990). Also, one acre of round potato produces up to 120 (100kg) bags versus about 20 bags of maize. According to CIP (2008), one hectare of round potato can yield two to four times the food value of grain crops and produces more food per unit of water than any other major crop and are up to seven times more efficient in using water than cereals. The prices of grain crops (such as maize) and round potato are comparable per 100kg bag, in some instances, maize sales higher than round potato while quite often round potato sales higher than maize (Bank of Tanzania (BoT), 2010). Furthermore, round potato produces remarkable quantities of calories comparable to cereals (Scott *et al*., 2000). This means that round potato can address both food security as well as cash needs of the rural farmers. Indeed, because of its potentiality, the crop is considered to be a hidden treasure for smallholder farmers (Blanken *et al*., 1994; FAO, 2006; CIP, 2008).

Studies on round potato have shown that production and consumption of the crop is increasingly becoming popular (Blanken *et al*., 1994; Anderson, 1996; Koizumi, 2007; Anderson, 2008; Kabungo, 2008). The increasing popularity of round potato is also evidenced by the rise of the urban street round potato chips vendors; local smallholder crisps processors; and large scale processors such as Crispo Company at Iringa in Tanzania (Anderson, 2008; Kabungo, 2008). The crop has great potential in both national and regional markets, due to growing demand for chips and snacks/crisps (Anderson, 2008). This growth in demand can be traced to many factors, including increasing economic activities, urbanisation, tourism, and changing lifestyles, all of which are

shifting consumer food preferences towards easy to cook and processed foods such as chips and crisps (Anderson, 2008; CIP, 2008; FAOSTAT, 2008).

Given the potentiality of round potato production and from the standard economic theory which treats an economic person as a maximising agent of short run profit it would be expected that farmers would commercialise the crop (Rudra, 1983; Sokoni, 2008; Wolter, 2008b). This could be achieved by allocating more acreage to it and by selling a bigger part of the produce (Chavas and Holt, 1990; Nyikai, 2003; Pingali *et al*., 2005; Sokoni, 2008; Wolter, 2008b). They would also be expected to select varieties in accordance with the market preferences so as to get higher profits (Rudra, 1983; Soleri and Cleveland, 2004; Nagarajan *et al*., 2005; Asrat *et al*., 2009).

1.1 Problem Statement and Justification

In the Southern Highlands of Tanzania (SHT) there are various round potato varieties including *Kikondo* (CIP 720050), *Arka*, *Kagiri*, *Kidinya*, *Tigoni*, *Baraka*, and *Sasamua* (UARC, 1990; Kyando, S. and Kitigwa, M., Personal Communication, 2009). Those varieties have different characteristics such as size, shape, colour, taste, dry-matter content, processing qualities, yield, storability, and resistance to diseases such as late blight and bacterial wilt (UARC, 1990). In terms of taste, dry matter content, and processing quality, some varieties are good for boiling, others for chips, and others for processing into snacks or crisps (UARC, 1990).

The variations in round potato varieties indicate that there could be different markets for respective varieties and hence different profitability. Nonetheless, previous studies in round potato production and marketing in Tanzania, such as Macha *et al*. (1982), Shao *et al*. (1988), Blanken *et al*. (1994), Anderson (1996), Koizumi, (2007), Mwakasendo *et al*.

(2007), Kabungo (2008), and Namwata *et al*. (2010) have treated round potato as one variety. Also, adoption studies often assumed that market preference was not important in the adoption of production technologies such as improved varieties (Mafuru *et al*., 2007). As such, the market preferences for certain varieties, farmers' criteria for selection of the round potato varieties they produce, and profitability by varieties have not been studied and analysed in a Tanzanian context. Moreover, the extent to which smallholder round potato production is oriented towards the market remained unknown.

The current study was undertaken to fill this knowledge gap. This was achieved by: analysing the market preferences for certain round potato varieties by using a small market survey; farmers' criteria for variety selections by using both descriptive statistics and logistic regression; profitability of round potato by varieties by using gross margin (GM) analysis and the ANOVA model from regression point of view; and the extent to which round potato production was oriented towards the market by using the proportion of land allotted to it and the commercialisation index (CI).

This study has both descriptive and normative aims. Firstly, it aimed at increasing knowledge on the microeconomic behaviour of smallholder farmers. The potential here is often overlooked, because subsistence farmers using small and fragmented plots generally risk not meeting even their own food requirements, let alone producing a surplus. Secondly, this study aimed at informing policymakers and stakeholders in agriculture who can develop policies and strategies to stimulate market based production. Indeed, agricultural policy has an impact on competitiveness and farm-level profits (Monke and Pearson, 1989). It was not the aim of this study to provide a normative formula to help subsistence farmers to become market oriented, but rather to develop a fuller understanding of their orientation. For instance, an understanding of the reasons why

farmers select the crops or crop varieties they cultivate will help the private and government institutions to identify the appropriate strategies and the support required to stimulate market based production (Lukanu *et al*., 2004). Market based smallholder production is essential in improving the income and livelihoods of these farmers and assuring their food security (Ahmed, 1994; Nyikai, 2003; OECD, 2008; Sokoni, 2008).

1.2 Objectives

1.2.1 Overall objective

The overall objective of this study was to investigate the market orientation of round potato farmers in SHT. A market or commercial oriented farmer was expected to select round potato variety(ies) with higher profit potential and in accordance with the market preferences (demand). This market based production of food crops is important for improvement of the income and livelihoods of the rural farmers and for assuring their food security.

1.2.2 Specific objectives

i. To determine the market preferences for round potato varieties;
ii. To determine factors guiding farmers' selection for the round potato varieties they produce;
iii. To analyse the profitability of round potato by varieties at farmers' level;
iv. To analyse the extent to which round potato production is market oriented.

1.3 Research Hypotheses

i. Wholesalers and retailers are not sensitive to round potato varieties;

ii. There is no significant relationship between the market based selection of varieties produced and factors such as age of the farmer, gender, education level, exposure to extension services, location, price of the previous season, and ownership of radio sets and mobile phones;

iii. There is no significant variation in profitability among round potato varieties;

iv. The commercialisation index for round potato is less than 50%.

1.4 Scope and Limitations of the Study

Economic analysis of smallholder agricultural production is a very broad subject. This is so because these farmers produce many crops and some keep livestock at the same time. In this case the choice of a particular crop to analyse the microeconomic behaviour of farmers is not easy. However, this study selected the round potato in order to assess the market orientation of the smallholder farmers in SHT. The major reason for this choice is that round potato is one of the most popular crops in SHT others being maize, rice, wheat, and beans. However, for the reasons discussed in the preceding sections, round potato has been shown to have higher potential than many other food crops.

Smallholder farmers are simultaneously engaged in both consumption and production. They are neither fully subsistence nor fully commercial. This is to say that they have one foot in the market and another foot in subsistence. However, it is still important to study their market orientation by referring to the proportion of farm output which is directly sold in the market rather than consumed by them, and whether or not their selection criteria of crops or crop varieties are guided by the market demand. Also, farmers may decide to produce certain crops primarily for home consumption and other specific crop(s) for the market. In this case, the market orientation of these farmers should be studied with respect

to the specific crop in question. This is the direction that this study took by studying the market orientation of farmers with respect to round potato production.

The sample which was used in this study may not be gender sensitive. This is because men are more likely to dominate when the crop is perceived to be a commercial engagement. Indeed, it has been well documented that the gender division of labour which allocates childcare, household activities, water and wood carrying to women constraint their capacity to participate in market based production irrespective of opportunities (Ellis, 1988; Kaaria *et al*., 2007; World Bank, 2009).

This was a cross-sectional study whereby data were collected from both round potato markets and farmers' surveys at one point in time. In this way the output was assumed to be a function of certain agricultural inputs such as labour, seeds, fertilisers, and herbicides. Thus, other natural phenomena such as rainfall, weather, and policy decisions were not considered. However, data for the farmers' survey were collected in two seasons in order to offset or reduce the effect of what might be a bad and a good year/season.

One of the analyses carried out in this study was the profitability analysis by using the gross margin (GM). However, GM analysis requires proper record keeping. In situations such as this where the farmers' survey was conducted in rural areas where record keeping remains to be a challenge may have an effect on statistics used in this study. Thus, this study cannot claim perfection based on the data used. Nonetheless, attempts such as using follow up and/or cross-checking questions were made to ensure for accuracy of the data collected. Also, some of farmers used own labour and stored seed tubers while other did not use inputs such as fertilisers and herbicides hence the GM analysis included only those

who had incurred the said costs. This means that the GM analysis as used in this study was computed for all costs that were paid in cash rather than in kind.

1.5 Organisation of the Thesis

The rest of the thesis is organised as follows. Chapter two presents the review of the literature. The literature starts with a discussion of the global round potato production and consumption to a Tanzanian context. The relative importance of round potatoes in relation to other crops, movement of round potato within Eastern and Central Africa, marketing channels, production and marketing constrains are discussed in detail. Also, a theoretical perspective, an empirical review, and the review of analytical techniques are discussed. Chapter three presents the materials and methods used in this study. Conceptual framework, study locations, sample and sampling procedure, pilot survey, data collection and analytical techniques and tools are presented. In chapter four the results and detailed discussion of the study are presented in relation to the objectives. Then, the descriptive statistics of the farmers' survey are presented and discussed followed by the descriptive results and discussion of the mini-market survey. Econometric analyses and the commercialisation index are also presented and discussed. Finally, the thesis ends with a summary, conclusion, policy implications/recommendations and a direction for further research.

CHAPTER TWO

2.0 LITERATURE REVIEW

In this chapter seven major things are discussed namely: round potato production and consumption both worldwide and Africa; overview of the agricultural sector in Tanzania; policy framework related to the agricultural sector in Tanzania; round potato production and marketing in Tanzania; theoretical perspectives; empirical review; and review of methods or techniques used in similar studies. Round potato production and consumption is widely discussed ranging from global round potato production, Africa and East Africa to a Tanzanian context. This helps to make comparison of the round potato subsector in Tanzania with the rest of the world. The history of round potato production in SHT is also provided together with the marketing channels, production and marketing constraints, and the relative importance of round potato in comparison to other food crops. Then a theoretical perspective is given where the theory of profit maximisation, bounded rationality and the new institutional economics are briefly discussed. Also, an empirical review is presented in which factors for farmers' crop or crop variety selections are widely discussed followed by the commercial/market orientation of the farmers. The chapter ends with a discussion on empirical methods used in similar studies and a direction of the analytical models used for this study.

2.1 Round Potato Production and Consumption

2.1.1 World's round potato production and consumption

Round potato originated in the Andean Highlands and was first domesticated near Lake Titicaca, in the Northeast of Peru, nearly 7 000 years ago (CIP, 2008). It has been documented that Spanish explorers brought the round potato plant from South America to

Spain in the mid-sixteenth century. Later, the plant was taken to Italy, and other European countries and the rest of the world. To date, round potato is the main root and tuber crop and the third most important food crop in the world after rice and wheat (CIP, 2008). It is grown in over 125 countries and over a billion people eat it (CIP, 2008). Annual production exceeds 320 million tonnes, where China, the world's biggest producer of round potato produces over 70 million tonnes a year (FAOSTAT, 2008). Both production and consumption of the crop has been increasing. For example, round potato production in the world is increasing at an annual rate of 4.5% and area planted at 2.4% (CIP, 2008; FAOSTAT, 2008). Also, consumption of round potato is increasing in developing countries from 9kg/capita in 1961-63 to 14kg/capita in 1997 (CIP, 2008). However, this consumption is still very low compared to Europe (86kg/capita) or North America (63kg/capita) suggesting that an ample room exists in business for continued consumption increases (CIP, 2008).

The production and consumption of the crop is increasing even in countries other than America and Europe, where until 1990s were biggest producers and consumers (FAOSTAT, 2008). After 1990s there has been a tremendous increase in round potato production and demand in Asia, Africa and Latin America, where total output rose from 30 million tonnes in the early 1960s to more than 165 million tonnes in 2007 (FAOSTAT, 2008). According to FAOSTAT (2008), for the first time, in 2005 round potato production in developing countries exceeded that of the developed world. As seen in Fig.1, round potato production is on the increase in developing countries while declining in the developed world. The declining round potato production in the developed world increases the opportunity for round potato export markets of the developing countries (Anderson, 2008; CIP, 2008).

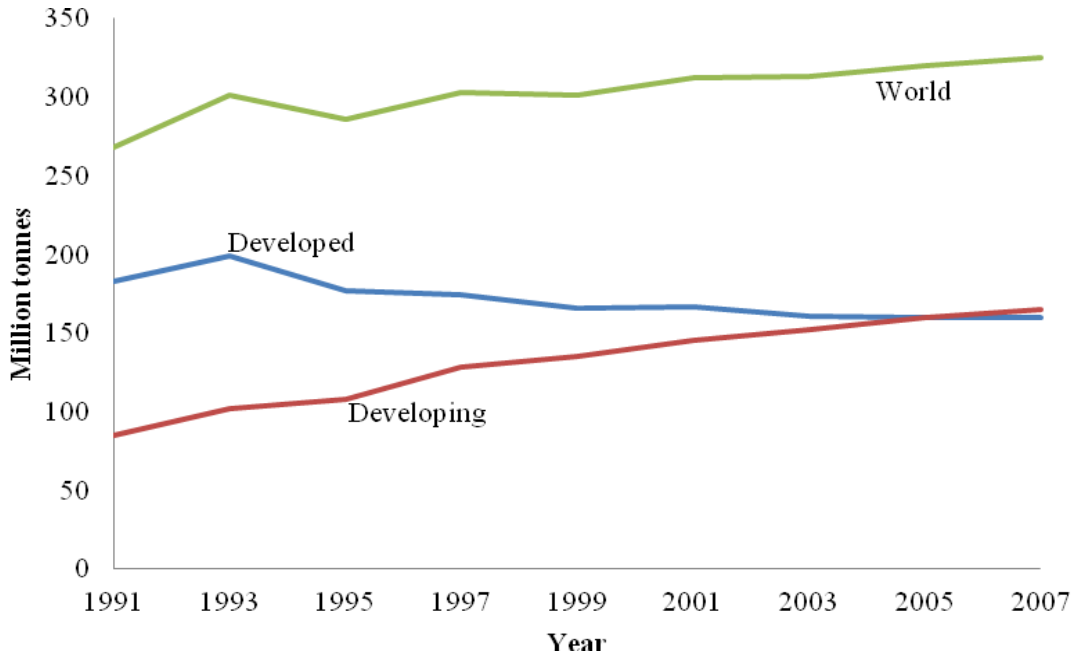

Figure 1: World round potato production, 1991-2007

Source: FAOSTAT (2008)

China is the leading round potato producer and almost a third of all world round potatoes is harvested in China and India (FAOSTAT, 2008). As shown in Table 1, in 2007, China produced a total of 72 040 000 tonnes of round potatoes from the 5 000 000 ha with an average yield of about 14.4 t/ha. This yield is, however, very low as compared to Netherlands (44.7 t/ha) or United States (44.6 t/ha) (FAOSTAT, 2008). This means that China still has a potential to more output by improving its productivity. If this happens, China will be able to produce up to more than three times of current output without expanding the production area. As seen in Table 1, none of the African countries features on the list of world top 10 round potato producers despite the conducive weather and the availability of arable land.

Table 1: Top 10 world round potato producers

Rank	Country	Quantity (tonnes)	Harvested area (ha)	Yield (t/ha)
1	China	72 040 000	5 000 000	14.4
2	Russian Fed.	36 784 200	2 851 660	12.9
3	India	26 280 000	1 600 000	16.4
4	United States	20 373 267	456 906	44.6
5	Ukraine	19 102 300	1 453 300	13.1
6	Poland	11 791 072	569 600	20.7
7	Germany	11 643 769	274 961	42.3
8	Belarus	8 743 976	412 553	21.2
9	Netherlands	7 200 000	161 000	44.7
10	France	6 271 000	145 000	43.2

Source: FAOSTAT (2008) and CIP (2008)

In terms of consumption, Europe and North America are leading in the per capita consumption (FAOSTAT, 2008). The round potato per capita consumption in Europe is 87.8 kg and in North America is 60.0 kg. Africa is the lowest with a 13.9 kg per capita as compared to the world average of 31.3 kg per capita. Table 2 shows the top 10 world round potato consumers by quantity and by per capita consumption.

Table 2: Top 10 world round potato consumers

By total quantity consumed			By per capita consumption		
Rank	**Country**	**Quantity (t)**	**Rank**	**Country**	**kg per capita**
1	China	47 594 193	1	Belarus	181
2	Russian Fed.	18 828 000	2	Kyrgyzstan	143
3	India	17 380 730	3	Ukraine	136
4	United States	17 105 000	4	Russian Fed.	131
5	Ukraine	6 380 850	5	Poland	131
6	United Kingdom	6 169 000	6	Rwanda	125
7	Germany	5 572 000	7	Lithuania	116
8	Poland	5 000 000	8	Latvia	114
9	Bangladesh	4 041 463	9	Kazakhstan	103
10	Iran	3 991 142	10	United Kingdom	102

Source: FAOSTAT (2008)

Almost half of the world's round potato supply is consumed in Asia (FAOSTAT, 2008). This is due to its huge population because its per capita consumption was only 24 kg in 2005 as compared to Europe (87.8 kg) or North America (60.0 kg). In Africa and Latin

America per capita consumption is lowest but increasing. Rwanda is the only African country that features on the list of world's top 10 countries in terms of per capita consumption of round potato. Rwanda ranks sixth in per capita round potato consumption (125 kg) after Belarus (181 kg), Kyrgyzstan (143 kg), Ukraine (136 kg), Russian Federation (131 kg), and Poland (131 kg) (FAOSTAT, 2008).

2.1.2 Round potato production in Africa and Eastern Africa

According to CIP (2008), round potato arrived in Africa around the turn of 20th century. In recent decades, production has been expanding from 2 million tonnes in 1960 to a record of 16.7 million tonnes in 2007. In Africa, round potato is grown under a wide range of conditions – from irrigated commercial farms in Egypt and South Africa to intensively cultivated tropical highland zones of Eastern and Central Africa (ECA), where it is mainly a smallholder farmer's crop (CIP, 2008).

As seen in Table 3, Egypt is the Africa's biggest producer of round potato with an annual output of about 2.6 million tonnes followed by Malawi, South Africa, Algeria, and Morocco. However, the table also shows that South Africa has the highest yield in Africa followed by Egypt and Morocco. In total, Africa produces 6% of the world's round potatoes. Egypt, Malawi, South Africa, Algeria and Morocco produce more than 80% of all round potatoes in the region (CIP, 2008).

Table 3: Africa's top 15 round potato producers

Rank	Country	Quantity (tonnes)	Harvested area (ha)	Yield (t/ha)
1	Egypt	2 600 000	105 000	24.8
2	Malawi	2 200 402	185 000	11.9
3	South Africa	1 972 391	58 000	34.0
4	Algeria	1 900 000	90 000	21.1
5	Morocco	1 450 000	60 000	24.2
6	Rwanda	1 200 000	133 000	9.0
7	Nigeria	843 000	270 000	3.1
8	Kenya	800 000	120 000	6.7
9	Uganda	650 000	93 000	7.0
10	Angola	615 000	120 000	5.1
11	Ethiopia	525 657	73 095	7.2
12	Tunisia	350 000	24 550	14.3
13	Sudan	263 900	15 708	16.8
14	Tanzania	240 000	37 000	6.5
15	Madagascar	225 000	38 000	5.9

Source: FAOSTAT (2008) and CIP (2008)

Using Table 3 to group the East African countries, then Tanzania is the 4th round potato producer after Rwanda, Kenya, and Uganda. Also, Table 3 shows that Tanzania is the least both in production and in yield per unit of land. Although the annual production of 240 000 tonnes shown in Table 3 for Tanzania contradicts with the value of over 500 000 tonnes as reported by URT (2006, 2007), in either case, the rank of Tanzania in East Africa cannot change. This is because Rwanda, Kenya and Uganda each produce over 600 000 tonnes of round potato annually. Given that Tanzania is the biggest country in East Africa in terms of land size and potential arable land, a lot has to be done to increase and/or improve production (Stein, 2010).

2.1.3 Potential of round potato relative to other food crops

Round potato is a very significant food crop as it is one of the three most important crops in the world (CIP, 2008; Scott *et al*., 2000). Round potato is relatively easier to farm, does not need heavy rainfall as are other food crops, has stable yield levels even under conditions which other crops may fail and produces remarkable quantities of energy (Scott

et al., 2000). The crop has large content of carbohydrates, some protein, minerals, vitamins, and water (UARC, 1990).

Table 4: The world: Agricultural commodity yields in metric tonnes per hectare, 2003

Commodity	ECA	Africa	Global
Maize	1.39	1.16	4.47
Rice	1.12	1.87	3.84
Wheat	1.38	2.03	2.66
Sorghum	0.67	0.88	1.30
Millet	0.47	0.70	0.82
Round potatoes	7.46	11.17	16.45
Sweet potatoes	4.29	4.32	13.49
Cassava	8.18	8.83	10.76
Beans	0.60	0.62	0.70
Groundnuts	0.62	0.86	1.35
Sugarcane	4.11	56.74	65.29
Bananas	4.69	6.59	15.25
Coffee	0.57	0.45	0.75
Tea	1.85	1.95	1.33
Barley	1.18	1.24	2.48
Oil seed	0.51	0.69	1.75

Source: FAOSTAT (2008)

Round potato is an early maturing crop as it takes up to three months to harvest compared to grain crops such as maize which takes up to 10 months (UARC, 1990; CIP, 2008). The crop is very responsive to low inputs such as fertilisers (CIP, 2008). Generally, the crop is very easy to farm and has a relatively high yield per hectare compared to other crops. Table 4 provides a list of selected crops indicating their yields in metric tonnes per hectare. It is easily seen round potato has one of the highest yield in Eastern and Central Africa (ECA), Africa, and globally.

Round potato production is growing at relatively higher rates compared to other crops (FAOSTAT, 2008). Recently, round potato production has surpassed that of sweet

potatoes. Fig.2 below shows the growth trends of various crops including round potato. It can easily be seen that currently round potato is the leading crop in terms of growth potential.

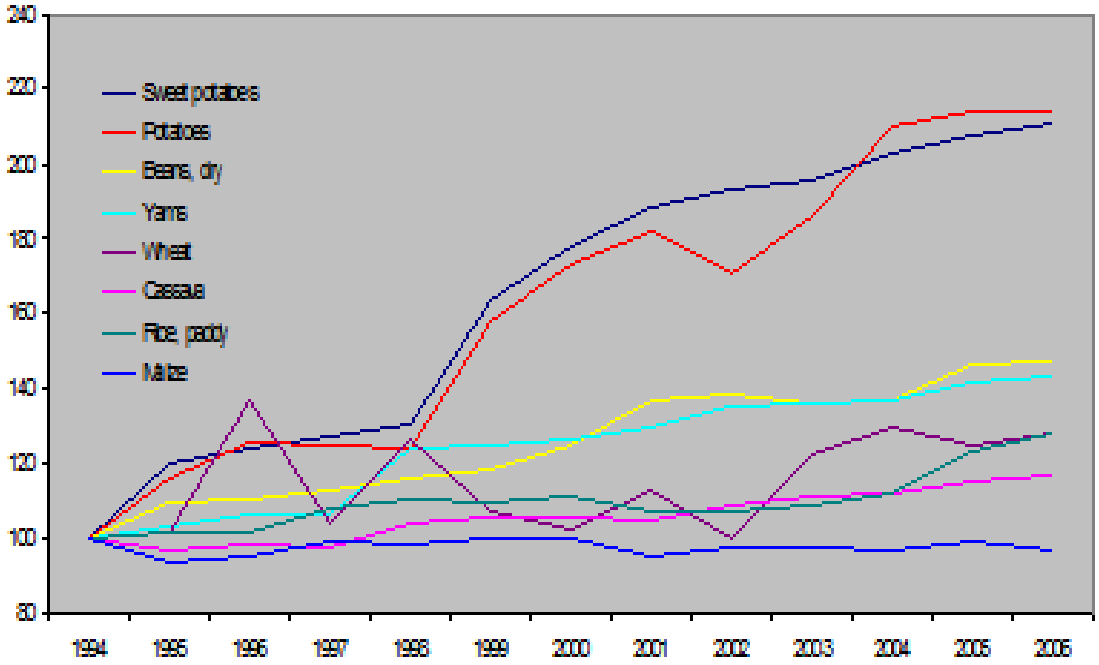

Figure 2: Trends in selected crops area in Sub-Saharan Africa

Source: FAOSTAT (2008)

In addition to round potato being an important food crop it is also an important income earner and a very profitable crop to produce. Previous studies such as Anderson (1996), Koizumi (2007), Anderson (2008), and Kabungo (2008) indicated that round potato production was profitable. Also, Blanken *et al*. (1994) and Goossens (2002) argue that generally round potato is more profitable than many other food crops.

2.1.4 Movement of round potatoes within Eastern and Central Africa

Knowledge of round potato movements within the ECA is important for planning purposes. It helps to know where round potato comes from and where it goes. This is especially important in identifying potential export markets. Although the exact quantities

within ECA have not been well documented, Goossens (2002) outlines some movements of the round potato with reference to Rwanda. Goossens (2002) reports the flow of round potato in opposite directions between Tanzania and Kenyan border. Tanzania imports round potato from Kenya while Kenya imports some from Tanzania at the same time. It is said that Kenya imports round potato from Arusha in Tanzania to supplement local production. However, traders from Mwanza in Tanzania buy round potato from Kenyan farmers in Meru district through a broker (Okoboi (2001) as cited by Goossens, 2002). Meru district is well known for high-quality red skinned round potato, commonly known as Kerr's Pink. Also, round potato from Kenya often finds its way to Northern Tanzania such as Arusha and Kilimanjaro (Anderson, 1996). According to Anderson, round potato in Northern Tanzania originated from Kenya. Traders from Mwanza do not buy round potato from Arusha or SHT such as Iringa and Mbeya because of transport costs and quality. According to Goossens (2002), quality is understood as the high dry-matter content of round potato because it directly affects storage period and quality of chips.

Kenya does not import round potato from Uganda (Goossens, 2002). Also, no round potato trade movement is reported between Tanzania and Uganda. However, there is some minor movement of round potato between Rwanda and Uganda especially during the months of September to November when there is a shortage of supply in Uganda (Goossens, 2002). Informal cross-border trade between Uganda and Rwanda exists during this period, but is mainly organised by Ugandan traders.

According to Goossens (2002), Rwanda exports considerable quantities of round potato to Burundi. Burundian traders buy ware-potatoes in Rwanda, as Burundian round potato is said to be of a very mediocre quality (Goossens, 2002). Burundi remains to be a major market for Rwandan round potato. Also, Rwanda imports some round potato from

Democratic Republic of Congo (DRC) through North Kivu. It has been reported that round potato producers in DRC are smallholder poor farmers, practicing shifting cultivation (Goossens, 2002). These farmers do not use fertilisers, pesticides or machinery, as farm-gate prices are very low. The main constraint is market access because of bad roads.

There is no evidence of movement of round potato from Tanzania to Rwanda or Burundi. However, Rwanda exports to Tanzania small quantities of round potato that is transported by truck-drivers plying the Kigali-Isaka route (Goossens, 2002). They often buy in the Nyabugogo market at Kigali. Goossens (2002) estimates that Rwandan total export to Tanzania are lower than 2 000 tonnes per year.

A bulk of Tanzanian round potato export is said to be taken to Zambia and Malawi (Kabungo, 2008). Most of the round potato export to Malawi and Zambia comes from Mbeya. Existence of imports from Malawi and Zambia to Tanzania has not been reported.

2.2 Overview of the Agricultural Sector in Tanzania

Despite the important contribution of agriculture to employment and the national economy the sector faces a number of challenges related to productivity (URT, 2009a). Generally, the productivity of smallholder farming is very low. For example, the average food crop productivity in Tanzania is 1.7 tonnes per hectare, whereas good management and optimal fertiliser use should result in yields of 3.5 to 4.0 tonnes per hectare (Wolter, 2008a). Only about 15% of all farmers are said to be using fertilisers (Wolter, 2008a). The use of traditional farming tools and the heavy reliance on traditional rain-fed cropping methods hamper productivity.

The country is still far from the agricultural production levels, which are possible with existing technologies and available resources (URT, 1997; 2008b; 2009a). This is mainly due to: weak market linkages due to poor infrastructure; shortage of inputs and credit facilities necessary to stimulate product diversification; lack of market knowledge and information necessary to facilitate market diversification; and limited access to extension services (URT, 2003a).

In terms of infrastructure, a good proportion of agricultural harvest is lost because farmers cannot get their produce to the market. Furthermore, because of lack of storage facilities they are unable to store their produce after harvest. The marketing systems, road infrastructure, and storage facilities do not guarantee producers of having reliable and timely buyers of their crops in addition to the problem of perishability and other risks associated with these arrangements (URT, 2008a). Such factors and associated risks reduce the motivation of farmers to produce for the market.

Regarding access to credit, farmers are not able to obtain the financial means needed to buy productivity enhancing inputs, such as seeds, fertilisers, chemicals and pesticides (Wolter, 2008b). Only about 3% of agricultural households have access to credit. Agricultural lending is viewed negatively by financial institutions and too few banks are located in rural areas (Wolter, 2008a).

Agribusiness is still in its infancy and commercial ventures are found mostly in traditional export crops such as coffee, tea, cotton, cashews, tobacco, and on smaller scale, cloves and sisal (Wolter, 2008a). As a result of declining world market prices for agricultural commodities, traditional agricultural exports accounted for only 20% of total merchandise exports in 2006 as compared to over 55% in 1995/96 (Wolter, 2008a; 2008b). The

declining contribution of the traditional export crops, calls for alternative commercial crops such as food crops whose prices have been increasing over the past decade because of increasing global food shortage (Sadik, 2001; FAO, 2009).

Indeed, Tanzania has the potential of becoming a major food producer, able to feed itself and the whole of East Africa (URT 1997; OECD, 2008; URT, 2009a). However, currently it still struggles to meet its own food requirements due to low productivity and the predominance of subsistence farming (Wolter, 2008a). In fact, Wolter (2008a) describes Tanzania as a 'Sleeping Giant.'

Food export is a promising option for Tanzania as it has abundant natural resources and shares borders with eight African countries that are Burundi, DRC, Kenya, Malawi, Mozambique, Rwanda, Uganda and Zambia. Although Tanzania's arable land is estimated to be 44 million hectares, but only about 10 million hectares (23%) are currently under production (URT, 2009a). The planted area has remained relatively the same for many years which implies that land expansion could also be a major source of agricultural growth (URT, 2009a).

The current situation shows that Tanzania is not taking advantage of its agribusiness opportunities and is far from being a major food exporter. As a result, agricultural imports have been increasing, with food imports, including wheat, rice, and dairy products, taking the largest share of about 80% of total merchandise imports (Wolter, 2008a). Therefore, the country needs to address this situation in order to improve the agricultural and agribusiness sector. Since majority of smallholder farmers is engaged in food crops, one of the challenges ahead is to move beyond subsistence farming by commercialising food production.

2.3 Policy Framework Related to Agricultural Sector

The government of Tanzania recognises the challenges and constraints facing the agricultural sector (URT, 2009a). As a result, a number of measures and strategies have been undertaken. These include the establishment of various policies such as the Food and Nutrition Policy for Tanzania of 1992, Agricultural and Livestock Policy (ALP) of 1997, Rural Development Policy, Agricultural Sector Development Strategy (ASDS) of 2001, Cooperative Development Policy of 2002, National Trade Policy of 2003, Agricultural Sector Development Programme (ASDP) of 2005, National Livestock Policy of 2006; and the Agricultural Marketing Policy (AMP) of 2008 to mention but a few. Also, the National Development Vision (NDV) 2025 and the National Strategy for Growth and Reduction of Poverty (NSGRP or commonly known as MKUKUTA) recognise that agriculture is the main source of livelihoods for the majority and that it determines the overall improvement in people's living standards as well as the development of the economy (URT, 2000; 2005). In this section, the Agricultural and Livestock Policy of 1997 and the Agricultural and Marketing Policy of 2008 are briefly discussed because they are directly related to the agricultural sector.

The focus of the Agricultural and Livestock Policy of 1997 was to commercialise agriculture so as to increase income levels and well being of the people whose principal occupation and way of life is based on agriculture (URT, 1997). In this policy, the government sought to assure for basic food security for the nation, and to improve national standards of nutrition by increasing output, quality and availability of food commodities. Also, to collect and disseminate market information in order to integrate the domestic markets and make foreign markets accessible, to improve the agricultural extension

services, and to facilitate the provision of a good infrastructure, especially transport and storage facilities.

Regarding the Agricultural Marketing Policy, the overall objective was to facilitate strategic marketing of agricultural products while ensuring fair returns to all stakeholders based on a competitive, efficient, and equitable marketing system (URT, 2008a). The policy was set to overcome the agricultural marketing challenges such as: inadequate value addition in agricultural produce; inadequate adherence to grades, standards, and quality in agricultural products marketing; weak legal, regulatory, and institutional framework on agricultural marketing; inadequate access to financial services for agricultural marketing activities; inadequate marketing linkages; and inadequate capacities to utilise opportunities emerging in the local, regional, and international markets including preferential markets.

While a number of policies are in place, there appears to be poor coordination and lack of implementation strategies (Gabagambi, 2009). It has been a general observation that policy response to agricultural problems has, in most cases, been a shortcut. For example, banning cross border trade of major staples so as to ensure for food security, and dictating time and the form in which the product should be marketed and waving import duty (Gabagambi, 2009). However, government interference is contrary to its own policy, which seeks to commercialise smallholder production by facilitating access to both internal and external markets (URT, 1997; 2008a).

2.4 Round Potato Production and Marketing in Tanzania

2.4.1 History of round potato production in Tanzania and in SHT

The history and production of round potato in Tanzania has been documented by Macha *et al*. (1982), Shao *et al*. (1988), UARC (1990), Anderson (1996), Mussei *et al*. (2000), Koizumi (2007), Mwakasendo *et al*. (2007), Kabungo (2008), and Namwata *et al*. (2010). Round potato was introduced in Tanzania by German missionaries around the 1920s (Macha *et al*., 1982; Anderson, 1996; Koizumi, 2007). The crop was brought to the Southern Highlands of Tanzania where local farmers began to plant it in small plots (Macha *et al*., 1982). Since then, the crop has been popular among smallholder producers in the highlands of Tanzania, especially over the past 20 years (Anderson, 1996; Koizumi, 2007).

The highlands' areas are most suitable for round potato production. The most suitable areas are between 1 700 and 2 800 metres above the sea level (UARC, 1990). Although highlands' areas are the most suitable for round potato, it can be grown even in areas below 1 700 metres (UARC, 1990). Also, the crop grows well in relatively cold areas with rainfall of not less than 600 millimetres per season. In Tanzania, the cold areas with relative high rainfall favourable for round potato production include areas in the Southern Highlands, such as Mbeya (Mporoto, Kikondo, Kawetere, Ileje, and Mbozi), Makete (Kitulo and Bulongwa), Njombe and Mufindi, as well as areas elsewhere in the country such as Mbinga (Ndengo and Miyao), Rukwa (Matai, Songambele, Msanga, Muungano, Molo, Kantawa, Nkundi, and Kipande), Tanga (Usambara), Kilimanjaro, Arusha, and Mara (UARC, 1990).

In SHT, round potato is considered by farmers to have as much potential as maize, rice, and wheat (URT, 2007). It is mainly grown by smallholder farmers for both income and food (UARC, 1990). The crop is preferred by smallholder farmers and poor families because of its short maturity period and because in some areas it can be grown throughout the year (CIP, 2008). The short maturing period of round potato makes it especially attractive in areas with high altitude, where maize, for example, takes 8 to 10 months to mature while round potato takes only about 3 months (UARC, 1990).

Despite its potential, data on output of round potato are not readily available. When available they are often unreliable and sometimes contradictory. For instance, according to FAOSTAT (2008), the annual production of round potato in Tanzania is 240 000 tonnes while other sources estimate at 500 000 tonnes (URT, 2006; URT, 2007). The information gaps surrounding round potato production figures are a consequence of priority being given to the collection and documentation of data on the most important cash crops like coffee, tea and cotton, which are traded in international markets (Kabungo, 2008). Given the absence of weighing scales at farmers' level and that some produce is consumed at home, the reported statistics could be lower than they actually are. In this case, it is convenient to use the statistics from URT (2007), which are relatively higher than those reported by FAOSTAT (2008). According to URT (2007), about 504 000 tonnes of round potatoes are produced in Tanzania annually. Most of this output is produced in Iringa, Mbeya and Kilimanjaro (Table 5). Iringa alone produces about 276 000 tonnes, which is about 60% of the national production (URT, 2007).

Table 5: Tanzania: Important regions producing round potato

Region	Area under potato in '000' ha	Production '000' tonnes	Yield in kg/ha
Iringa	65	276	4 246
Mbeya	50	160	3 166
Kilimanjaro	19	19	1 000

Source: URT (2006) and URT (2007)

Although there are annual variations in production and yield of round potatoes, in general, both production and yield are increasing (FAOSTAT, 2008). These production and yield levels are far below those of other East African countries, such as Rwanda, Kenya and Uganda which each produces over 650 000 tonnes per year (CIP, 2008; FAOSTAT, 2008). Given that Tanzania has ample land conducive for round potato production, improving productivity and yield levels is certainly possible. One way of improving the situation is to move from subsistence farming to commercial production (Sokoni, 2008; Wolter, 2008b).

2.4.2 Adoption of improved round potato varieties in SHT

Adoption of improved round potatoes has been studied and documented by Anderson (1996), Namwata *et al*. (2010), Koizumi (2007), and Mussei *et al*. (2000) among others. Both Anderson (1996) and Koizumi (2007) argue that the adoption of agro-technologies such as improved round potato varieties and farming practices cannot be explained outside the social context in which smallholder farmers operate. For instance, Anderson (1996; 86) argues "The selection of particular potato varieties and specific cultivation practices cannot be understood outside the social context in which these are adopted," while Koizumi (2007; 4) citing Ngware (1997) argues that simply referring to agriculture divorced from its social context is conceptually and technologically weak as a means of addressing problems. This means that natural and social environments, material and human resources, and informal and formal policies are intertwined in the agrarian issues (Koizumi, 2007).

According to Koizumi (2007), differences in farming practices have historically developed in ways that reflect the actions and choices of local people, influenced by local conditions with regard to regional politics, Christianisation, and post-colonial economic development. He argues that although many factors such as availability of land, soil fertility, and climate are critical issues regarding agro-technological adoption, the local history and the social interactions among and within ethnic groups may also be important in the choice of farming systems and labour styles, as well as the choice of crops.

Adoption of various round potato varieties in SHT is a result of social processes especially the movement of people in and outside of the area (Anderson, 1996). According to Anderson (1996), local people in the area migrated to the Northern parts such as Arusha and Kilimanjaro because of shortage of land in the Mporoto area in Mbeya Rural. On their return, they brought new round potato varieties to SHT. Anderson (1996) further argues that most of the present cultivars originated from Kenya, where there is long standing tradition of round potato production and research. The new cultivars released by Kenyan round potato research such as Tigoni (Kabira, 2002); soon find their way into Northern Tanzania through cross-border trade. Such varieties are later taken to SHT.

According to Anderson (1996), research and extension in SHT have not been successful in introducing new round potato varieties into sustainable production. This is so because the varieties used by local producers are as foreign to the area as those introduced by researchers. In the first place, all round potato varieties in SHT were once new as they were brought by foreigners. Hence, the discussion on adoption of new or improved varieties is a complex issue.

While Anderson (1996) and Koizumi (2007) argue that agro-technological adoption cannot be isolated from the social environment, Namwata *et al*. (2010) develop a linear regression model to determine factors that influence adoption of improved agro-technology for round potatoes. They found that higher household income, being a male or married by a household head, farming experience, access to credit and extension services were positively and significantly associated with adoption of improved agro-technologies for round potatoes. They argue that the positive association between marriage and adoption of improved agro-technologies for round potatoes could be attributed to the desire to meet increased household needs as a result of marriage by increasing production. Other factors such as education, age, household size, farm size, membership to organisation, perceived market for round potato, and distance to market centre were not significant. But the linear regression analysis carried out by Namwata *et al*. (2010) is questionable. In their model they had 13 independent variables with the total sample size of only 60 farmers, which makes a sample size to have variable ratio of about 4:1. The recommended ratio for meaningful and rigorous regression analysis is at least 15:1 (Hair *et al*., 2006).

Generally, Namwata *et al*. (2010) found that out of 60 round potato farmers in Mbeya Rural district about 58% used improved varieties. Earlier, Kabungo (2008) found that about 21% of 90 round potato farmers in Mbeya Rural district were growing/producing improved varieties. Hence, this shows an increase in the use of improved round potato varieties in SHT. However, both studies (i.e. Namwata *et al*. (2010) and Kabungo (2008)) did not define which varieties were considered as improved and which ones were considered as local. Lack of definition of what constitutes an improved and a local variety reduces the credibility of the available data on adoption of improved round potato

varieties, because, as Anderson (1996) argues, all varieties were once new. But how new is new, should be defined in the context of adoption studies.

2.5 Round Potato Marketing Channels in Tanzania

2.5.1 Overview of marketing channels

A marketing channel or distribution channel is a set of interdependent organisations that help make a product or service available for use or consumption by the consumer (Kotler and Armstrong, 2010; Kotler *et al*., 2009). Also, Clow and Baack (2010) define a marketing channel as the path that goods and services take from the producer to the end user. The channel follows a vertical structure where products flow from producer to the ultimate consumer. Producers, wholesalers, and retailers as well as other channel actors exist in channel arrangements to perform marketing functions that contribute to the product flow (Kotler and Armstrong, 2010). Actors that stand between producers and final users are known as intermediaries (Kotler and Armstrong, 2010; Clow and Baack, 2010). According to Kotler and Armstrong (2010), producers use intermediaries because they create greater efficiency in making goods available to target markets.

The objective of the marketing channels analysis is to provide a systematic knowledge of the flow of goods and services from their original producer to their final destination or consumers. This knowledge is acquired by studying the participants in the process i.e. those who perform physical marketing functions in order to obtain economic benefits. In carrying out these functions, marketing agents achieve both personal and social goals. They earn a personal financial reward by performing an activity desired by the society. Also, they add value to production and in doing so, they satisfy consumers needs (Kotler and Armstrong, 2010).

In making products and services available to consumers, channel members or participants add value by bridging the time, place, and possession gaps that separate goods and services from those who use them. According to Kotler and Armstrong (2010), participants of the marketing channel perform many key functions such as:

- *Information*: gathering and distributing marketing research and intelligence information about actors and forces in the marketing environment needed for planning and facilitating exchange;
- *Promotion*: developing and spreading persuasive communication about the offer;
- *Contact*: finding and communicating with prospective buyers;
- *Matching*: shaping and fitting the offer to the buyer's needs, including activities such as grading, assembling, and packaging; and
- *Negotiation*: reaching an agreement on price and other terms of the offer so that ownership or possession can be transferred.

Basically, when some of those functions are shifted from producers to intermediaries, the producer's costs and prices may be lower, but the intermediaries must charge more to cover the costs of their work (Kotler and Armstrong, 2010).

2.5.2 Round potato marketing channels in SHT

The marketing channels of round potato in Tanzania have been documented by Nyange (1993) and Kabungo (2008). According to Nyange (1993), the round potato marketing channel consists of producers, truckers, wholesalers, retailers, hawkers, and consumers. However, Kabungo (2008) identifies six key major components in the round potato chain;

farmers/producers, village traders, urban brokers, wholesalers, urban retailers, and consumers and processors.

It is reported that about 82% of round potato farmers in SHT sell the produce to traders direct from the field (Kabungo, 2008). Very few transport their crop to different places such as Tunduma in the Tanzania-Zambia border town, Dar es Salaam, and home/ware house stores. However, most flows of food crops including round potatoes within Tanzania are toward Dar es Salaam because of growth in population relative to the rest of the country (Gabagambi, 2003). Major customers are wholesalers, truckers, individual consumers and retailers. This means that many farmers sell the crop to traders who then transport to different places within and outside the country like Dar es Salaam and other urban centres in Tanzania, Malawi, Zambia, and DRC.

The movement of round potato along the marketing channels is shown in Fig.3. Farmers are the first link in the round potato market chain. They are both producers as well as consumers. According to Kabungo (2008), round potato farmers usually harvest their produce only when a buyer is available and has sent packaging bags. Usually village brokers or traders approach farmers, in some cases the vice versa is true after which a price deal is set. Often, the produce is sold at farm-gate and on a cash basis. Very few, supposedly wealthy farmers, directly transport and wholesale their produce to urban markets. Also, some farmers sell their produce by roadside or to the weekly village markets or to the village retailers.

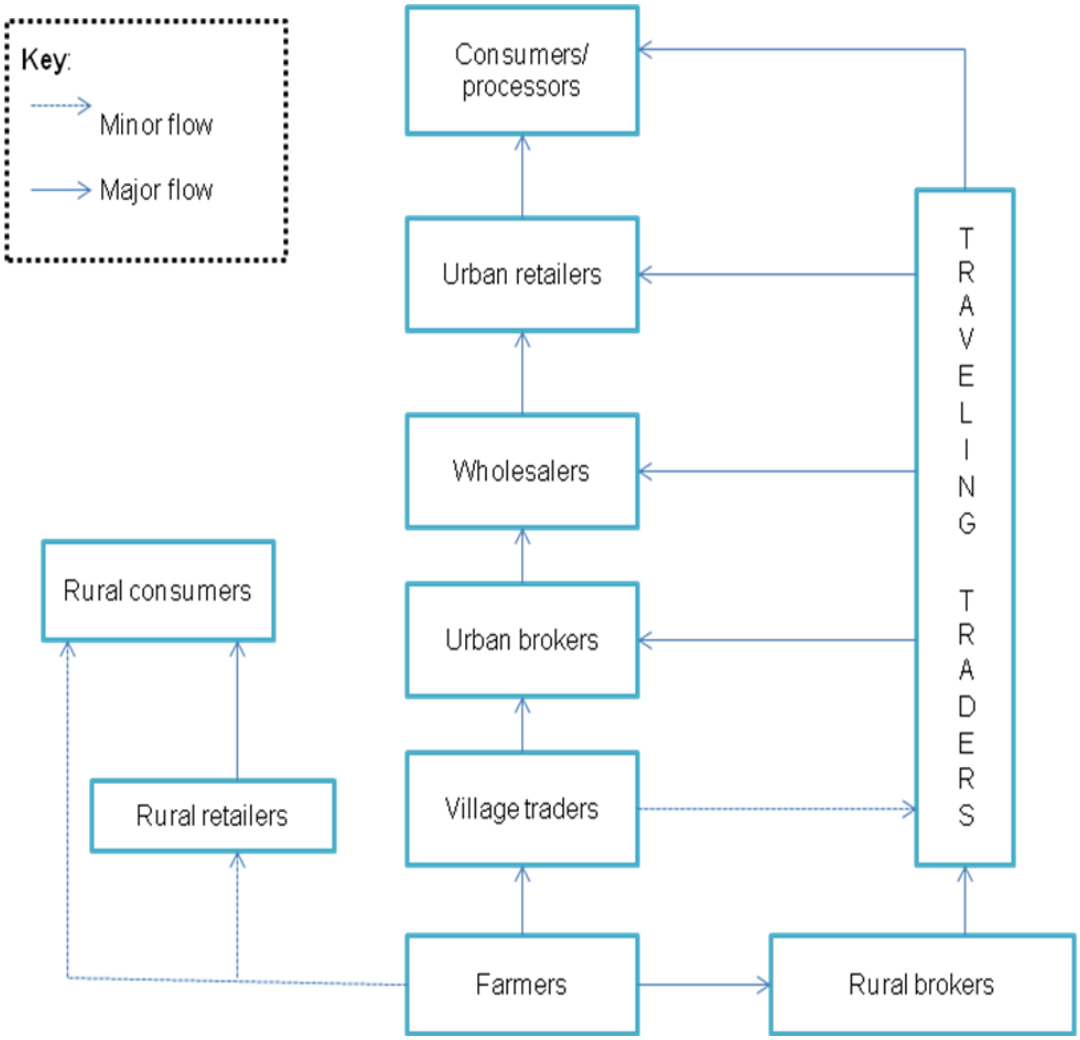

Figure 3: SHT: Round potato marketing channels

Source: Kabungo (2008; 46)

Village traders (also called assemblers or collectors) come from the production areas and know the farmers in their areas. Usually they know farmers who have grown round potato and when they are likely to harvest. These village traders are in contact with transporters, wholesalers and retailers through their mobile phones (Kabungo, 2008). After identifying farmers willing to sell at an agreed upon price, they make contact with the transporters (travelling traders) or wholesalers on the amount that would be available and the price. According to Kabungo (2008), usually a mark-up is put to the price they mention to transporters or wholesalers or urban traders/brokers. Travelling traders are traders with

trucks who buy the round potato from farmers or village traders and then transport and sell them to wholesalers and urban retailers. In Dar es Salaam, travelling traders can sell their truckload of round potatoes to one market agent. The process goes on as in Fig. 3, until the product reaches the final consumers.

In rural areas including the farming communities, round potatoes are consumed as staple food, mainly in boiled or mashed form by all age groups. Sometimes they mix with beans, beef, or other vegetable stew (Kabungo, 2008; Mwakasendo *et al*., 2007). However, in urban areas round potato consumers take in form of chips, crisps, and occasionally in a boiled or mashed form. According to Mwakasendo *et al*. (2007), many customers in hotels, bars and restaurants, students of higher learning institutions, and young people of working class prefer chips to boiled, mashed or grilled round potatoes.

2.6 Round Potato Production and Marketing Constraints in SHT

2.6.1 General production and marketing constraints

The smallholder agriculture in Tanzania as in many developing countries is confronted by a number of challenges. Smallholder farmers are constrained by poor access to markets and limited entrepreneurial skills for value addition and upgrading in terms of quantity and quality (Wolter, 2008a). Although there exist many opportunities for commercial agriculture in rural areas in terms of increasing domestic and regional markets and increasing prices because of the global food shortages, there are yet lots of barriers to allow a significant change to take place in the foreseeable future (Olomi, 2007). Some of the general barriers to improving smallholder production have been summarised by Arzeni *et al*. (2001), Wolter (2008a; 2008b), and Sokoni (2008). These include traditional farming in small and fragmented plots, low productivity as a result of obsolete and under-

mechanised farm technology, lack of the ability of farmers to connect to industrial transformation and market chain, ageing population in which energetic labour force is migrating to urban areas, lack of credit, and poor physical infrastructure which prevents easier access to markets and connection with urban centres.

The specific constraints facing the round potato sub-sector in SHT can be categorised into production and marketing constraints as follows:

2.6.2 Round potato production constraints

The production constraints include low yields, diseases such as late blight and bacterial wilt, poor access to inputs such as fertilisers and agro-chemicals, extension services, shortage of clean seed tubers, dependence on rainfall, and absence of economies of scale to mention but a few (Anderson, 1996; Kabungo, 2008; Wolter, 2008a).

Low yields are generally explained in terms of various diseases, poor quality of seed tubers used by farmers, and lower use of fertilisers and agro-chemicals. The most common diseases are late blight and bacterial wilt (UARC, 1990; Anderson *et al*., 2004). Round potato late blight, caused by *oomycete Phytophthora infestans*, is the most important biotic constraint to round potato production worldwide (Anderson *et al*., 2004). Clean seed production and certification does not exist. Farmers are said to be recycling their own tubers, some of which have already been infected by bacterial, fungal and viral diseases. This lowers yields and makes the round potato production to be a risky investment.

Round potato farmers are also constrained by shortage of inputs such as fertilisers and agro-chemicals. Fertilisers are not readily available and when they do they are generally

very expensive. The government on the other side focuses on major staples such as maize and rice, where most of the subsidies are directed. As a result farmers use fertilisers meant for maize production to other crops of their interest such as tomatoes and round potatoes (Gabagambi, 2009).

Dependence on rainfall is another constraint facing round potato farmers except in places where wetlands exist or there is a year round rainfall. However, wetland farming has been prohibited by government although some farmers continue to farm (Kyando, 2007). Farmers farm in small and fragmented plots and fail to apply economies of scale (Sokoni, 2008; Wolter, 2008a; 2008b). The absence of economies of scale also limits the development of large scale agro-processing because of lack of adequate and reliable supply. According to Wolter (2008a), scale enhancement may be pursued by organising farmers into large groups such as associations or cooperatives, which are currently missing.

Access to extension services is another constraint for round potato production. In some cases one extension officer serves a number of villages and sometimes the whole ward. For example, in a survey by Kabungo (2008) out of 90 round potato farmers, only about 51% had access to extension services in Mbeya Rural district. Also, another study by Namwata *et al*. (2010) among 60 round potato farmers, about 58% had access to extension services in Mbeya Rural district. However, access to extension services means availability of an extension officer from within the village or somewhere nearby. The actual contact between farmers and extension officers is another thing. This study focused attention to the actual contact between extension officers and farmers rather than the availability of the officers. Consultation with extension officers is said to have a positive effect on farming

practices, adoption of improved crop varieties, and use of agricultural inputs such as fertilisers and agro-chemicals (Namwata *et al*., 2010).

2.6.3 Round potato marketing constraints

There are a number of constraints surrounding the round potato marketing such as pre-mature harvest, low and unreliable supply, lack of grading or sorting, lack of weighing machines, low farm gate prices, dominance of middlemen, and poor infrastructure (Kabungo, 2008). Premature harvesting causes round potato skin to peel and consequently eliminating the possibility of storage (Goossens, 2002). Farmers harvest round potato tubers prematurely because of family need of cash and food. Generally, premature or inappropriate harvesting such as lack of dehalming (i.e. removing stems and leaves two weeks before harvest to increase dry-matter content) lead to weak, damaged skin and high water content (UARC, 1990; Goossens, 2002).

Some farmers harvest and/or sell surpluses when they are in need of cash, which results into low and unreliable supply, hence small transactions. Low and irregular supply is a result of dependence on rainfall, dominance of round potato diseases, and low use of fertilisers and agro-chemicals. However, traders, wholesalers, and processors require a regular, reliable supply of high quality and sometimes uniformly-sized round potato. But quality in terms of standardized and uniform sizes requires sorting and packaging, which is currently missing (Kabungo, 2008). The most common unit of packaging and marketing round potatoes is the sisal fibre-made bag (also known as jute) of about 100 kg.

Although the standard weight per bag of round potatoes is 100 kg, weighing at the farm-gate is virtually non-existence. Traders demand an “extended bag” commonly known as

lumbesa (with a kind of net extension woven onto each bag), which weigh up to 150 kg (Kabungo, 2008). The extended bag is sold at prices similar to the ordinary bag and no reference to weight is made. This denies farmers of their rightful share of the revenue.

Low farm-gate prices and the dominance of middlemen are intertwined. Round potato marketing system is dominated by a large number of intermediaries (Kabungo, 2008). Since farmers produce low quantities and are scattered they lack the bargaining power. Also, intermediaries leave a certain margin to cover for transactions cost. According to Kabungo (2008), farm-gate prices are likely to be less than half the ultimate retail price. For instance, Kabungo (2008) finds that the average selling price at farm-gate was about TZS 15 800 per bag while the price of the same bag goes up to about TZS 48 600 at wholesale and retail levels.

The constraint related to poor infrastructure cannot be overemphasized. Access to especially road infrastructure increases farmers' access to both input and output markets (Gabagambi, 2003). Access to output markets reduces both the transaction costs as well as the market and marketing information gaps (Pingali *et al*., 2005).

Despite the presence of the many constraints in the round potato production and marketing, the crop is still profitable (Blanken *et al*., 1994: Kabungo 2008; Goossens, 2002). Goossens (2002) argues that round potato is more profitable than most of other food crops. However, to what extent are farmers using the current opportunities to maximise such profits remains unknown. In the following section, the theories of profit maximisation, bounded rationality, and the new institutional economics are discussed.

2.7 Theoretical Perspective of Smallholder Farmers' Production

A theory can be defined as a set of interrelated constructs or variables, definitions, and propositions that present a systematic view of phenomena by specifying relationships among variables, with a purpose of explaining natural phenomena (Kerlinger, 1979 as cited by Creswell, 2003; 120). Among others, discussion of economic theory is useful in following ways: keeping track of benefits and costs; generating useful insights; telling what parameters are important and how they can be measured; providing a method for solving problems; and allows for quantification and calculation of economic problems (Varian, 1989). For instance, theoretical economics gives a framework to calculate and quantify economic relations. According to Varian (1989), this is the major difference between economics and other social sciences. Varian argues that there is little computation in sociology, political science, history or anthropology but economics is filled with computation. While Varian (1989) emphasises the role of economic theory in formulating mathematical models and computing economic relations, Gneezy and Rey-Biel (2010) argue that an economic theory needs not be expressed in mathematical models. They give examples that even the founding fathers of economics as an academic profession such as Adam Smith, David Ricardo, and Francois Quesnay used verbal arguments rather than mathematical models.

In research, economic theory helps to identify and measure parameters or factors that affect a certain problem of interest. A mathematical model can then be developed and measured. Economic theory, whether in verbal description or in mathematical model is a useful tool in explaining what might be the possible causes of a certain economic problem (Varian, 1989). It is therefore, a common practice to review theory(ies) guiding a quantitative study (Creswell, 2003; Kumar, 2011).

Common theories of smallholder production generally fall under profit and utility maximisation (Ellis, 1988). According to Ellis (1988), these theories are not mutually exclusive. They have much in common in the starting point, approach, logical method, and sharing of certain key assumptions meaning that they are variations on a single theme. For instance, where income is the only variable in the utility function, then profit maximisation and utility maximisation coincide. In this study, as it will further be shown, it was assumed that profit maximisation and utility maximisation for a smallholder farmer mean the same thing.

In this section, the theory of profit maximisation is discussed. Also, the bounded rationality, which is basically a relaxation of profit maximisation when there is limited information, is discussed. However, lack of, for example, market information to farmers make them vulnerable and therefore lose their bargaining power against the middlemen and traders (Poole and de Frece, 2010). In this case, the New Institutional Economics advocates for formation of farmers' associations and institutions in order to have a collective bargaining power. Thus, this section ends with the discussion of the theory of New Institutional Economics.

2.7.1 Theory of profit maximisation

Economic theory considers a firm as a transformation unit which converts input into output (Parkin, 1998). In the process of such conversion, the firm tries to create a surplus value, called a profit. According to Parkin (1998), the major objective of the firm is profit maximisation. He argues that while individual firms and entrepreneurs that run them can have many different objectives such as quality product, growth, market share, and employee job satisfaction, all such objectives are only a means to a fundamental and perhaps a deeper objective of profit maximisation.

Profit maximisation is considered as a rational behaviour of equilibrium assumption where marginal revenue is equated to marginal cost (Parkin, 1998; Baumol and Blinder, 1991; Anderson and Ross, 2005). A firm which aims to maximise profit will go on increasing its output till it reaches a maximum profit. Profit is the difference between total revenue and total cost (Parkin, 1998; Baumol and Blinder, 1991; Penson *et al*., 2006). The bigger the difference between total revenue and total cost the bigger the profit. Therefore, profit is maximised when there is maximum difference between total revenue and total cost (Penson *et al*., 2006).

This strong assumption that makes up the theory of the firm that business firms automatically maximise (economic) profit (and minimise costs) has been widely discussed, tested, and in many incidences criticised (Baumol and Blinder, 1991; Anderson and Ross, 2005; Koplin, 1963; Sevilla-Siero, 1991; Mohayidin, 1982). For instance, Baumol and Blinder (1991) argue that it is a strong assumption but literally not correct about the behaviour of business firms that firms strive for the largest possible profit. They criticise the objective of the firm because for them, a business firm has many objectives. They argue "Any attempt to summarise the objectives of the firm in terms of a single number (profit) is bound to be an oversimplification" (Baumol and Blinder, 1991; 517). According to them, decision making in industry is often of the satisficing nature rather than optimising. While they acknowledge that the assumption of profit maximisation gives us sharper insights, they argue that we usually pay with some loss of realism.

Another immediate criticism is the fact that profit maximisation is possible for an ideal market, where the decision-maker has full or perfection information. According to Anderson and Ross (2005), this means that all market participants have full and relevant information, that they are always aware of their particular demand curves, that they are

fully aware of all their costs at all times so that they would consistently set output where marginal revenue equals to marginal cost. However, it is known from experience that none of those provisions are true and an ideal market does not actually exist. In the same lines, Baumol and Blinder (1991) argue that while it would seem that firms choose the price and the quantity to be sold, in fact, they choose only one. Once they have selected the price, the quantity they will sell is up to the consumers. This is to say that if firms cannot predict with certainty the quantity they will sell then they cannot consistently maximise profit. Thus, Anderson and Ross (2005) argue that time factor, uncertainties, and other factors pertinent to the decision-maker should be considered.

The time factor is the focus of Rothbard's model. While in the neoclassical economics, costs, production, and sales occur at the same time Rothbard (1993) as cited by Anderson and Ross (2005; 36) argues that production costs occur before sales. That is production costs must be incurred before consumers can demonstrate their preference for the product. Therefore, the producer is governed by his perception of future conditions when he anticipates the goods to be sold. In his view firms predict prices at which they can sell the final goods and prices that they will pay for the factors of production. In the short-run, the producer predicts what will occur in the long-run in order to determine whether the firm's operation will be profitable. In the immediate-run the producer can only anticipate what marginal cost and marginal revenue might be. However, in the long-run the standard should be maximisation of sales or revenue, given that costs have already been paid. Maximisation of revenue or sales is consistent with the sales maximisation model as propounded by W. J. Baumol (Baumol and Blinder, 1991). According to Baumol and Blinder (1991), W. J. Baumol developed a sales maximisation model as an alternative for the profit maximisation. He argued that managers are more interested in maximising sales or revenue rather than short-run profit.

The other controversy surrounding the profit maximisation theory regards the agency or agents of profit maximisation, the question being; who really maximises profit? The theory of the firm assumes that only business firms whose management is separate from the owner can maximise profit while an individual business owner or the owner-manager maximises utility (Koplin, 1963). However, it has been argued that profit maximisation and utility maximisation for a proprietor mean the same thing (Koplin, 1963; Ellis, 1988). Usually from the individual proprietor, profit maximisation accompanies utility maximisation whereas utility maximisation by corporate managers does not imply profit maximisation by the firm. Koplin (1963) argues that while profit maximisation of a proprietorship can fail because of ignorance or irrationality of the owner, profit maximisation of a corporation can fail because of a conflict of interest between managers and owners.

In this study it was assumed that utility maximisation for a proprietor who is, in fact, a smallholder farmer means profit maximisation for him. According to Ellis (1988), the theory of profit maximisation treats the smallholder farmer as a farm firm, operating in fully formed and competitive input and output markets. Utility is solely a function of income, and utility maximisation coincides with profit maximisation. Profit maximisation predicts a positive response by the farmer to market price changes, i.e. an increase in the real price of output results in higher input use, higher output, and higher net income. Ellis (1988) further argues that the profit maximising hypothesis does not require the existence of profit in the form of a sum of money. What it requires is for there to be adjustment of inputs or outputs which would give the farmer a higher net income whether measured in money or physical terms.

The assumption that utility maximisation and profit maximisation mean the same thing for a smallholder farmer is, in fact, not new. Nyikai (2003; 592) while citing Ellis (1993) argues that recent theories in peasant economics depict the farmer as being both a profit maximiser as well as a utility maximiser. According to Nyikai (2003), the famer is assumed to be a profit maximiser but subject to minimum subsistence production. In this regard, given a set of available crops and/or crop varieties, a farmer is expected to grow crops or crop varieties that subject to probabilities, promise to yield the maximum profit. Such a farmer is also expected to allocate more acreage to more profitable crops or crop varieties (Rudra, 1983). The profit maximisation assumption of farmers is also consistent with the current government effort of commercialising smallholder production (URT, 1997; 2008a).

2.7.2 Bounded rationality

Profit maximisation is usually a central or a primary objective when perfect information is available. But in the absence of perfect information alternative theories such as bounded rationality are required (Tauer, 1995). Bounded rationality means that decision makers are rational but since they lack perfect information they use decision criteria other than profit maximisation (Tauer, 1995; Zietz and Seals, 2006; Radner, 1996; Tiwana *et al*., 2007; Aumann, 1997).

Bounded rationality is the rationality that is exhibited by decision makers of limited abilities or information (Doyle, 1998). It refers to the limits experienced by decision makers in their ability to process and interpret a large volume of pertinent information in the decision-making activities (Simon, 1979) as cited by Tiwana *et al*. (2007; 160)). Bounded rationality was propounded by Herbert Simon in 1955 (Aumann, 1997; Doyle,

1998). It began by relaxing the optimality requirements of profit maximisation (Doyle, 1998).

Simon (1955) as cited by Doyle (1998; 2) formulated the theory of 'satisficing' in which decision makers seek only to find alternatives that are satisfactory in the sense of meeting some threshold or 'aspiration level' of utility. Simon described decision-making as a search process guided by aspiration levels. An aspiration level is a value of a goal variable (e.g. profit or market share) which must be reached or surpassed by a satisfactory decision alternative (Selten, 1999). Usually decision alternatives are not given but found one after the other in the search process. The search process goes on until a satisfactory alternative is found which reaches or surpasses the aspiration level. This process refers to 'satisficing' because managers are looking for the satisfactory rather than the optimal alternative. According to Selten (1999), aspiration levels are not fixed at all times but are dynamically adjusted to the situation. They are usually raised when it is easy to find satisfactory alternatives and lowered when it is hard to find one.

Like the previously discussed controversy on whether or not farmers can maximise profit, the economic rationality of peasant farmers has long been questioned (Gyimah-Brempong, 1993). Are peasant farmers rational decision makers? Is their behaviour consistent with profit maximisation? According to Gyimah-Brempong (1993), if farmers were rational, then the quantities of the crops they offer for sale would be positively related to the producer prices of those crops and inversely related to the opportunity cost of producing the crops, *ceteris paribus*. Also, if non-price factors such as availability of inputs and credit that affect profitability of producing a particular crop changes, rational farmers would change the composition of their output. According to Simon (1978) as cited by Gyimah-Brempong (1993; 188), rational farmers are expected to behave in a consistent

way in order to achieve an objective. However, Beckford (2002) argues that while smallholder farmers' decisions may at some instances seem backward they have a rational basis. It is said that some times smallholder farmers consider other factors that are more important than the market. This means that the rationality of smallholder farmers cannot be solely explained with respect to the market.

2.7.3 The New Institutional Economics

Literature on smallholder farmer associations generally falls under the New Institutional Economics of transaction costs (Hu *et al*., 2005; Poole and de Frece, 2010). Smallholder farmers' associations refer to diverse types of groups who act collectively in order to benefit either as individuals or as a group (Poole and de Frece, 2010). This kind of association may be formal shared ownership or an informal set of social and business connections among farmers and between farmers and traders. Although there are debates about the effectiveness of farmer associations, North (1990) as cited by Poole and de Frece (2010; 19) argues that the historic development has proceeded most effectively where economic activity has been supported by an institutional framework of incentives. According to the New Institutional Economists, it is the lack of institutional development that has characterised the low level of economic development in poor countries.

Markets in developing countries are often characterised by weak institutional environment which means high transaction costs, significant business risks, weak information flow, and poor infrastructure (Valentinov and Baum, 2008). In this case, third sector organisations such as cooperatives and associations are important in addressing market failures in rural areas. Among other organisational forms, cooperatives have always been a prominent organisation (Hu *et al*., 2005). Such cooperatives are important to agriculture in both developed and developing countries. For instance, according Hu *et al*. (2005): in the

European Union there were 132 000 cooperatives with 83.5 million members and 2.3 million employees in 2001; in the US there were 47 000 cooperatives with 100 million members in 2001; and in China there were 94 771 cooperatives with 1 193 million members in 2002.

In African context, Alene *et al*. (2008) as cited by Poole and de Frece (2010; 12) argue that it is the small-scale institutional innovations in local market organisation and other non-price factors, rather than the macro trade and price policies, that are likely to stimulate smallholder participation in input and output markets, particularly in staple food markets. Although there are said to be many examples of successful formal cooperatives in Africa there have been questions of whether or not cooperatives work in Africa (Poole and de Frece, 2010). These questions arise because by the 1990s the general consensus was that cooperatives in Africa failed (Gabagambi, 2003; Poole and de Frece, 2010). This failure can be attributed to the historical context in which they were operating, mainly the political interference (Gabagambi, 2003). Dependency on government agricultural policies at the end of colonial period and into the independence era restricted the development of strategic enterprise (Poole and de Frece, 2010).

Despite the ups and downs of the cooperatives in Africa, Poole and de Frece (2010) argue that collective ways of organising agricultural marketing can work. Needles to say, such marketing organisation must be entrepreneurial. According to Eaton and Meijerink (2007), more efforts are required to learn from existing and ongoing initiatives in agricultural development that attempt to stimulate these enabling market conditions. Both successes and failures provide a wealth of new understanding (Eaton and Meijerink, 2007).

The preceding discussion means that institutional and organisational interventions are needed to help smallholder farmers access the input and output markets at lower transaction costs. The institutions are the rules of the game, humanly devised constraints that shape the human interaction and structure incentives in human exchange. They reduce uncertainty by establishing a stable structure to human interaction (North, 1990) as cited by Poole and de Frece, 2010; 31). Such institutions can be formal or informal, created or evolving, written and unwritten. Like institutions, organisations provide a structure to human interaction but they are the players of the game rather than the rules. Organisations are influenced by the institutional framework and in turn, influence institutions, for example, by advocacy and lobbying (Poole and de Frece, 2010). Thus, there is a linkage between organisations (the players) and institutions (the rules) as depicted in Fig.4.

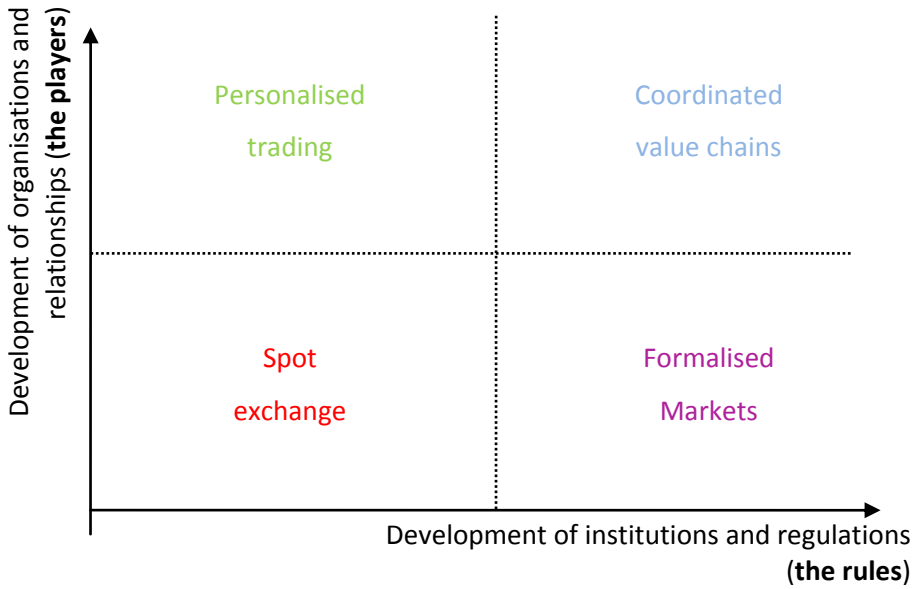

Figure 4: Institutional and organisational interventions and market types

Source: Poole and de Frece (2010; 32)

Interventions can be primarily of the organisational type or can be attempts to change the institutional framework within which farmers and organisations operate. When both institutions and organisations are developed the resulting market type is that of

coordinated value chains as shown in Fig.4. The development of coordinated value chains is desirable in agricultural production. Thus, policies for the development of markets and to increase smallholder access to markets should embrace elements of both institutions and organisations approaches.

In the following section, empirical studies on crop variety choices and commercial orientation of smallholder farmers are discussed. This helps in delineating whether or not profitability is considered in crop variety selections among smallholder farmers. The question is that if profitability is not considered then what are the factors that do?

2.8 Empirical Review

2.8.1 Crop variety selections among smallholder farmers

Crop breeders develop varieties often using yield as the sole criterion although sometimes they look at other factors such as response to fertiliser, resistance to pests and diseases, and maturity time (Linnemann and Siemonsma, 1989; Joshi and Bauer, 2006). However, smallholder farmers have own criteria for crop variety choice such as good yield, which is reliable and stable and at times they prefer a mixture of varieties to minimise risks. Basically, the choices of crop varieties differ upon the concerns of the farmers, which are defined by the attributes (Joshi and Bauer, 2006; Isin and Miran, 2005). According to Isin and Miran (2005), farmers may assess a new technology such as crop variety, in terms of a range of attributes, such as quality, yield, and input requirements. Understanding farmers' variety preference serves as input to future variety development and diffusion. In this regard, a number of studies have been conducted in various countries about farmers' choice of crop varieties. Such studies include but are not limited to: Kudi and Abdulsalam

(2008); Joshi and Bauer (2006); Asrat *et al*., (2009); Smale *et al*., (2001); Linnemann and Siemonsma (1989); and Rudra (1983).

While there are many factors in the literature that can affect farmers' selection of particular crops or crop varieties, it appears that those factors can broadly be categorised into five groups. These include: crop factors; farmer and/or household factors; extension services; location factors; and farmer organisations. In the following sub-sections, these five categories are discussed in detail.

2.8.1.1 Crop factors and farmers' selection

One of the criteria that farmers use to select certain crops or crop varieties is that based on the attributes of the crop or crop variety (Joshi and Bauer, 2006). Such attributes include: yield; tolerance to diseases; taste; colour; shape; size; earliness to maturity; adaptability; and stability (Kudi and Abdulsalam, 2008; Beckford, 2002; Linnemann and Siemonsma, 1989; Asrat *et al*., 2009).

Kudi and Abdulsalam (2008) found that the main reason for farmers' choice over certain varieties of maize in Nigeria were high yield and tolerance to diseases and pests. However, a good proportion of other farmers were attracted to good taste while others were attracted to beautiful seed colour. Although the proportion of farmers who chose some varieties of maize primarily because of seed colours was relatively small, it still attracts attention in the sense that some of them do not have any prime objective but colour. Since, Kudi and Abdulsalam (2008) do not provide details of, for example, why colours? Do consumers also buy the maize by looking at colours? Were these colours natural or coated by the seed agency or manufacturers? If the colour was coated by the seed producing agency then this

certainly has an implication on the way seeds are prepared. For example, beautiful colours could be coated to highly potential seeds such as those with high yield, resistant to diseases and early maturing. In either case, Kudi and Abdulsalam's findings are interesting in the sense that some farmers choose certain crop varieties primarily because of the attractiveness of the seed colours. While this seems interesting, it appears to be not uncommon. According to Linnemann and Siemonsma (1989), colour is one of the criteria that farmers use in selecting seed varieties.

Size of especially tubers has also been identified as an important factor in selection of seed tubers among smallholder farmers. Beckford (2002) finds that size of yam tubers was an important factor for adoption of improved yam varieties. Farmers perceived a direct relationship between tuber size and overall yields. Since improved yam produced smaller tubers than the traditional ones, farmers perceived that its yields were lower. Thus, the larger tubers produced using the traditional yam stick methods were more desirable by farmers than the improved ones. In fact, improved yam had a higher density of planting and yields per unit area were greater than the traditional ones. In incidences such as these, farmer education is very important. That tuber size may bear no relationship with yield. In the Beckford's study, traditional yams produced bigger tubers but their overall yields were much lower than the improved yams which produced smaller tubers but with high density.

Seed source, earliness to maturity, and less irrigation requirements are also factors for farmers' crop selection (Joshi and Bauer, 2006). Using the multinomial logit (MNL) model, Joshi and Bauer, found that among other factors, seed source, earliness to maturity, and less irrigation requirements were statistically significant factors in explaining farmers' choice over modern rice varieties in Nepal. Seeds from formal sources were more preferred and trusted than seeds from other non-formal sources.

Other crop factors are related to adaptability and yield stability (Asrat *et al*., 2009). Farmers would prefer crop varieties that are adaptable to their environment and those that promise to produce stable yield over time. While there appears to be many factors related to the attributes of the crop that farmers consider in their selection, Linnemann and Siemonsma (1989) had argued that farmers do not necessarily select for a uniform type of seed. In fact, they may choose seeds so as to maintain a certain variation in earliness, yield, shape, colour, and taste of product.

2.8.1.2 Farmer and/or household factors

According to Heisey and Brennan (1991), seed variety replacement choice differs from decision about inputs such as fertiliser or agrochemical because seeds can be reproduced by farmers themselves for the next crop season. However, at the household level there are certain variables such as aversion to risk and uncertainty; experience in farming; gender; resource endowments; and intrahousehold interaction that affect the choice of a variety (Lockheed *et al*., 1980; Heisey and Brennan, 1991; Phillips, 1994; Luh, 1995; Lukanu *et al*., 2004; Isin and Miran, 2005; Pingali *et al*., 2005; Hawassi, 2006; Joshi and Bauer, 2006; Nkumba, 2007; Asrat *et al*., 2009; Kilima *et al*., 2010). Such factors influence the costs of information seeking, negotiating, monitoring, and enforcement and hence variety choice and use.

Age, gender, and education can affect variety choice in different ways (Luh, 1995; Kilima *et al*., 2010). Age can be an indicator of farming experience, which makes certain informational and search costs easier. According to Luh (1995), it is a widely accepted proposition in economics of production that there is a positive relationship between efficiency and accumulated experience. Empirical studies such as Nkumba (2007) and Hawassi (2006) find similar relationship. Nkumba (2007) finds that household

characteristics such as age of the family head influence the adoption of new banana varieties in Kagera. Also, Nkumba (2007), Lockheed *et al*. (1980), and Phillips (1994) find that education level of the farmers influences productivity through the decisions to use purchased inputs and adoption of new varieties.

Other household factors such as resource endowments (e.g. land) can affect farmers' choice over certain crop varieties (Smale *et al*., 2001). Poor households are more likely to choose traditional crop varieties because of the associated costs of production. Also, poor households farm for home consumption; hence, they are likely to choose varieties that suit them rather than the market. Smale *et al*. (2001) found that in Mexico the most significant factor for maize variety choice were related to family's consumption of maize rather than to the suitability of the variety for market sale or that it was cheap to produce. Although farmers cited the suitability for market sales and cost of production as important variety attributes, these did not contribute statistically to explaining variation in area shares. The choice of crop varieties basing on family consumption can reflect the subsistence farming practices among smallholder farmers in many developing countries. According to Rudra (1983), most farmers desire to achieve self sufficiency in all crops which they need for home consumption.

2.8.1.3 Extension services

In developing countries such as Tanzania where majority of farmers are subsistent peasants, the role of extension services cannot be overemphasised. Extension officers are expected to provide both formal and informal education regarding best farming practices including crop variety selections. For example, Smale *et al*. (2001) and Namwata *et al*. (2010) find that contact with extension services was a major factor causing the variations in crop variety preferences among farmers. Similar results were found by Asrat *et al*.

(2009) that the level of access to agricultural extension affect farmers' private valuations of crop variety traits. Hence, farmers who receive extension or advisory services are more likely to choose certain (perhaps improved) varieties than those who do not.

2.8.1.4 Location factors

In terms of location, smallholders are generally dispersed over wide areas and infrastructure connecting farms with the availability of both input and output markets is often poor (Omamo, 1998). This certainly has a negative effect on prices of input factors including those of improved seeds. Omamo (1998) argues that location matters in explaining crop choices. Also, according to Pingali *et al*. (2005), variations across regions matter in determining the level of transaction cost and hence input use decision. Farmers in high potential areas (i.e. area with high access to input and output markets) may experience lower total transaction costs than those in low potential areas. They argue that higher-potential areas have more reliable access to production inputs and markets and hence face lower costs and risks associated with the switch to high-value crop production.

High potential areas generally have better transport and communication infrastructure. Where road density is low, especially in low potential areas, accordingly transaction costs associated with accessing input and output markets and information tend to be high. In the same token, distance to a paved road have a significant but negative effect on the use of purchased inputs and access to output markets (Ahmed, 1994; Gabagambi, 2003; Pender and Alemu, 2007).

Also, Smale *et al*. (2001) compared the variations in preferences for crop varieties in terms of region where farmers came from and in terms of infrastructure development. They found that infrastructure development and the interaction of productivity potential with

infrastructure were the most important in terms of magnitude of the share of the area allocated to certain maize varieties.

2.8.1.5 Farmer associations and social networks

Social networks or capital and farmer organisations such as cooperatives and associations are said to influence farmers' decisions on crop and crop variety selections (Ortman and King, 2007; Batt, 2003). According to Batt (2003), social network or capital facilitates cooperative behaviour and transfer of information and resources. As such it makes it possible to achieve desired outcomes that would be impossible without it or could only be achieved at considerable cost.

Farmers who are members of certain farmer organisations or cooperatives are expected to be more informed and therefore be able to choose improved crop varieties as compared to those who do not belong to such organisations. According to Ortman and King (2007), the presence of social networks and organisations may substantially increase the likelihood to purchase improved and high yielding varieties.

In many studies profitability did not explicitly feature out as one of the factors in crop or crop variety selections. This raises questions about the commercial orientation of small scale farmers. As it was mentioned earlier, it would be expected that farmers would cultivate only such crops or crop varieties that promise to yield the maximum profit (Rudra, 1983). Also, such farmers would select crop varieties in accordance with the market preferences. In the following section, the market orientation or commercialisation of smallholder production is discussed.

2.8.2 Commercialisation of smallholder production

Literature shows that commercialization of agriculture is occurring rapidly in some developing countries (Von Braun and Kennedy, 1994; Pender and Alemu, 2007). Commercialisation of smallholder production has been identified as a viable strategy for up-scaling the income and living standards of the rural population (Von Braun and Kennedy, 1994; Hau and Von Oppen, 2001; URT, 2006; Haule *et al*., 2010; Hemachandra and Kodithuwakku, 2010). This strategy depends on the commercial orientation as opposed to production orientation of the rural population. Commercial oriented farmers take advantage of the market conditions such as high market price, place and time of sale to obtain price advantages, and the form of which the product should be sold (Tauer, 1995; Maredia and Minde, 2002; Hemachandra and Kodithuwakku, 2010). In contrast, production oriented farmers decide on what to produce based on availability of materials (quite often that is available free of charge). Their decision is based primarily on meeting some consumption needs.

Production oriented decision making that is not economically viable is regarded as a prominent reason for the socio-economic failure of smallholder farmers (Balint, 2004; Hemachandra and Kodithuwakku, 2010). It has been observed that majority of rural farmers tend to follow well-established routine traditional decision paths. These routines have been established mainly as a result of the increased openness of the agricultural production environment and have been identified as being production oriented (Hemachandra and Kodithuwakku, 2010). According to Hemachandra and Kodithuwakku (2010), rural farmers allocate more time, energy, and resources for production than marketing and the eventual result is low income leading to socio-economic failure.

From economic point of view, farmers are regarded as maximisers of short-run profit (Rudra, 1983; Tauer, 1995; Maredia and Minde, 2002). Therefore, it would be expected that farmers would produce less of crops needed for home consumption and more of the most profitable crops (Rudra, 1983; Von Braun and Kennedy, 1994). This is the behaviour that would be considered rational from a point of view of standard economic theory (Rudra, 1983). However, the contrary has been observed by many empirical studies.

The empirical studies such as Herath *et al*. (1982) and Hemachandra and Kodithuwakku (2010) in Sri Lanka, Rudra (1983) in India, Smale *et al*. (2001) in Mexico, Beckford (2002) in Jamaica, Joshi and Bauer (2006) in Nepal, Kudi and Abdulsalam (2008) in Nigeria, and Bekele *et al*. (2011) in Ethiopia generally indicate that farmers showed a greater inclination towards production orientation than market/commercial orientation. Farmers had considered only a very limited number of commercial oriented criteria as opposed to a higher number of production oriented criteria considered by them. For instance, although Rudra (1983) observed that potato was more profitable than, for example, mustard but it was allotted on the average to a much smaller amount of land. Although this is a clear contradiction with the principle of profit maximisation it appears that profit maximisation for smallholder farmers depends very much on other factors. That is why they are still regarded as rational producers (Beckford, 2002).

The production orientation as opposed to market/commercial orientation has prompted some researchers to conclude that smallholder farmers should be treated as a special case because in their farming decisions they consider many factors perhaps more important than the market. For instance, citing Wigley (1988), Beckford (2002) argues:

> "*...Tropical small-scale farming should be recognised as a unique farming system. Examined in this context, it would become evident that, unlike commercial farmers in developed countries, small-scale farmers are influenced by factors more important than the market and hence their decisions, whilst seemingly backward, generally have a rational basis...*" (Beckford, 2002; 251).

While Wigley (1988) as cited by Beckford (2002) urges for smallholder farmers to be treated as a special case, Nyikai (2003) argues that very few smallholder farmers remain strictly subsistence. According to Nyikai (2003), many smallholder farmers, for example, in Kenya become semi-commercial (or semi-subsistence) actively producing industrial crops or have been forced into it passively by having to sell part of the meagre food output for cash requirement. Nyikai (2003) further argues that agricultural production is only for three purposes: subsistence; commercial; and as a hobby. However, subsistence farming does not adequately even address food insecurity because it neglects the non-food needs of a person, which compete with the often low food outputs of many households. On the other hand, agricultural production as a hobby is not common. Thus, Nyikai (2003) argues that sustainable food security would probably be addressed most effectively through commercial agriculture.

Following Nyikai (2003)'s discussion it still lands to the assertion that smallholder farmers are not commercial/market oriented. Being semi-commercial or semi-subsistence means that farmers neither reap the maximum profit nor adequate food. Further, the idea that many farmers are forced to sell part of their food outputs because of cash requirements does not necessarily mean they are commercial or profit oriented. However, it follows clearly from Nyikai (2003) that subsistence farming because of its nature will not assure

for food security. This discrepancy in the practice of farmers of using criteria other than market forces is important in informing policies especially in the efforts of commercialisation of smallholder farming in Tanzania.

2.9 Empirical Methods

2.9.1 Profitability analyses

In carrying out profitability analyses, a number of studies use gross margins (GM) and net margins as indicators to estimate crop and farm profitability (Al Said *et al*., 2007). Usually net margins are different from net returns because the cost of management, cost of capital, and the opportunity cost of the land are not accounted for. Studies that have used GM analysis in measuring profitability include: Rudra (1983); Takele (2001); Maredia and Minde (2002); Al Said *et al*. (2007); Ortega-Ochoa *et al*. (2007); Monlruzzaman *et al*. (2009); Ojo and Ehinmowo (2010); and Sulumbe *et al*. (2010). For example, Al Said *et al*. (2007) used the GM (1) to estimate the crop and farm profitability of farms specialising in vegetable production.

$$GM_i = Yield_i \times \Pr ice_i - Variable\cos ts_i \quad \text{..... (1)}$$

Where, $yield_i$ is output in kg/unit of land for crop *i*; $price_i$ is the price of output *i* in units of money/kg; *variable costs*$_i$ are the cost of seeds, fertilisers, agrichemicals, occasional labour and transport to market for crop *i* in units of money/unit of land. In this study, GM analysis was used to determine the profitability of round potato production.

GM analysis is one of the widely used analytical techniques for planning and analysis of projects by consultants, researchers, and producers. It is used as a measure of farm profitability and as a means of selecting farm plans. The fundamental advantages of GM

analysis as an economic tool include its easiness to understand and utilise the logical interrelations of economic and technological parameters, and its ability to forecast rational variants for the operational structure of an enterprise or individual farmer. Although GM is not an exact estimation as it does not include fixed or overhead costs such depreciation, machinery purchases, or permanent labour and comparison can be misleading, it does give a clear indication of financial direction.

2.9.2 Effect of varieties on profitability

Models that are used to assess the effect of variety on profitability generally fall under analysis of variance (ANOVA) and regression analysis (Gujarati, 2006; Hair *et al*., 2006; Gujarati and Sangeetha, 2007). In ANOVA the dependent variable is a continuous or metric variable while the independent variable is categorical with two or more categories. Hence, if variety, for example, has two or more categories i.e. the different varieties of round potato then ANOVA can be used to assess whether significant differences exist in mean profitability measured by GM.

According to Pindyck and Rubinfeld (1991), Hair *et al*. (2006), and Gujarati and Sangeetha (2007), a problem that can be approached using ANOVA can very well be approached using regression analysis. In fact, they argue that ANOVA and regression analysis are an illuminating and complementary way of looking at the statistical inference problem. This implies that one can study ANOVA from the regression point of view. Hair *et al*. (2006) and Gujarati and Sangeetha (2007) define that a regression model in which all regressors are exclusively dummy or qualitative in nature, are called ANOVA models. Thus, an ANOVA model with one continuous dependent variable and one qualitative variable with three or more categories can expressed as in (2).

$$Y_j = \beta_0 + \sum_{i=2}^{n} \beta_{ij} D_{ij} + \mu_j \quad \text{..... (2)}$$

Where Y_j is the (average) GM of agricultural produce for variety j and D_{ij} are dummy variables. The intercept value (β_0) represents the mean value of the benchmark category, β_{ij}'s for $i \geq 2$ are differential intercept coefficients and μ is the stochastic error term.

One can observe from equation 2 that there are $m-1$ dummy variables. This is always the case in order to avoid perfect collinearity. According to Gujarati and Sangeetha (2007), where there is a dummy variable for each category or group and also an intercept, there is always a case of perfect collinearity, that is, exact linear relationship among the variables. Thus, the rule of thumb is that if a categorical variable has m categories then one should introduce $(m-1)$ dummy variables. In other words, for each qualitative regressor the number of dummy variables introduced must be one less than the categories of that variable. The category for which no dummy variable is assigned is known as the base, benchmark, control, comparison, reference, or omitted category (Pindyck and Rubinfeld, 1991; Gujarati and Sangeetha, 2007). In this study, ANOVA from a viewpoint of regression analysis was used to assess whether significant differences existed in profitability by varieties.

2.9.3 Crop variety selection

The decision of whether or not to select a certain crop variety is a binary decision (Isin and Miran, 2005). This variable is qualitative and it can only take two values in a model representation. However, when there are many crops or crop varieties from which to choose a multinomial logit (MNL) is used. For example, in crop variety selection, Joshi

and Bauer (2006) used the multinomial logit (MNL) model to analyse factors affecting the choice of rice varieties among smallholder farmers in Nepal. They assumed that the utility *U* to an adopter from choosing a particular alternative is specified as a linear function of the farm and farmer characteristics (β) and the attributes of that alternative (*X*) as well as a stochastic error component (*e*):

$$U = \beta X + e \quad \text{..... (3)}$$

Supposing that the observed outcome (dependent variable) is choice *j*, then for a given adopter: $U_{alternative\ j} > U_{alternative\ k}\ \forall k \neq j$, or

$$\beta X_j + e_j > \beta X_k + e_k\ \forall k \neq j \quad \text{..... (4)}$$

The probability of choosing an alternative is equal to the probability that the utility of that particular alternative is greater than or equal to the utilities of all other alternatives in the choice set. Let the probability that the i^{th} farmer chooses the j^{th} variety be P_{ij} and denote the choice of the i^{th} farmer by $Y_i^{/} = (Y_{i1}, Y_{i2}, ..., Y_{iJ})$ where $Y_{ij} = 1$ if the j^{th} variety is selected and all other elements of $Y_i^{/}$ are zero. If each farmer is observed only once, the likelihood function of the sample values $Y_{i1}, Y_{i2}, ..., Y_{iJ}$ is:

$$L = \prod_{i=1}^{T} P_{i1}^{Y_{i1}} P_{i2}^{Y_{i2}} ... P_{iJ}^{Y_{iJ}} \quad \text{..... (5)}$$

Assuming that the errors across the variety (e_{ij}) are independent and identically distributed leads to the following multinomial logit (MNL) model.

$$P\{y_i = t\} = \frac{\exp(X_{it}^{/}\beta)}{1 + \exp(X_{i2}\beta_2) + ... + \exp(X_{iJ}\beta_J)} = \frac{\exp(X_{it}^{/}\beta)}{1 + \sum_{j=2}^{J} \exp(X_{ij}\beta_j)} \quad \text{..... (6)}$$

The MNL model (6) is used to predict the probability that a farmer demands a certain variety and how that demand is conditioned by different farm and farmer characteristics and attributes of the variety valued by the farmer (Joshi and Bauer, 2006). This model is generally enough to be used as a tool for studying different circumstances faced by farmers and different problems encountered in the context of choice among multiple varieties. Other commonly used models in variety selection are the binary probability models such as Linear Probability Model (LPM), logit and probit models. For instance, Asrat *et al*. (2009) applied a logit regression model to a random utility framework since farmers preferences were observed in terms of their choices.

The LPM is the simplest of the three (i.e. LPM, logit, and probit) models to use but has several limitations such as non-normality of the error term, heteroscedasticity and the possibility of the estimated probability lying outside the 0-1 bounds (Isin and Miran, 2005). Logit and probit models are quite comparable and they yield similar results although the logit model has slightly flatter tails than the probit model (Isin and Miran, 2005; Gujarati, 2006; Gujarati and Sangeetha, 2007). Both logit and probit models guarantee that the estimated probabilities lie in the 0-1 range and that they are nonlinearly related to the explanatory variables (Isin and Miran, 2005).

The comparability of the logit and probit models makes the choice between them to be of (mathematical) convenience and ready availability of computer programmes (Isin and Miran, 2005). According to Gujarati (2006) and Gujarati and Sangeetha (2007), the choice between logit and probit models often depends upon the researchers' interests. Further, the choice between MNL on one hand, and LPM, logit, and probit models on the other hand, depends on the number of possible responses in the categorically dependent variable. If there are binary responses then LPM, logit or probit model is used. But if there

are three or more responses then either a multinomial logit or multinomial probit model is used (Gujarati, 2006; Gujarati and Sangeetha, 2007). In this study the logit regression model was used to analyse factors for smallholder farmers' selection of round potato varieties.

2.10 Conceptual Framework

Macroeconomic as well as individual farmers' factors are expected to influence the commercial/market orientation and crop variety selection of farmers. Macroeconomic factors such as infrastructure, technology, and extension services affect farmers' access to input and output markets and hence their market orientation and choice of crop variety. Farmers in high potential areas where, for example, road infrastructure is developed with availability of farm technology such as improved crop varieties and extension services are more likely to produce for the market and to choose crop varieties according to market preferences than those in lower potential areas where such services are underdeveloped.

As shown in Fig.5, there are individual factors such as experience in farming, level of education and membership to a social network that influence farmer's decision on variety selection. It is expected that experienced farmers especially in terms of age, those with higher education level, and those who belong to certain organisation or cooperatives will be more market oriented and are more likely to choose crop varieties in accordance with market preferences as compared to those who do not possess such characteristics.

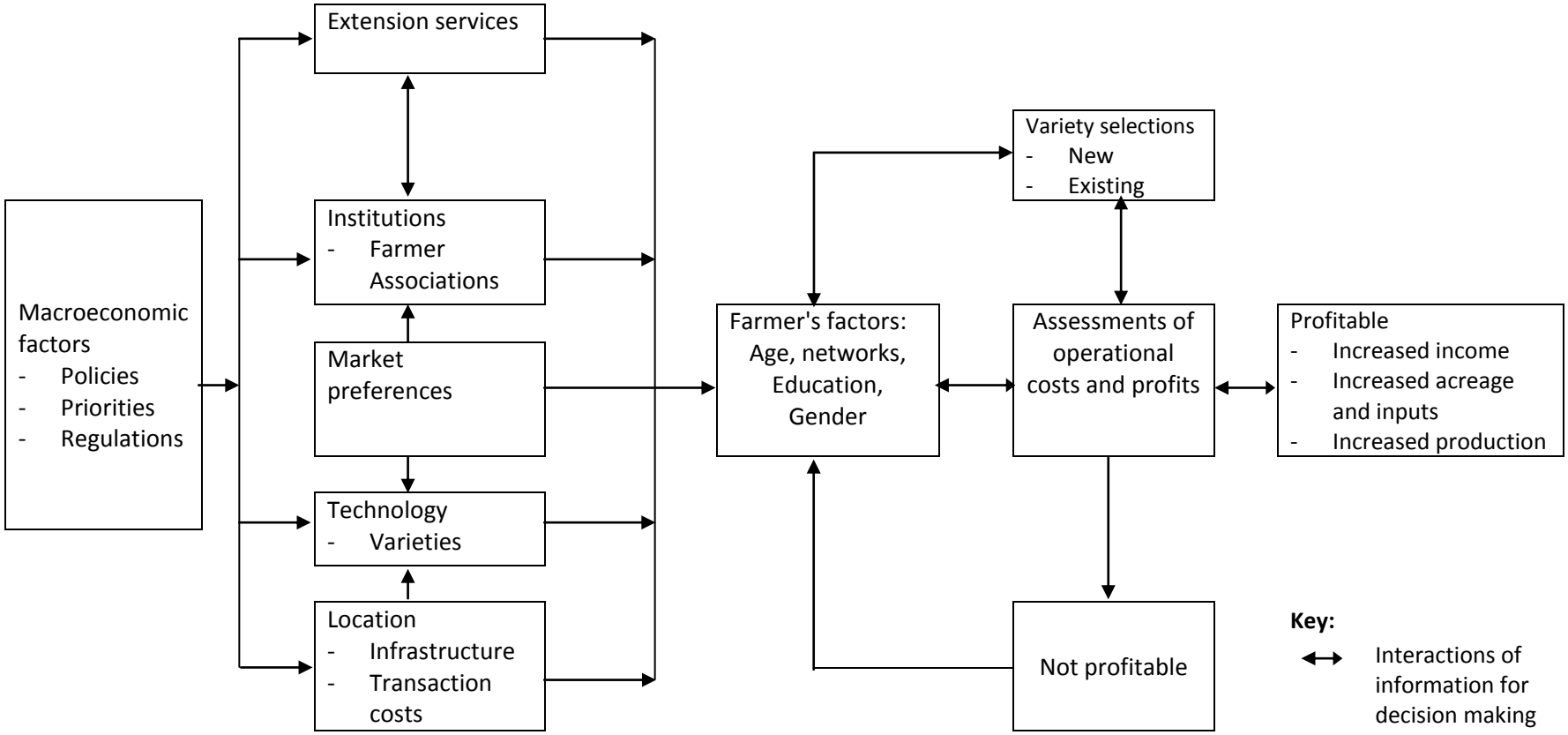

Figure 5: Conceptual framework

From Fig.5 it is assumed that factors such as exposure to extension services, market demand, location (infrastructure and transaction costs), farmer associations, technology (availability of seed tubers), and farmers' factors such as gender, farm experience (i.e. age), education level and networks affect the farmers' choice of round potato variety to grow. According to Ahmed (1994), infrastructural development affects the attitude and values of rural farmers. Development of transport and communication infrastructure enhances mobility of people and information flow through reduction in cost and time (Gabagambi, 2003; Mpogole *et al*., 2008). The resulting increase in interaction with the outside world and the informal education process that such interactions are involved contribute to changes in attitude and values. The effects of these attitudinal changes are reflected in the farmers' selection or demand for new crop varieties.

In the process of selecting crop varieties, a farmer may choose to continue with existing variety or choose a new one. If the selected variety has a market and is profitable the farmer is likely to increase its production leading to increase in income. The increased income will further lead to increase in acreage and input use. The increase in acreage of cultivation and input use will increase the farmer production. However, if the selected variety is not profitable, the farmer is likely to select another one that promises to yield higher profit.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

3.1.1 Farmers' survey

The round potato farmers' survey was conducted in the SHT. SHT is very much suitable for round potato production. It has already been shown that round potato grows well in specific climatic areas such as in mountainous and/or highlands. The SHT consisted of four regions which are Iringa, Mbeya, Rukwa, and Ruvuma. However, only three Districts namely, Njombe District in Iringa, Mbeya Rural District in Mbeya, and Nkasi District in Rukwa were surveyed (Fig.6). According to the available statistics, Iringa was the leading round potato producer in Tanzania, followed by Mbeya and Kilimanjaro (URT, 2007). Within Iringa, Njombe District was the largest producer of round potato (URT, 2007). In Mbeya region, Mbeya Rural District was the largest producer of round potato. Major round potato production in the Mbeya Rural District occurs around the Mporoto area (Anderson, 1996; Koizumi, 2007; Kabungo, 2008; Namwata *et al*., 2010).

Minor production also occurs in Rukwa, Ruvuma, Mara, and Tanga regions (Macha *et al*., 1982; UARC, 1990). Hence Nkasi in Rukwa was chosen for comparison purposes with Njombe and Mbeya Rural in terms of access to input and output markets and transport infrastructure. Njombe and Mbeya Rural Districts were within the availability of tarmac roads and were closer to sources of inputs and output markets than Nkasi. Also, according to the National Sample Census of Agriculture of 2002/2003, Iringa and Mbeya were the leading regions in terms of access to agricultural extension services (URT, 2006).

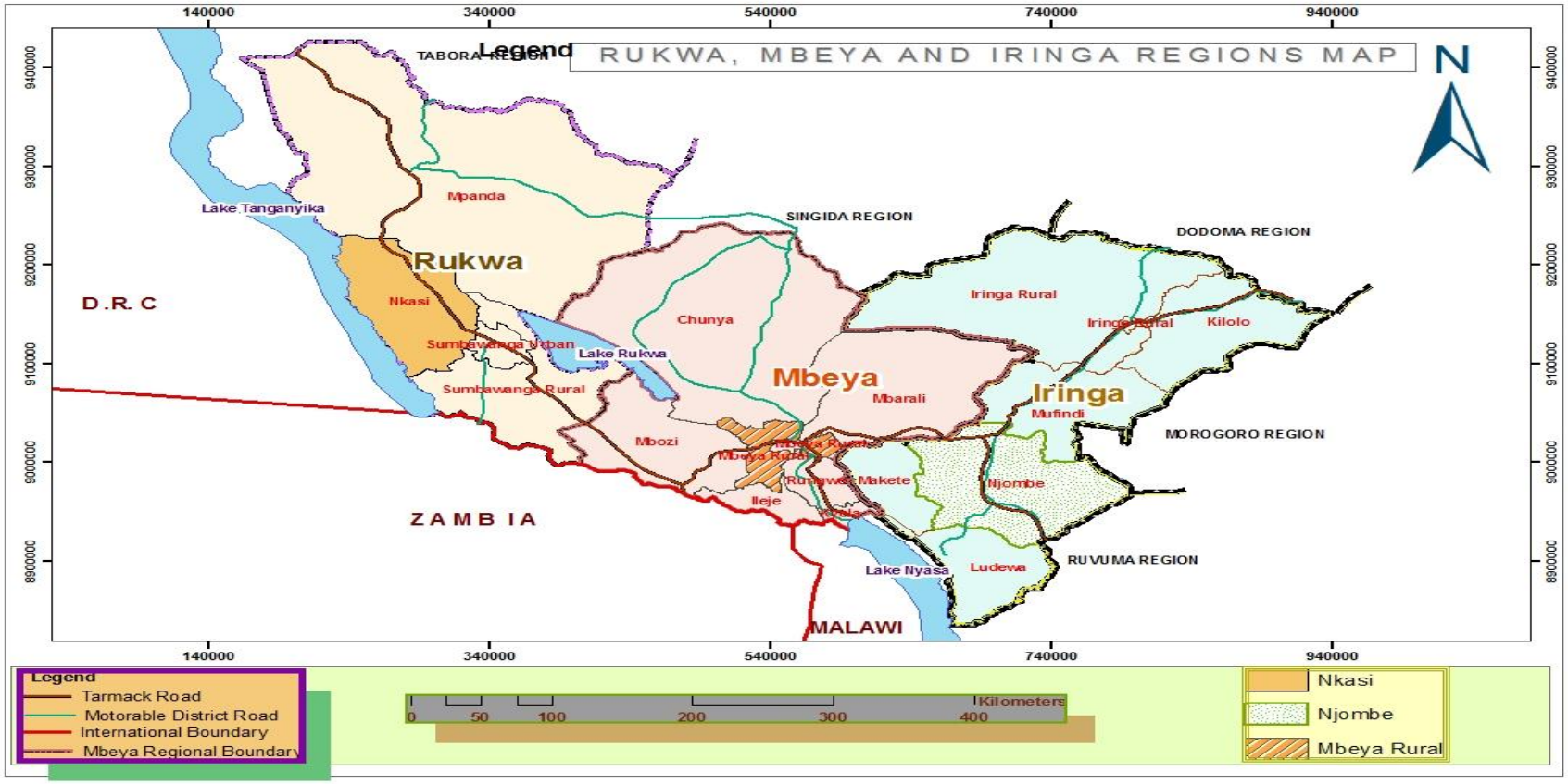

Figure 6: SHT: Map showing the study areas

Source: National Bureau of Statistics (NBS)

In Njombe District, four wards namely, Uwemba, Makoga, Ulembwe, and Igosi were visited. In Mbeya Rural around the Mporoto area, three wards namely, Tembela, Ulenje, and Ilungu were surveyed. While at Nkasi District, only two wards namely, Kipande and Kandasi were surveyed.

3.1.2 Market survey

The market survey for round potato was conducted at market places, hotels/restaurants/pubs, and street chips vendors in urban areas of Mbeya, Iringa, Morogoro, Dodoma, and Dar es Salaam in Tanzania. These locations were purposively identified because they were the major routes of round potato from SHT (Kabungo, 2008). Although it was reported that some round potatoes from SHT were exported to Zambia and Malawi, a large volume finds its way to Dar es Salaam (Kabungo, 2008). It has also been reported that round potato especially in form of chips were very popular and mostly consumed in urban areas.

According to Creswell (2003) and Kumar (2011), the selection of study area(s) depends upon among other things the characteristics of interest of the study population. Hence, it was expected that the selected cities/towns would represent the true characteristics of round potato wholesalers/retailers and/or consumers.

3.2 Study Design

Basically, there are three research approaches, quantitative, qualitative, and the mixed methods (Creswell, 2003). The three approaches differ according to their specific methods of data collection and analysis. These include their use of closed-ended versus open-ended questioning and their focus for numeric versus non-numeric data analysis.

Quantitative research employs strategies of enquiry such as surveys and experiments, and collects data on predetermined instruments that yield statistical data/results with intent of making generalisation (Creswell, 2003). In this approach, the researcher uses mostly closed-ended questions on a predetermined instruments resulting into numeric data. However, the researcher's values, interpretation and feelings are not very much considered (Kumar, 2011). The aim of quantitative research is usually to test or verify certain theories or explanations. The researcher identifies variables to study and relates them to questions or hypotheses. Statistical procedures are usually employed (Creswell, 2003).

Qualitative research approach, on the other hand, uses strategies of enquiry such as case studies, narratives, ethnographies, and exploration among others. The researcher collects open-ended emerging data with the primary intent of developing themes from the data (Creswell, 2003). In this approach, the researcher seeks to establish the meaning of a phenomenon from the views of the participants. Individuals are interviewed at some length to determine how they have personally experienced a certain problem related to the study. Also, researcher's values, interpretation and feelings are usually brought into the study (Creswell, 2003; Kumar, 2011).

Each of the two approaches has its own specific strengths and weaknesses. For instance, while it is possible to generalise the results from a quantitative study it is difficult to get the stories or experiences surrounding a particular problem. Also, the closed-ended nature of questions limits respondents from sharing new experiences which were not included by the researcher. On the other hand results of the qualitative study cannot be generalised (Creswell, 2003; Kumar, 2011). In this case, Creswell (2003) proposes the use of mixed methods approach that captures the best of both quantitative and qualitative approaches. In a mixed methods approach the researcher first surveys a large number of individuals, then

follows up with a few of them to obtain their specific language and voices about the topic. In these situations, the advantages of collecting both closed-ended quantitative data and open-ended qualitative data prove advantageous to best understand a research problem. In this way, quantitative and qualitative approaches used together can be viewed as complementing rather than opposing each other. This study, therefore, adopted a mixed methods approach. The quantitative part was conducted using a descriptive cross sectional survey and the qualitative part using in-depth interviews.

3.3 Sample Size and Sampling Procedure

3.3.1 Round potato farmers' survey

3.3.1.1 Sample size of farmers

The exact sample size required for a particular study is usually difficult to establish. However, there must be a rational method of estimating the sample size (Snedecor and Cochran, 1989). This is important in order to avoid making the sample so small that the estimate is too imprecise to be useful. Equally, one wants to avoid taking the sample that is too large thus unnecessarily using lots of scarce resources. Thus, in establishing the required sample size, the first step is to decide how large an error to tolerate in the estimate. The second step is to express the allowable error in terms of confidence limits (Snedecor and Cochran, 1989). The confidence interval to be used will depend on whether the estimate is a population mean or a population proportion. According to Berenson *et al*. (2002) and Snedecor and Cochran (1989), if the interest is in population proportion then the sample size, *n*, can be estimated by using equation 7:

$$n = \frac{Z^2 p(1-p)}{e^2} \quad \text{..... (7)}$$

Where: Z is the abscissa of the normal curve that cuts off an area at the tails (1 - equals the desired confidence level, e.g. 95%); e is the desired level of precision; and p is the

estimated proportion of an attribute that is present in the population, e.g. the proportion of farmers who produce round potato for the market. With the commonly used 95% confidence level, *Z = 1.96*, thus equation 7 becomes:

$$n = \frac{(1.96)^2\, p(1-p)}{e^2} \quad \text{..... (8)}$$

Or approximately:

$$n = \frac{4p(1-p)}{e^2} \quad \text{..... (9)}$$

In order to use equation 9 an advance estimation of p is required. However, an advance estimation of p is usually very subjective in the absence of past information for the same (Snedecor and Cochran; 1989; Berenson *et al*., 2002). On the other hand, taking $p = 50\%$ brings a conservatively larger sample size than might be required. Hence, there is a need for an alternative way of estimating the required sample size.

According to Hair *et al*. (2006), any reasonable sample size usually suffices for descriptive statistics. But a good sample size is needed for rigorous statistical analyses. For the case of rigorous statistical analysis, the alternative way of estimating the required sample size is by comparing the number of variables in the multivariate model and the number of cases per variable (Hair *et al*., 2006; Tabachnick and Fidell, 2007). The more the variables included in the analysis the larger will be the required sample size. For this purpose, Hair *et al*. (2006) suggest a ratio of 1 variable to at least 15 cases.

In this study, the model with highest number of variables was ANOVA from regression point of view, which had 10 variables. Since comparison was to be made among the three

Districts namely, Njombe, Mbeya Rural and Nksai and taking into account of the Hair *et al*. (2006)'s suggestion, then a sample size of 150 was needed for each District. Also, a margin of 20 cases was added to cover for non-responses, hence making a sample size of 170 in each District. Therefore, the total sample size for this study in all three Districts was 510 round potato farmers. This sample size was considered to be adequate for all types of analyses carried out in the study. As such, no threats or limitations were expected on data quality associated with the sample size.

3.3.1.2 Sampling procedure for farmers

Data were collected from 15 villages, which were purposively selected basing on the volume of production of round potato. In those villages, respondents were obtained from farmers' meeting called by village executive officers (VEOs). The VEOs were informed at least a day prior to the visit and they were requested to call for round potato farmers' meeting on the day of the visit. In total, 510 farmers were included in this study (Table 6).

Table 6: SHT: Sample of the farmers' survey

Njombe		**Mbeya Rural**		**Nkasi**	
Village	**Frequency**	**Village**	**Frequency**	**Village**	**Frequency**
Igagala	40	Igoma	34	Kantawa	46
Magoda	38	Kikondo	31	Kipande	55
Makoga	28	Kimondo	38	Milundikwa	24
Njoomlole	28	Simambwe	35	Nkundi	45
Uhekule	17	Usoha	32		
Usalule	19				
Total	**170**	**Total**	**170**	**Total**	**170**

Five research assistants were present to assist in order to reduce farmers' waiting time. No incentives were given to respondents, except that one of the research assistants was an experienced agricultural officer so farmers had a chance of asking him questions regarding the best practices in round potato production and farming in general.

3.3.2 Round potato market survey

The market survey was conducted in Mbeya and Dar es Salaam cities, and Iringa, Morogoro, and Dodoma municipalities. A sample of 155 round potato wholesalers, retailers, hotels/restaurants/fast foods/pubs, chips kiosks, and processors was included in this survey. Table 7 indicates the sample for the market survey from the five locations. The sample size for Dar es Salaam was twice as much of other locations because of its population. Visits were made to popular round potato markets, hotels/restaurants/pubs that sold round potato chips and/or related products, chips kiosks and crisps processors.

Table 7: Tanzania: Sample for market survey

Location	Frequency
Dar es Salaam	50
Mbeya	30
Iringa	25
Morogoro	25
Dodoma	25
Total	**155**

Popular market places that sold round potatoes were identified using the following procedure. A visit was made to the major or central market place commonly known as *Soko Kuu* for each survey town or city. A central crop market or *Soko Kuu* is a place where raw food crops and/or semi processed food crops and other food products such as fish are traded. At such a market place both wholesaling and retailing are done. Retailers come to buy commodities in wholesome in order to retail at other small markets or food kiosks around the town or city. From the *Soko Kuu*, other small markets around the survey town/city were identified and visited. Both wholesalers and retailers were interviewed.

Similar visits were made to popular hotels, restaurants, fast food shops, pubs, and chips kiosks. Again, either the manager or the seller was interviewed depending on who was

available at the time of the visit. In cases where both were present then the person who was in a better position to provide information regarding the varieties of round potatoes they used and customer preferences was interviewed.

3.4 Pilot Survey and Test of Instruments

A pilot survey was conducted prior to the main round potato farmers' survey. The pilot survey aimed at pre-testing the questionnaire in order to validate the relevance of the questions and to familiarise with the study areas. The pilot survey was conducted in two villages, Ulembwe in Njombe, and Mwazazi in Mbeya Rural. The two villages were purposively selected. Ulembwe is along the Njombe – Makete road where most of the round potato farming is practiced. Also, Mwazazi is along the Uyole-Kitulo/Makete road at Mporoto area where most of the round potato farming is practiced for the case of Mbeya Rural. Those pilot villages were not included in the main survey.

A visit was made to Uyole Agricultural Research Centre to identify the list of available round potato varieties, their characteristics and markets. This was considered important so as to assist the researcher in assessing farmers' awareness of different round potato varieties and markets. The researcher obtained a copy of the extension leaflet No. 49, titled '*Kilimo Bora cha Viazi Mviringo'* which had a list of some round potato varieties available in SHT and their characteristics.

During the pilot survey, it was found that farmers indicated the amount of output by referring to those sold. They did not consider the amount consumed or stored seed tubers as part of their output. So, during the main survey, farmers were asked for the amount of round potato sold, amount of stored seed tubers and estimated amount consumed in order to get the total output. However, some farmers in Njombe were growing the round potato

for home consumption in their maize farms while round potato for commercial purposes was grown in separate fields.

It was also found that when mentioning about the amount of fertilisers used per acre, farmers were referring to the number of bags required rather than the amount they used. So, in the main survey they were asked about the number of bags they used and not the ones required. Those who still mentioned the required amount were further asked, 'So, how many bags did you use?' This helped to get the actual amount of fertilisers they used per acre.

Farmers in Mbeya Rural had very small and fragmented plots as compared to their Njombe counterparts. The fragmented plots in Mbeya Rural were a result of the nature of the land itself which is characterised by steep mountain slopes and valleys. As such, when farmers in Mbeya Rural were asked about the acreage they grew round potato, they mentioned the number of plots and then combine them to an equivalent acreage. The size of plots was known because when farmers had to hire people for cultivation, weeding, or sowing then each plot had to be measured. Also, the problem of shortage of land was more pronounced in Mbeya Rural than in Njombe. As such, some smallholder farmers in Mbeya Rural were growing round potato and maize in same plots. In some cases, farmers contracted the plot to someone else to grow round potatoes while they themselves grew maize in the same plot. Hence, the acreage and output of round potatoes per farmer was much smaller in Mbeya Rural as compared to Njombe. But farmers in Mbeya Rural had the advantage of growing and producing round potato throughout the year.

Farmers sold the round potato at different times with different prices. For instance, a farmer could sell 70 bags at one time at TZS 22 000 per bag and then sell again 20 bags

one month later at TZS 25 000 per bag. Since there was a question on the price that farmers sold their produce, the researcher decided to take the price at which most of the produce was sold.

Finally, farmers sold the round potato to traders at their fields. Traders first bring the empty bags to farmers. Then some time afterwards they bring their trucks to the fields or somewhere close by. Harvesting costs included carriage to the truck and therefore depended on distance from the place where the truck parked. Hence, the two questions on distance of the farm from the market centre and the corresponding carriage cost to the market centres were removed from the survey questionnaire.

3.5 Data and Collection Procedure

Primary and secondary data were used in this study. Structured survey questionnaires consisting of both closed and open-ended questions and depth interviews were used to collect primary data. There were two types of questionnaires, one for round potato farmers (Appendix 4) and another for the market survey (Appendix 5) which included wholesalers/retailers/processors and hotels/restaurants and chips vendors.

Farmers' questionnaire included questions on: demographic and socio-economic characteristics; types of crops produced; number and names of round potato varieties grown; farmers' preferences for certain varieties; seed sources and availability; knowledge of other round potato varieties, usage and markets; considerations for acreage decisions among crops/varieties, main reasons for selected round potato variety(ies), production costs per acre; round potato output; volume of round potato sold; selling price of variety(ies) produced in the current and previous seasons; access to extension services; availability and costs of agricultural inputs; and access to market information.

Farmers' questionnaires were administered by five trained enumerators together with the researcher in two seasons from March 2010 to June 2011. The market survey was conducted between December 2010 and January 2011 using a structured survey questionnaire. The questionnaire included questions on: demographic information of the respondents such as age, education level, and gender; nature or type of the business; volume of round potatoes sold by varieties and sources; qualities they considered when buying round potatoes; whether customers ask about varieties when they buy round potatoes, chips or related round potato products; qualities that customers liked about round potatoes; and whether there was seasonality in supply of round potato. This information was important in order to ascertain whether farmers produced round potato for and in accordance with the market needs. Producing for market is one of the most important challenges in the government efforts of commercialising food production (URT, 1997; Sokoni, 2008; Wolter, 2008b).

Questions for both farmers and the market surveys were written in English but enumerators read to respondents in *Swahili*, the Tanzanian national language. Enumerators were trained prior to the survey. The training aimed at familiarising them with the purpose and objectives of the study, introducing to them the survey questionnaires, interviewing skills and ethics, and recording answers. The experiences from the pilot survey were shared and discussed. Also, they were trained to use probing and cross-checking questions to validate answers when necessary.

In addition to farmers' interviews, depth interviews were conducted to agricultural research officers from Uyole Agricultural Research Centre in Mbeya and Uyole-Milundikwa Centre at Nkasi. The interviews focussed on the available round potato

varieties and their markets, round potato farming experiences, and the opportunities and challenges surrounding the round potato production in the study areas.

Secondary data were obtained from various sources including previous studies and publications, Uyole Agricultural Research Centre, regional and national agricultural documents, National Bureau of Statistics (NBS) and Ministry of Agriculture and Food Security, Sokoine National Agricultural Library (SNAL), International Potato Centre (CIP) and the UNFAO.

3.6 Data Processing and Analysis

3.6.1 Data processing

The data collected from the survey questionnaires were coded and entered into the Statistical Package for Social Sciences (SPSS 16.0) and validated. According to Tabachnick and Fidell (2007), collected data should be cleaned, validated and/or transformed to ensure for accuracy with which data have been entered, treatment of missing data, meeting the assumptions of the multivariate procedures, and detecting the presence of outliers. Since many multivariate procedures are based on assumptions then the fit between own data set and such assumptions is assessed before the procedure is applied. Also, transformations of variables to bring them into compliance with requirements of analysis should be considered (Tabachnick and Fidell, 2007).

In this study, the accuracy with which data were entered and the presence of outliers were assessed by using frequency tables and descriptive statistics such as minimum and maximum values, means and standard deviations. Also, missing values were treated differently depending on the type of analysis to be run. In some cases missing values were replaced by means or the most frequent values. However, in other cases missing values

were not treated. One of the situation in which the missing values were not treated is in the GM analysis. For instance, in some cases like Njombe District, majority of respondents used own stored seed tubers rather than buying. Also, at Nkasi District, most of the respondents did not use farm inputs. Thus, in these situations replacing the missing values with the means or modes would imply that such respondents had bought seed tubers or used farm inputs while, in fact, they did not. Also, depending on the type of analysis, some outliers were replaced by means or by missing values.

Transformation of some variables was conducted. For instance, some continuous metric variables such as age were transformed into some categories to depict a clear distribution. Some variables were transformed into binary responses depending on the requirements of the multivariate procedure used. Also, respondents were asked of the total output and the total acreage, so output per acre was computed by dividing the total output by acreage cultivated. These and other transformations were done by using SPSS 16.0.

Cleaned data were mostly analysed using SPSS 16.0. These included descriptive statistics such as frequency/percentage tables, means, standard deviations, box and whisker plots, commercialisation index (CI), and GM analysis. Some frequency tables generated from SPSS were taken to MS Excel for generation of bar charts. Also, the binary logistic regression analysis was run using SPSS while the ANOVA model from regression point of view was done in STATA. In the following sub-sections, some detailed discussion is given on the selection of the models and the software package used for each econometric analysis.

3.6.2 Analytical techniques

There were five main types of analyses performed in this study. These include thematic analysis, gross margin (GM) analysis, analysis of variance (ANOVA), binary logistic regression, and the commercialisation index. In the following subsections, each of the five analyses is discussed in detail.

3.6.2.1 Thematic analysis

Qualitative data obtained from the in-depth interviews were analysed thematically. All transcriptions were typed in MS Word whereby each interview session was entered as a single file. There were ten single files for analysis each corresponding to one in-depth interview session. The files were prepared for interpretation of substantive themes that were developed. This approach was considered appropriate in order to obtain useful information behind the statistics generated in the quantitative data (Creswell, 2003).

3.6.2.2 Profitability analysis

As discussed previously, GM is used to assess the profitability of an agricultural produce (Maredia and Minde, 2002; Said *et al*., 2007). Hence, profitability analysis of round potato production in SHT was carried out using model (1). This model was further disentangled into (10).

$$GM = P_Q Q - P_i \boldsymbol{X_i} \quad \text{..... (10)}$$

Where P_Q is price of output Q, P_i is price of ith input, and $\boldsymbol{X_i}$ is the ith input. It was assumed that Q is a function of inputs $\boldsymbol{X_i}$ and a technology parameter, T, defined by round potato variety, fertiliser use, and agrochemicals, $Q = f(\boldsymbol{X},T)$. In this study, GM was first analysed by location because the use of inputs and prices differed among the three study Districts.

Second, GM was used in the model of ANOVA from regression viewpoint to determine differences in profitability be varieties.

3.6.2.3 ANOVA model

The ANOVA from regression point of view, model (2), was used to determine whether significant differences in profitability existed among different round potato varieties. The regression model for the effect of variety on profitability was developed as in (11).

$$GM_i = \beta_0 + \beta_1 D_{1i} + \beta_2 D_{2i} + \beta_3 D_{3i} + \beta_4 D_{4i} + \beta_5 D_{5i} + \beta_6 D_{6i} + \beta_7 D_{7i} + \beta_8 D_{8i} + \beta_9 D_{9i} + \mu_i \quad \text{..... (11)}$$

Where: β_0 is the (average) GM of *Kikondo* variety and μ_i is the error term;

D_{1i} = 1 if *Kikondo* variety and = 0 if otherwise

D_{2i} = 1 if *Arka* variety and = 0 if otherwise;

D_{3i} = 1 if *Kagiri* variety and = 0 if otherwise;

D_{4i} = 1 if *Kidinya* variety and = 0 if otherwise;

D_{5i} = 1 if *Tigoni* variety and = 0 if otherwise;

D_{6i} = 1 if *Malita* variety and = 0 if otherwise;

D_{7i} = 1 if *Msafiri/Mtega* variety and = 0 if otherwise;

D_{8i} = 1 if *Sasamua/Baraka* variety and = 0 if otherwise;

D_{9i} = 1 a mixture of two or more varieties and = 0 if otherwise;

β_i for $i = 1, 2, 3, 4, ..., 9$ are the differential intercept coefficients.

Since the variable variety has nine categories as shown, model (11) should contain only eight dummy variables so as to avoid the incidence of perfect collinearity as pointed out

by Pindyck and Rubinfeld (1991) and Gujarati and Sangeetha (2007). In this case, we let $\beta_1 = 0$ so that model (11) becomes:

$$GM_i = \beta_0 + \beta_2 D_{2i} + \beta_3 D_{3i} + \beta_4 D_{4i} + \beta_5 D_{5i} + \beta_6 D_{6i} + \beta_7 D_{7i} + \beta_8 D_{8i} + \beta_9 D_{9i} + \mu_i \quad \text{..... (12)}$$

In model (12), *Kikondo* variety is the control or the benchmark. The intercept (β_0) represents the mean value of the benchmark i.e. the mean GM of the *Kikondo* variety. The coefficients attached to the dummy variables in (12) i.e. β_2 through β_9 are differential intercept coefficients because they tell by how much the value of the intercept that receives the value of 1 differs from the intercept coefficient of the benchmark category (Pindyck and Rubinfeld, 1991; Gujarati and Sangeetha, 2007).

Assuming that the error term in (12) satisfies all the Ordinary Least Squares (OLS) assumptions, on taking the expectation of (12) on both sides we have the following:
Mean GM of the round potato of the *Arka* variety:

$$E(GM_i | D_{2i} = 1,\ D_{ji} = 0 \ for\ j = 3,4,5,...,9) = \beta_0 + \beta_2 \text{..... (13)}$$

Mean GM of the round potato of the *Kagiri* variety:

$$E(GM_i | D_{3i} = 1,\ D_{ji} = 0 \ for\ j = 2,4,5,6,7,8,9) = \beta_0 + \beta_3 \text{..... (14)}$$

Mean GM of the round potato of the *Kidinya* variety:

$$E(GM_i | D_{4i} = 1,\ D_{ji} = 0 \ for\ j = 2,3,5,6,7,8,9) = \beta_0 + \beta_4 \text{..... (15)}$$

Mean GM of the round potato of the *Tigoni* variety:

$$E(GM_i | D_{5i} = 1,\ D_{ji} = 0 \ for\ j = 2,3,4,6,7,8,9) = \beta_0 + \beta_5 \text{..... (16)}$$

Mean GM of the round potato of the *Malita* variety:

$$E(GM_i \mid D_{6i} = 1,\ D_{ji} = 0\ for\ j = 2,3,4,5,7,8,9) = \beta_0 + \beta_6 \quad \text{..... (17)}$$

Mean GM of the round potato of the *Msafiri/Mtega* variety:

$$E(GM_i \mid D_{7i} = 1,\ D_{ji} = 0\ for\ j = 2,3,4,5,6,8,9) = \beta_0 + \beta_7 \quad \text{..... (18)}$$

Mean GM of the round potato of the *Sasamua/Baraka* variety:

$$E(GM_i \mid D_{8i} = 1,\ D_{ji} = 0\ for\ j = 2,3,4,5,6,7,9) = \beta_0 + \beta_8 \quad \text{..... (19)}$$

And the mean GM of the round potato of the mixture of two or more varieties:

$$E(GM_i \mid D_{9i} = 1,\ D_{ji} = 0\ for\ j = 2,3,4,...,8) = \beta_0 + \beta_9 \quad \text{..... (20)}$$

Similarly, the mean GM of the round potato of the *Kikondo* variety, which is the benchmark category, is β_0 or:

$$E(GM_i \mid D_{ji} = 0,\ \ for\ j = 2,3,4,...,9) = \beta_0 \quad \text{..... (21)}$$

Equations (13) through (21) tell us that the mean GM of round potato of the *Kikondo* variety is given by the intercept, β_0, and the slope coefficients β_2 through β_9 tell by how much the mean GM of round potato of the *Arka*, *Kagiri*, *Kidinya*, *Tigoni*, *Malita*, *Msafiri/Mtega*, *Sasamua/Baraka*, and the mixture of two or more varieties differ from the mean GM of round potato of the *Kikondo* variety.

The ANOVA model (12) from the regression point of view was run using STATA (Appendix 3). Although such model could also be run in SPSS 16.0, STATA provide concise results in just one table (Rabe-Hesketh and Everitt, 2007).

3.6.2.4 Logistic regression model

The dependent variable was the round potato variety (VARIETY) that respondents produced. This VARIETY had many categories because there were over 10 varieties of round potato grown in the study areas. Whereas the dependent variable has many such categories it is recommended to use the extended (multiple or multinomial) logit model (Pindyck and Rubinfeld, 1991; Powers and Xie, 2000). However, the variable, VARIETY, has too many categories some of which have relatively small sample size. Running a multinomial logit model in this case would not provide meaningful results. According to Gujarati (2006) and Gujarati and Sangeetha (2007), it is up to the researcher to decide on the number of categories to be used. Where many categories exist, merging some of them is a common practice. Therefore, the varieties of round potato were divided into two (binary variable), one group representing *Kikondo* and *Arka* and the second group representing other varieties such as *Kagiri*, *Kidinya*, *Tigoni*, *Malita*, *Mtega*, *Sasamua*, *Baraka*, and a mixture of varieties. According to the market survey undertaken in this study, *Kikondo* and *Arka* were the mostly preferred varieties. As such it was important to ascertain whether or not famers' selection of round potato varieties is in accordance with the market needs. Hence, the binary logistic regression model was used.

The logistic regression begins with the explanation of the logistic function (Stock and Watson, 2007; Tabachnick and Fidell, 2007):

$$P(Z) = \frac{1}{1+e^{-Z}} \quad \text{..... (22)}$$

In equation (22), the input is Z and the output is $P(Z)$. Where Z represents the exposure to some predictor factors, while $P(Z)$ represents the probability of a particular outcome, given the set of predictor factors. Z is the measure of the total contribution of all the

predictor factors in the model and is known as the logit. However, the logits of the unknown binomial probabilities (i.e. logarithms of the odds) are modelled as a linear function of the $X_i's$ so that:

$$Z = \log it(P_i) = \ln\left(\frac{P_i}{1-P_i}\right) = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + ... + \alpha_n X_n + \varepsilon \quad \text{..... (23)}$$

Where, ε is the stochastic error term α_0 is the intercept and $\alpha_i's$ are regression coefficients of $X_i's$ respectively. The dependent variable (Z) is the natural logarithm of the probability of selecting round potato variety(ies) in accordance with the market needs (P_i), divided by the probability of not selecting varieties basing on the market needs ($1-P_i$). Therefore, from equation (23), Z is usually defined as:

$$Z = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + ... + \alpha_n X_n + \varepsilon \quad \text{..... (24)}$$

The intercept is the value of Z when the value of all predictor factors is zero. Each of the regression coefficients describes the size of the contribution of that factor. A positive regression coefficient means that that predictor variable increases the probability of the outcome while a negative coefficient decreases the probability of the outcome. Hence, from equation (24) above, the binary logistic regression model for this study was developed as in equation (25).

$$\begin{aligned} VARIETY = {} & \alpha_0 + \alpha_1 SEX + \alpha_2 AGE + \alpha_3 EDUC + \alpha_4 \ln PRICE + \alpha_5 RADIO \\ & + \alpha_6 MOBILE + \alpha_7 LOCAT + \alpha_8 EXT + \varepsilon_i \end{aligned} \quad \text{..... (25)}$$

Description of each variable used in (25) together with the measurement scale are provided in Table 8.

Table 8: SHT: Definition of the variables used for logistic regression model

Variable	Definition	Type	Measurement
VARIETY	Dependent variable used in the logit model	Binary	1 = Kikondo/Arka 0 = otherwise
SEX	Gender of the respondent	Binary	1 = male 0 = female
AGE	Age of the respondent	Metric	Years
EDUC	Number of years in school	Metric	Years
PRICE	Selling price last season	Metric	TZS/100kg bag
RADIO	Ownership of a radio set	Binary	1 = Owns a radio set 0 = otherwise
MOBILE	Ownership of a mobile phone	Binary	1 = owns a mobile phone, 0 = otherwise
LOCAT	Location of the respondent	Binary	1 = Njombe/Mbeya 0 = otherwise
EXT	Consultation with extension officers	Binary	1 = if consulted 0 = otherwise

Farmer characteristics such as gender, age and level of education are said to influence farming decisions. Selling price of the agricultural produce also affects the decision of the farmer regarding the crop or crop variety to be produced. However, farmers decide on the crop or crop variety to produce based on previous season prices. This is usually the case because the production period takes time then supply will be inelastic so producers will use the current prices to decide on the crop to produce for the next season.

Ownership of a radio set and a mobile phone facilitates the information search process. According to Mpogole *et al*. (2008), mobile phones have the power of reducing the information asymmetry of the rural population. It was expected that farmers owning radio

sets and/or mobile phones would be more informed of the market demand and prices than others.

Location and consultation with extension services were also expected to influence farmers on the decision of the round potato variety to grow. It has been detailed in the literature that farmers from high potential areas are more likely to adopt best practices in farming as opposed to those from low potential areas in terms of access to both input and output markets. Also, farmers who make consultation with extension officers are more likely to farm for the market than others.

Consideration of the number of variables to be included in a multivariate model such as equation (25) is important. According to Tabachnick and Fidell (2007), the general rule is to get the best solution with fewest variables. As more and more variables are included, the solution improves, but only slightly. Sometimes the improvement does not compensate for the cost of degrees of freedom of including more variables, so the power of the analysis diminishes. Tabachnick and Fidell (2007) further argue that another thing to consider in model specification is overfitting. Overfitting occurs when too many variables are included in an analysis relative to the sample size. Therefore, the general rule is to include only a limited number of uncorrelated variables in each analysis while ensuring the normality of variables.

Assessing variables for normality by using either statistical or graphical methods is an important early step in almost every multivariate analysis (Stock and Watson, 2007; Tabachnick and Fidell, 2007). However, when the sample is large it is a good idea to examine the shape of the distribution by using graphical methods instead of using statistical tests because the standard error for both skewness and kurtosis decrease with

larger samples (Tabachnick and Fidell, 2007). Therefore, in this study, normality of variables was assessed by using the expected normal probability plots (normal P-P plots) and the detrended normal P-P plots (Appendix 1). The normal P-P plots indicated that the logistic regression variables did not significantly deviate from the normal distribution because most cases lined up along the diagonal with minor deviations due to random processes (Appendix 1). Also, the detrended normal P-P plots showed that the cases distributed themselves evenly above and below the horizontal line that intersects the *Y* axis at 0.00, the line of zero deviation from expected normal values.

Model (25) was estimated by using the Forward Stepwise (Likelihood Ratio) procedure. The forward stepwise procedure includes one variable at a time while observing the pseudo R-square. Variables that improve R-square are retained while those which reduce it or only improve slightly are removed from the equation. This analysis was carried out by using SPSS (Appendix 2), which is very flexible and user friendly in terms of choice of the methods and procedures to use.

3.6.2.5 Commercialisation index

Commercialisation of subsistence agriculture can take place on the output side as well as on the input side (Von Braun and Kennedy, 1994). On the output side of production, commercialisation is manifested by the increased marketed surplus while on the input side it is shown by the increased use of purchased inputs. This study assessed the commercialisation of round potato production from the output side. According to Von Braun and Kennedy (1994), commercialisation on the output side is defined as in equation (26):

$$Commercialisation\,of\ agriculture = \frac{Value\,of\ agricultural\ sales\,in\,markets}{Agricultural\ production\,value} \quad \text{..... (26)}$$

The Commercialisation Index (CI) was used to determine the extent of commercialisation of round potato production. Deriving from Von Braun and Kennedy (1994), Strasberg *et al*. (1999), and Bekele *et al*. (2011), the commercialisation index (CI) for round potato production can be defined as:

$$CI = \frac{Gross value of\ all\,round\ potato sales}{Gross value of\ all\,round\ potato\,production} \times 100\% \quad \text{..... (27)}$$

CI measures the extent to which round potato production is oriented toward the market, so a value of zero would signify a totally subsistence-oriented farmer while the closer the index is to 100%, the higher the degree of market orientation (Strasberg *et al*., 1999). Since CI depends on the output *Y*, and assuming that farmers consume a fixed amount, *c*, of round potato, then:

$$CI = \frac{Y - c}{Y} \times 100\% \quad \text{..... (28)}$$

This assumption is realistic since farmers' consumption of a particular food crop cannot increase indefinitely with increasing production, *e.g.* if a farmer or rather a household consumes an amount equal to *c*, then any excess above *c* should be sold. The relationship in (28) is desirable since the higher the production (*Y*) the higher is the CI, *i.e*.

$$\lim_{Y\to\infty}(CI) = 100\% \lim_{Y\to\infty}\left(\frac{Y-c}{Y}\right) = 100\% \lim_{Y\to\infty}\left(1-\frac{c}{Y}\right) = 100\% \quad \text{..... (29)}$$

Relation (29) means that as *Y* becomes very large relative to *c*, CI approaches 100%.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

In this chapter, results of the study are presented and discussed. The results are of three main categories namely, the farmers' survey, the market survey, and the depth interviews. Presentation and discussion of the results were organised in the following order: characteristics of the surveyed farmers; market survey; variety selections among farmers; profitability analysis of round potato; commercial orientation of farmers; and challenges faced in round potato production. The market survey was undertaken to assess the preferences for round potato varieties. This served as a benchmark to further analyse whether variety selection among smallholder farmers in SHT was commercial or market oriented. Discussions of depth interviews carried out with selected round potato farmers in SHT and research officers from UARC were summarised in the form of challenges in round potato production.

4.1 Socio-economic Characteristics of the Surveyed Round Potato Farmers

4.1.1 Gender, age, education, and marital status

4.1.1.1 Gender

Results show that the majority of respondents were males as shown in Table 9. The percentage of male respondents was 62%, 79%, and 67% in Njombe, Mbeya Rural, and Nkasi respectively. On average, 69.6% of the all respondents were male while 30.4% were females. Although the percentage of male respondents is higher than that of female, population statistics indicate that the country constitutes more of women than men (URT, 2003b). According to the 2002 National Census, females constituted about 51% of the total population (URT, 2003b). Thus, it can be inferred that the higher percentage of men in this study might be a reflection of the commercial nature of round potato production in

the study areas. This follows the fact that the majority of farmers undertake round potato farming for commercial purposes. According to Kaaria *et al*. (2007) and World Bank (2009) in Africa, studies have shown that when a crop is perceived as commercial, men are more likely to take over from women, and therefore women do not benefit from commercial production as men do.

In this study, it was also expected that gender would have an influence on round potato variety selections because most of the farmers' decisions are based on their socio-economic characteristics. Previous studies such as Makindara *et al*. (2009) and Kilima *et al*. (2010) had similar assumptions.

Table 9: SHT: Sex, age, education, and marital status of farmers visited

	Njombe	Mbeya Rural	Nkasi
	Percent (n=170)	Percent (n=170)	Percent (n=170)
Sex			
Female	37.6	20.6	32.9
Male	62.4	79.4	67.1
Total	100.0	100.0	100.0
Age			
14-29 years	8.2	18.8	19.4
30-44 years	58.2	53.5	57.6
45-64 years	30.6	25.9	22.4
65 years and above	2.9	1.8	.6
Total	100.0	100.0	100.0
Education level			
No formal education	3.5	7.6	3.5
Primary education	81.8	85.3	92.4
O-level secondary education	14.1	5.3	4.1
A-level secondary education/certificate	.6	1.8	0.0
Total	100.0	100.0	100.0
Marital status			
Married	85.9	87.1	92.4
Single	4.1	5.3	3.5
Separated/widowed	10.0	7.6	4.1
Total	100.0	100.0	100.0

4.1.1.2 Age

Table 9 shows that majority of the respondents aged between 30 to 44 years. This age group accounted for about 58% in Njombe and Nkasi Districts and about 54% in Mbeya Rural District. Also, those aged between 45 to 64 years accounted for about 31%, 26%, and 22% in Njombe, Mbeya Rural, and Nkasis Districts respectively. The proportion of respondents in the 14 to 29 years group and the 65 years and above was relatively small. Although the age composition among groups differs in the three Districts they exhibit similar trends. This result indicates that few youths, for example, primary and secondary school leavers were involved in round potato farming activities.

Age of the respondents was expected to affect round potato farming practices and round potato variety selections. Quite often, age is used as an indicator of farming experience. This experience makes certain informational and search costs to be easier. Also, a positive relationship is often expected between efficiency/technology adoption and accumulated experience (Luh, 1995; Makindara *et al*., 2009; Kilima *et al*., 2010).

4.1.1.3 Education

The survey results on the education level of respondents indicated that about 82%, 85%, and 92% of respondents from Njombe, Mbeya Rural, and Nkasi Districts respectively had primary education (Table 9). Also, about 14%, 5%, and 4% of respondents from Njombe, Mbeya Rural, and Nkasi respectively had secondary education. The proportion of respondents with secondary education was nearly 3 times those of Mbeya Rural or Nkasi. However, the trend is similar. The proportion of respondents with no formal education was highest in Mbeya Rural.

The level of education of the farmer was expected to influence decisions on round potato variety selections. It would have been expected that farmers with higher education would have been more commercial oriented than those with lower levels of education. Other studies such as Hawassi (2006), Nkumba (2007) and Kilima *et al*. (2010) found that education level had a positive effect on productivity, market access, and adoption of improved technologies. Also, education level influences the cost of information seeking and negotiating and hence commercial orientation (Von Braun and Kennedy, 1994; Pingali *et al*., 2005; Asrat *et al*., 2009).

4.1.1.4 Marital status

Results on marital status show that about 86% of respondents from Njombe District, 87% from Mbeya Rural District, and 96% from Nkasi District were married while the rest were single, widowed or separated (Table 9). It would be expected that respondents who were living single would have been more involved in commercial farming than married ones because the married farmers would be more concerned with food production for family needs than for profit (World Bank, 2009). For instance, Kilima *et al*. (2010) indicated that married household heads had significantly less maize area under improved technologies than single household heads. Kilima *et al*. (2010) further found that being a married household head reduced the probability of adopting improved technologies by 0.19.

4.1.2 Land ownership, mode of acquisition, and crop allocation

Round potato farmers were asked of the total land they owned, total land they cultivated and the mode of acquisition of most of their land. However, the statistics of the total land owned by respondents were not reported in this study because it was observed that farmers did not measure the total land they owned but rather the land under cultivation. The land under cultivation was measured because when one hires people for cultivation and

weeding whether by hand hoe or oxen then the field had to be measured. The total land under cultivation and the proportion of land for round potato production are discussed in another section. Hence, in this section the means of acquisition of most of the land and criteria used to decide the land sizes for various crops are presented and discussed.

Table 10 shows that the major mode of acquisition of most of the land was through inheritance for all the three Districts. The proportion of farmers who acquired land through inheritance was highest at Nkasi District while Njombe and Mbeya Rural Districts were comparable. According to Gabagambi (2003), the modes of acquisition usually vary from place to place reflecting the scarcity of land.

The common crops grown in the study areas were maize, round potato, beans, wheat, pigeon pea, millet, and vegetables. In Njombe and Mbeya Rural Districts, crop rotation was practiced especially in the round potato fields. After harvesting the round potato, farmers grew either pigeon peas or wheat. This helped to reduce the incidences of soil and tuber born diseases such as those caused by bacteria and virus (UARC, 1990; Goossens, 2002). At Nkasi District, round potato was most intercropped with maize except for a few cases especially at Kipande village.

Table 10: SHT: Mode of acquisition and land size allocation for crops

Mode of acquisition	Njombe	Mbeya Rural	Nkasi
	Percent (n=170)	Percent (n=170)	Percent (n=170)
Inherited	64.7	65.3	74.1
Bought/hired or otherwise	35.3	34.7	25.9
Total	100.0	100.0	100.0
Decision on land allocation for crops			
Food security	50.6	33.5	49.4
Profitability	26.5	25.9	18.8
Cost of production	14.1	31.2	20.6
Availability of seeds	8.8	9.4	11.2
Total	100.0	100.0	100.0

Given that respondents practice intercropping it was important to ask the main criterion they used in deciding the land size for each crop. As shown in Table 10, food security was the most important criterion for land size allocation to various crops at all of the three Districts. Generally, the shortage of land was much severe at Mbeya Rural than Njombe or Nkasi Districts. Also, the maize, which was considered as the staple food at Njombe and Nkasi Districts was not popularly grown in Mbeya Rural where it takes too long to mature because of cold weather.

4.1.3 Use of fertilisers and pesticides in round potato production

Use of fertilisers in round potato production was highest in Njombe District followed by Mbeya Rural while at Nkasi District the use of fertilisers was almost negligible (Table 11). Generally, farmers at Nkasi District were sceptical of using inorganic fertilisers in any crop because they think that they destroy the natural soil fertility. However, some of the farmers were completely unaware that fertilisers can also be applied in round potato production.

Table 11: SHT: Use of fertilisers and herbicides in round potato production

		Njombe	Mbeya Rural	Nkasi
		Percent (n=170)	Percent (n=170)	Percent (n=170)
Use of fertilisers	Yes	97.6	85.9	4.7
	No	2.4	14.1	95.3
	Total	100.0	100.0	100.0
Use of agrochemicals	Yes	96.5	90.0	7.1
	No	3.5	10.0	92.9
	Total	100.0	100.0	100.0

The picture for use of agrochemicals in round potato production was similar to that of fertiliser application. Nkasi District had the lowest use of agrochemicals. Generally, farmers in Njombe and Mbeya Rural Districts considered round potato production as a commercial engagement. This made them apply a lot of fertilisers to increase the output and agrochemicals to prevent the plants from late blight disease. It was common in Njombe and Mbeya Rural Districts for farmers to use the subsidised fertilisers intended for maize production into round potato production. This phenomenon is not uncommon because according to Gabagambi (2009), although the government provides subsidies to major staples it is said that farmers have their own priorities. As such they would allocate subsidised inputs into crops of their own interest rather those directed by the government.

4.1.4 Access to and consultation with extension officers

Many studies evaluate the effect of extension service by measuring the farmers' access to it. Farmers are said to have access to the extension services when an extension officer is available at the village or somewhere nearby. For example, Kabungo (2008) and Namwata *et al*. (2010) estimated that over 55% of round potato farmers in Mbeya Rural had access to extension services. However, access to extension services is not a good indicator of measuring the effect of such services to agricultural production. This is true for the reason

that even when extension officers are present at the village it does not automatically mean that farmers consult them. For example, Fig.7 shows a very big discrepancy between the presence of the extension officer(s) at the village and the actual consultation between the officers and the farmers.

Overall, about 77% of all respondents reported to have been visited by extension officers at their villages. However, only about 27% of all respondents had made consultation with the officers. Even at Nkasi District, where extension officers were present at all of the survey villages but only 16.5% had made consultation with them (Fig.7). At this point two things can be inferred. First, it could be that extension officers were not availing themselves to farmers. Second, it could be that farmers were just reluctant to consult the officers or did not know the role of such officers to them. For instance, regarding the non-use of fertilisers and herbicides at Nkasi where farmers did not know whether such inputs are important in round potato production amid the presence of extension officers. Thus, thorough investigation may still be required to assess the role and effectiveness of the extension officers.

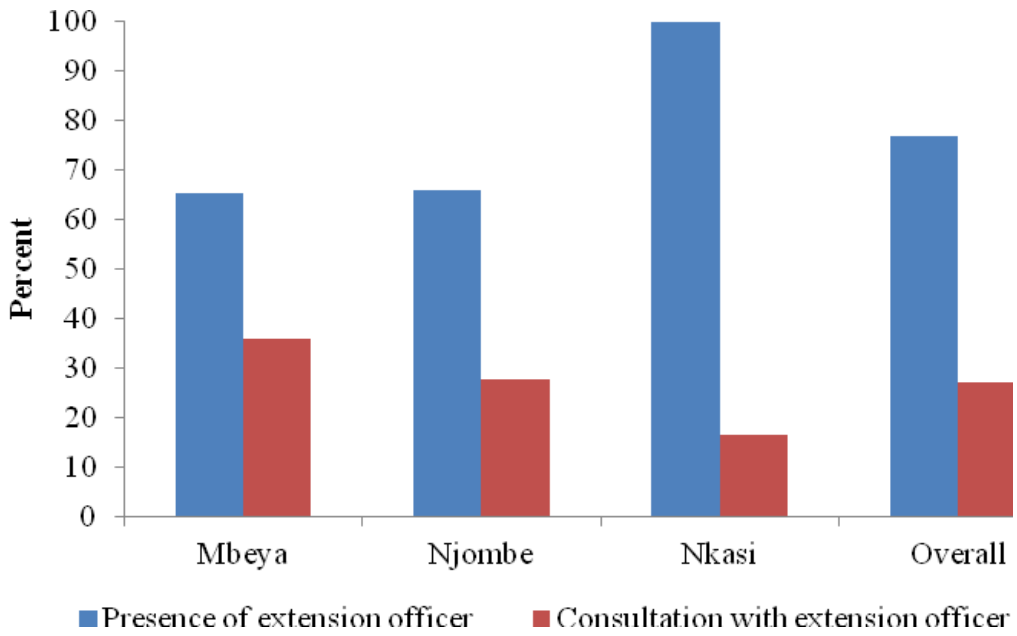

Figure 7: SHT: Access to and consultation with extension officers

4.1.5 Round potato productivity

Fig.8 shows yield levels of round potato for the three districts. Round potato productivity was measured in terms of yield per acre. The crop yield varied greatly in the three districts reflecting the level of inputs used. In Njombe District the minimum yield per acre was 8 (100 kg) bags and the maximum was 107 bags with the average of 44 bags (11 tonnes per hectare). In Mbeya Rural District the minimum yield was 4 bags per acre and the maximum was 100 bags with the average of 33 bags (8.25 tonnes per hectare). Nkasi District had the lowest yield, where the minimum was 1 bag per acre and the maximum was 33 bags with the average of 12 bags (3 tonnes per hectare).

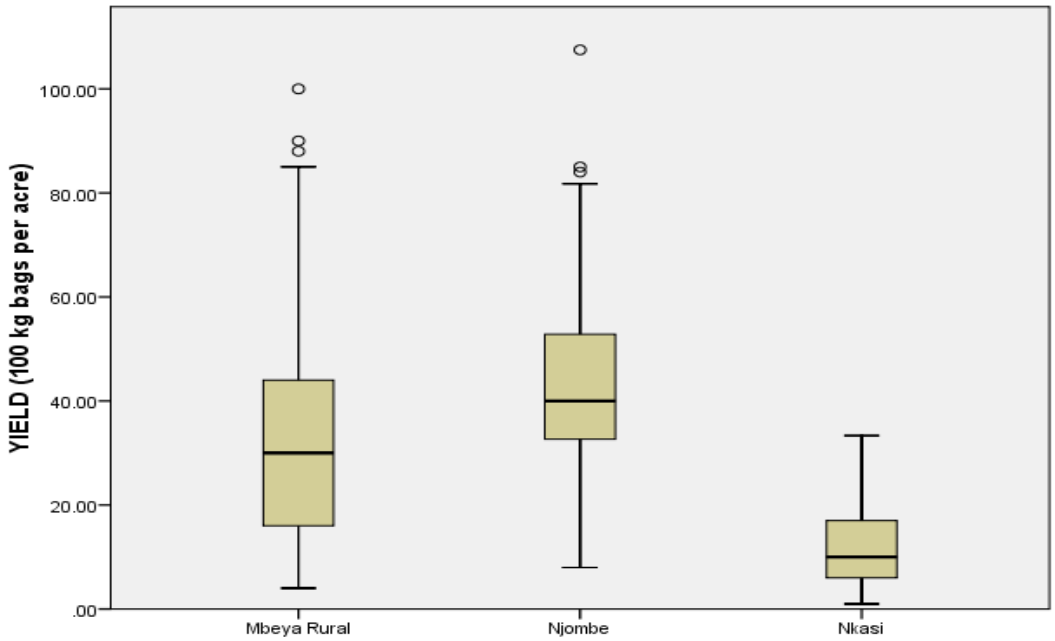

Figure 8: SHT: Round potato productivity in the study areas

The productivity of round potato farmers in SHT is very low. According to FAOSTAT (2008), more yields would be expected under optimal conditions. For example, the round potato yield in South Africa is 34 and in Egypt is 25 tonnes per hectare. This means that potential still exists for improved productivity by proper use of inputs such as fertilisers and herbicides and the use of clean and improved seed tubers.

4.2 Market Preferences for Round Potato Varieties

4.2.1 Introduction of the market survey

Round potato is not just one, there are many different varieties. Different varieties have different characteristics and taste (UARC, 1990). However, while farmers produce those varieties the market preference was not clearly known. For instance, do consumers ask for certain varieties when they buy? How about those who consume the already processed or cooked round potatoes? If they do care, what are the qualities of the varieties they prefer? Answers to these questions were important in explaining the variety selections among

smallholder farmers. That is to say, without knowing the market conditions one cannot certainly justify whether the variety selections criteria that farmers consider are consistent with the market demand.

According to Mafuru *et al*. (2007), it is generally expected that farmers' decision on producing certain crop varieties should base on consumer demand. However, Anyonge and Roshetko (2003) argue that often farmers start planting crops without knowing the market. Producing without knowing the market is contrary to the demand driven production, which requires that farmers produce for the market (OECD, 2008). It is said that the supply driven production creates a mismatch between supply and demand. Whereas farmers complain of lack or shortage of markets, consumers complain of low supply and/or low quality of commodities they need. In this regard, working on market issues may stimulate and increase farmers' production. In fact, it is not just increasing production but rather changing the current practices by making smallholder farmers produce what they can market rather than trying to market what they produce (Kaaria *et al*., 2007). It is argued that when farmers understand and appreciate market demand and conditions, they will demand certain technologies such as improved and high yielding varieties to increase production (Connel and Pathammavong, 2005). Thus, a mini market survey was conducted in Mbeya, Iringa, Morogoro, Dodoma, and Dar es Salaam in order to assess whether or not consumers prefer certain specific varieties of round potato. Therefore, in this section the results of the market survey are presented.

4.2.2 Nature of businesses/sellers visited

A sample of 155 round potato wholesalers, retailers, hotels/restaurants/fast foods/pubs, chips kiosks, and processors was included in the market survey. Visits were made to popular round potato markets, hotels/restaurants/pubs that sold round potato chips and/or

related products, chips kiosks and crisps processors. Table 12 shows the distribution of respondents by nature of their businesses. As it can be seen from Table 12, nearly half of the market survey respondents were round potato retailers.

Table 12: Tanzania: Respondents by nature of the business

Type of business	Percent (n=155)
Wholesaling	3.2
Retailing	48.4
Hotel/restaurant/fast foods	18.7
Chips kiosks	20.0
Processors	2.6
Bar/pubs	7.1
Total	**100**

The market survey data were organised in terms of frequency tables, percentages and cross-tabulations. It should be understood that this was a descriptive survey aiming at obtaining a general picture of the market preferences towards certain varieties of round potato. Therefore, rigorous statistical analysis was not performed at this stage as the market survey did not aim at meeting any statistical significance (see Kumar (2011) and Baker (2003)).

4.2.3 Characteristics of the market survey respondents

Both male and female respondents were included in the market survey. As shown in Table 13, about 66% of respondents were male and only about 34% were female. Like in the farmers' survey, this means that women did not very much participate in round potato related business as men did.

The age distribution of the market survey respondents was as follows: the 26–35 years age group accounted for 46.5%; the 36–45 years group accounted for about 26%; and the 18–

25 years group accounted for about 23% (Table 13). As it can be seen from Table 13, the 46–60 years age group was relatively very small, perhaps reflecting the age distribution and life expectancy in Tanzania. According to National Bureau of Statistics (NBS) (2010), life expectancy at birth in Tanzania mainland is 51 years. At this point it can be inferred that round potato business in the market is dominated by youths of about 26 to 45 years.

Table 13: Tanzania: Age, gender, education and designation of market respondents

Age	**Percent (n=155)**	**Designation**	**Percent (n=155)**
18 - 25 years	23.2	Owner Manager	18.7
26 - 35 years	46.5	Manager	9.7
36 - 45 years	25.8	Seller	48.4
46 - 60 years	4.5	Chips vendor	20.0
		Chef	3.2
Total	**100.0**	**Total**	**100.0**
Education level		**Gender**	
No formal education	11.6	Male	65.8
Primary education	61.9	Female	34.2
Secondary education	21.9		
Certificate/Diploma	3.2		
University/Postgraduate	1.3		
Total	**100.0**	**Total**	**100.0**

With regard to education, about 62% of the respondents were primary school leavers while about 12% did not have any formal education (Table 13). According to the Household Budget Survey (HBS) of 2007 (URT, 2009b), about 24% of adults in Tanzania mainland do not have any formal education. By definition, adults with no formal education are those who never attended school whether primary or adult education programmes (URT, 2009b). It was expected that individuals with higher education would be more informed about consumer variety preferences and qualities of various round potato varieties.

As detailed in chapter three, the study aimed at interviewing persons who were in a better position to explain about round potato varieties they sold, qualities, and consumer

preferences. Hence, in this market survey, about 48% of the respondents were sellers, 20% were chips vendors, about 19% were owner managers, and about 10% were managers (Table 13).

4.2.4 Varieties sold by respondents and consumer preferences

The study assessed the varieties that were handled or sold by respondents, sources/locations where the round potato was produced, and varieties that were mostly preferred by customers. Table 14 shows that about 73% of respondents handled or sold less than 5 (100 kg) bags of round potato per week. This means that majority of market survey respondents were small dealers of round potato.

Varieties that were handled/sold by respondents include *Kikondo*, *Arka*, *Kagiri, Kidinya*, and *Tigoni* (Table 14). *Kikondo* and *Arka* dominated the round potato markets as they accounted for about 91%. Not all respondents knew the common names of varieties but majority used the names of the location where the round potato originated. For instance, *Kikondo* was commonly called *Kiazi cha Njombe* (i.e. potato from Njombe)) because it came from Njombe. *Arka* was called *Kiazi cha Mbeya* because it was predominantly produced in Mbeya. Also, *Tigoni* was called by various names including *Mwai Kibaki*, *Obama*, and *Kenya One* because it originates from Kenya. So, sources or originality of the round potato were more pronounced than the actual or common names of the varieties.

Table 14: Tanzania: Varieties handled/sold, sources, and preferences

Varieties	Percent (n=155)	Sources of round potatoes	Percent (n=155)
Kikondo	31.0	Iringa	28.4
Arka	15.5	Mbeya	23.9
Kikondo and Arka	44.5	Iringa and Mbeya	39.4
Kagiri	2.6	Tanga/Arusha/Kilimanjaro	8.4
Kidinya	3.2		
Tigoni	3.2		
Total	**100.0**	**Total**	**100.0**
Mostly preferred varieties		**Volume handled (100kg bags/week)**	
Kikondo	30.3	Less than 5 bags	72.9
Arka	10.3	6 - 10 bags	13.5
Kikondo and Arka	12.9	11 - 30 bags	8.4
Kagiri	1.3	31 and above bags	5.2
Do not know	45.2		
Total	**100.0**	**Total**	**100.0**

Over 90% of the market survey respondents sold round potato that came from either Iringa or Mbeya or both (Table 14). Only a small proportion of round potato came from Tanga, Arusha, and Kilimanjaro. This reflects the production volume in SHT, which is the biggest producer of round potato in the country. According to URT (2007), Iringa alone produces about 60% of all round potato in Tanzania. Mbeya region ranks second after Iringa.

The mostly preferred variety was *Kikondo* followed by *Arka* as shown in Table 14. About 91% of the total sample said that *Kikondo* and/or *Arka* were the mostly preferred varieties. Other varieties seen in the market were *Kidinya*, *Tigoni*, and *Kagiri*. The characteristics of those varieties were summarised in Table 15.

Table 15: SHT: Characteristics of selected round potato varieties

Variety	Characteristics	Usage	Markets
Kikondo	It is reddish in colour Can be stored for a longer time Higher dry matter content Relatively better taste.	Very good for boiling Very good for chips Good for industrial processing into crisps.	Almost everywhere, but mostly Tanzania mainland Most preferred or popular variety.
Arka	It is also reddish in colour Has deeper eyes than *Kikondo* It is mostly affected by bacterial wilt It is relatively older than *Kikondo* and at times it is considered as a local variety.	Mostly similar to *Kikondo* in terms of boiling and chips.	Mostly Tanzania mainland Second preferred after *Kikondo.*
Kidinya	It is reddish in colour Beautiful and attractive in shape High yielding Early sprouting Easy to peel It came to Mbeya from Lushoto.	Can be made into chips but have lower dry matter content Not good for boiling.	Mostly in Zanzibar It is very popular in Lushoto and Moshi It is also said to be exported to Arab countries from Zanzibar.
Kagiri	Whitish skin with reddish or dark-pink surface eyes To some extent resembles *Kidinya* Completely roundish, hence easy for peeling by a machine.	Suitable for chips Not good for boiling.	Mostly in Zambia and Malawi Also Dar es Salaam and Zanzibar.
Tigoni	It is whitish in colour Irregular roundish in shape Resistant to late blight but highly affected by bacterial wilt Easy to cook and very tasty High yielding It came to Tanzania from *Tigoni* Research Institute in Kenya.	Very good for chips Very good for boiling and mashing into pasta *Tigoni* chips are very tasty and attractive in colour.	Increasingly marketable in Zanzibar and Dar es Salaam.

Source: Observations, S. Kyando and M. Kitigwa (Personal communication, 2009)

Other older varieties such as *Baraka*, *Sasamua*, *Tana*, *Subira* (EAI 2329), and *Bulongwa* (K59 a [26]) have been documented in UARC (1990). However, these varieties are currently disappearing mainly because of low yields, taste, or difficulty in preparation especially boiling or preparing for chips. For example, *Baraka* produces large but hollow tubers.

Tigoni is a relatively new variety in Tanzania originating from Tigoni Research Institute in Kenya. *Tigoni* is a high yielding and tasty variety comparable to *Kikondo*. However, it is highly perishable especially when exposed to moisture. It is early sprouting and hence cannot be stored for a long time as compared to *Kikondo*. It quickly changes colour into greenish and sprouts earlier than *Kikondo*. *Kikondo* on the other hand is comparatively less perishable and can be transported long distances without considerable defects. For these reasons, *Kikondo* may continue to prevail in the market for quite some time although *Tigoni* is also being spread in other areas such as Mufindi and Kilolo Districts in Iringa region and Songea in Ruvuma region (Kyando, S. and Kitigwa, M., Personal Communication 2010).

As shown in Table 14, about 45% of respondents were not able to mention the mostly preferred varieties. This is simply because their customers did not ask about varieties when they come to buy the product especially the cooked or fried potatoes/chips. Market survey respondents were asked whether or not consumers ask about varieties when they come to buy the round potatoes. The answers were summarised in Table 16 by cross-tabulating with the nature or type of business.

Table 16: Tanzania: Incidences of customers asking about varieties by business types

			Do customers ask about varieties?		
			No	Yes	Total
Nature of business	Wholesaler	Count	0	5	5
		% within Nature of business	0.0%	100.0%	100.0%
	Retailer	Count	15	60	75
		% within Nature of business	20.0%	80.0%	100.0%
	Hotel/restaurant /fast foods	Count	27	2	29
		% within Nature of business	93.1%	6.9%	100.0%
	Chips kiosk	Count	27	4	31
		% within Nature of business	87.1%	12.9%	100.0%
	Processor	Count	4	0	4
		% within Nature of business	100.0%	0.0%	100.0%
	Bar/pub	Count	11	0	11
		% within Nature of business	100.0%	0.0%	100.0%
Total			84	71	155
			54.2%	45.8%	100.0%

The market survey results showed that customers who purchased from wholesalers and retailers asked about varieties whereas those who consumed round potatoes or chips from hotels/restaurants, fast food shops, chips kiosks, bar/pubs and those who bought from processors did not generally ask about varieties. Those who bought cooked round potatoes, chips or crisps just ordered without any reference to varieties or originality. For farmers who sell to wholesalers and/or retailers who usually asked about varieties or at least the source where they come from, it is important that they produce varieties in accordance with the market preferences. In the following section, the preferred qualities of round potatoes are presented and discussed.

4.2.5 Preferred qualities of round potatoes by sellers and consumers

Wholesalers, retailers, chips vendors, and processors were asked about the general qualities that they considered when buying round potatoes and the qualities that were considered by their customers. Table 17 shows that colour, taste, dry matter content, and originality were considered as the most important attributes for round potatoes. For instance, wholesalers and retailers reported that their customers did not know much about the names of varieties but could very well distinguish them by colour and originality. Generally, wholesalers and retailers reported that red-skinned round potatoes reflecting *Kikondo* and *Arka* were mostly preferred by their customers. There were clear indications that consumers had associated colour and the dry matter content. They believed, for instance, that red-skinned round potatoes had higher dry matter content than white/purple-skinned ones. Also, the originality of round potatoes was considered as an important attribute. It was believed that round potato from Njombe in Iringa was the best in terms of taste and dry matter content. As such, consumers would ask for round potatoes from Njombe without any reference to the name of the variety.

Table 17: Tanzania: Preferred qualities as stated by wholesalers/retailers

Attribute	Very important	Important	Somehow important
Size		√	
Colour	√		
Shape			√
Taste	√		
Dry matter content	√		
Easy of peeling			√
Source	√		
Price		√	
Variety		√	

Size and shape were relatively less important attributes. This is because farmers and/or middlemen/traders packed the round potatoes in bags without sorting or grading by size or shape. In that case, wholesalers and retailers and their customers alike had to buy the

whole bag which comprises of many different sizes and different shapes of round potatoes. Sorting and grading for smallholder round potato farmers remain to be a challenge. Size and shape are increasingly becoming important attributes for those who peel by using a standardised machine. It is recommended that farmers should grade round potatoes by varieties and size to respectively serve various market segments.

4.2.6 Summary of the market survey

Common varieties that were sold by respondents include *Kikondo*, *Arka*, *Kagiri*, *Kidinya*, and *Tigoni*. *Kikondo* from Njombe in Iringa and *Arka* from Mbeya dominated round potato markets. Both *Kikondo* and *Arka* are red-skinned although *Arka* has deeper eyes than *Kikondo*. Sellers and consumers were not used to common names of respective varieties instead they referred them by names of the origin of the seed tuber. It was found that customers of cooked/boiled round potatoes or fried chips/crisps from hotels/restaurants, fast food shops, chips kiosks, bar/pubs, and processors did not generally ask about varieties. But those who purchased from wholesalers and retailers did ask about varieties in terms of colour and location where they were produced. Generally, red-skinned round potatoes were more preferred to white/purple-skinned ones. Sellers and customers associated colour with dry matter content. Red-skinned round potatoes were believed to have higher dry matter content than white/purple-skinned ones. Colour, taste, dry matter content, and source of round potatoes were considered as important attributes by sellers and consumers. However, customers did not have a choice in terms of size and shape because farmers packed round potatoes without sorting or grading in the first place. Although sorting and grading remain to be a challenge for round potato farmers, it was recommended that they should grade them especially by variety, size and/or shape to serve various market segments.

Understanding market preferences will help in the current government efforts on commercialising smallholder production by establishing a market driven supply. If, for instance, consumers do not ask about varieties when they buy, then farmers would just produce any variety that either minimises production costs or maximises profit.

4.3 Round Potato Variety Selection among Smallholder Farmers

In this section three issues were looked at: first, it was sought to identify the common round potato varieties produced in the study areas; second, since there were many varieties with different characteristics, it was of interest to know the criteria that smallholder farmers considered in the selection process; and third, a set of socio-economic factors were regressed against the varieties selected in order to estimate their effect on variety selections. The effect of the socio-economic factors on variety selection was estimated by using the logistic regression model as in equation (25). Therefore, in the following subsections: the common varieties of round potato produced; farmers perceived criteria for variety selections; and the results of the econometric model of variety selections are presented and discussed.

4.3.1 Common varieties produced in the study areas

There were many round potato varieties grown in the study areas. Common varieties included *Kikondo, Arka, Kagiri, Kidinya,* and *Tigoni, Malita, Mtega, Sasamua, Baraka,* and *Msafiri*. Others include *Tana, Loti, Kala, Ngolofu, Subira* and *Bulongwa*. *Kikondo* was predominantly grown in Njombe while *Arka, Kagiri, Kidinya* and *Tigoni* were mostly grown in Mbeya and *Malita, Mtega, Sasamua,* and *Baraka* are some of the old varieties grown mostly in Nkasi District in Rukwa. Table 18 shows the typical varieties grown by respondents by location. As it can be seen from the Table, Njombe District produces only one variety that is *Kikondo* mainly for commercial purposes. However, respondents

indicated that they also grow other local varieties such as *Loti* and *Kala* for home consumption. Round potatoes for home consumption were grown in the maize fields. Such round potatoes were not formally planted but germinate automatically from the previous year's tubers, which remained in the fields.

Table 18: SHT: Common varieties grown in the study areas

Variety	**Mbeya Rural**	**Nkasi**	**Njombe**
	Percent (n=170)	Percent (n=170)	Percent (n=170)
Kikondo (CIP 720050)	14.1	0.0	100.0
Arka	25.3	19.4	0.0
Kagiri	10.0	0.0	0.0
Kidinya	7.6	0.0	0.0
Tigoni	7.1	0.0	0.0
Malita	0.0	25.3	0.0
Msafiri/Mtega	0.0	17.1	0.0
Sasamua/Baraka	0.0	8.8	0.0
Two or more varieties on separate plots	35.9	4.7	0.0
Mixed varieties in same plot	0.0	24.7	0.0
Total	**100.0**	**100.0**	**100.0**

Farmers in Mbeya Rural around the Mporoto area grew a number of varieties including *Kikondo*, *Arka*, *Kagiri*, *Kidinya* and *Tigoni*. However, as seen in Table 18, many farmers in Mbeya grew two or more varieties in separate fields. This is so for three main reasons. First, is because of the fragmented nature of the family plots as characterised by steep mountain slopes and valleys. Second, is due to the shortage of seed tubers. Unlike in Njombe District where seed tubers can remain or be stored in the field until the next season, that was not the case in Mbeya. Generally, soil at Mporoto area in Mbeya Rural was moist almost throughout the year. Hence, seed tubers remaining in the field usually sprout and germinate in no time. So, farmers had to buy seed tubers almost every season from villages near the Kitulo Conservation Area. In this area the soil conditions are said to be similar to that of Njombe. The third reason is that Mbeya is within the catchment of

Uyole Agricultural Research Centre (UARC), which sometimes distributes improved seed tubers. Also, some researchers at UARC were themselves round potato farmers.

Plate 1: SHT: Farmers selling round potato by road side at Nkundi Village in Nkasi

The case of Nkasi District in Rukwa was quite different and unique in its own. Some smallholder farmers in this District were not even aware of the varieties they grew because they failed to name them. However, this is not surprising because after all, about 25% of respondents at Nkasi grew mixed varieties in the same plot. Further, respondents at Nkasi grew traditional varieties as compared to Njombe or Mbeya. As such they did not have reliable markets, except mainly selling by the road side that runs from Sumbawanga to Mpanda (Plate 1). Practically, no traders have been reported to go to get round potato from this area. Even street chips vendors at Sumbawanga and Namanyere (the capital of Nkasi District) are said to prefer buying the round potato from Mbeya rather than those from Nkasi.

4.3.2 Criteria used by farmers in selecting round potato varieties

Table 19 shows the criteria that respondents considered in selecting the round potato varieties they produced. Results showed that the criteria considered in variety selection varied among the three Districts. In Njombe District, out of the 170 respondents about 38% stated that the main criterion in variety selection was the market demand, while those who said availability of tubers at their locale was 19.4%, selling price was 16%, common practice (11%), and yielding variety (11%). In Mbeya Rural, those who stated that seed tubers availability was the main criterion in variety selection was 33% and those who mentioned market demand was also about 33% while selling price was 23.5% and suitability for home consumption was about 8%. At Nkasi District those who stated that the main criterion was seed tubers availability at their locale was 63.5% while common practice was 13.5%, yield was about 11%, and market demand was about 7%.

Table 19: SHT: Reasons for variety selections

Main reason for variety selection	Njombe	Mbeya Rural	Nkasi
	Percent (n=170)	Percent (n=170)	Percent (n=170)
High selling price for the variety	15.9	23.5	.0
High yielding variety	11.2	2.4	10.6
Most demanded in the market	37.6	32.9	7.1
Resistant to pests and diseases	.6	.6	.6
Seed tubers availability/most available	19.4	33.0	63.5
Recommended by extension officers	1.2	.0	1.2
Suitability for home consumption	2.9	7.6	3.5
Common practice	11.2	.0	13.5
Total	**100.0**	**100.0**	**100.0**

As mentioned previously, Njombe District produced only one variety partly because of market demand and availability of seed tubers. The majority of the farmers reproduced the seed tubers and hence grow same variety in all farming seasons. Also, it was reported that

Kikondo has high dry matter content suitable for boiling, baking, and processing into chips and crisps. As indicated by the market survey, these characteristics of the *Kikondo* made it to be the most preferred variety.

Availability of seed tubers and market demand were the main criteria in variety selection in Mbeya Rural District. Seed tubers created a great challenge because the year round moist soil made the storage of the tubers for the next season to be difficult. Hence, majority of the farmers had to purchase the seed tubers from some distant villages. Since such tubers were not available in abundant, quite often farmers had to purchase the varieties that were available. This is evidenced by the fact that respondents in Mbeya produced many different varieties, the common ones being *Arka, Kikondo, Kagiri, Kidinya,* and *Tigoni* as shown in Table 18. It was typical in Mbeya Rural for a respondent to produce more than one variety at the same time but in different plots because of the difficulty in obtaining enough tubers of one preferred variety.

Round potato variety selection at Nkasi District was mostly based on availability of tubers and the varieties that were traditionally popular in their locale. Incidences of mixed varieties in one plot were very common in this District. As such a good proportion of respondents were not able to name the varieties they produced.

The behaviour of smallholder farmers to use more production criteria than the market conditions in variety selections is not uncommon. For example, other studies such as Bekele *et al*. (2011), Hemachandra and Kodithuwakku (2010), Kudi and Abudlsalam (2008), Beckford (2002), and Rudra (1983) generally indicate that farmers had greater inclination towards production orientation than market/commercial orientation. They argue that farmers consider only a very limited number of commercial oriented criteria as

opposed to a higher number of production oriented or food sufficiency criteria. For instance, Kudi and Abudlsalam (2008) found that apart from other criteria some farmers based their decisions on the beauty of seed colours. While Beckford (2002) found that the size of produced yam tubers was an important factor for adoption of improved yam varieties. The larger tubers produced using the traditional yam stick methods were more desirable because farmers had perceived a direct relationship between tuber size and overall yields.

Since the reasons for variety selection among the three Districts varied, then location itself could also be a factor for variety selection. Location is said to have a negative effect on prices of input factors including those of improved seeds (Omamo, 1998; Pingali *et al*., 2005). Farmers in high potential areas (i.e. areas with high access to input and output markets) generally face lower transaction costs and less risks associated with the switch to high-value crop production. In this study, selection of round potato varieties of the farmers in Njombe and Mbeya Rural Districts were very different from the farmers in Nkasi District. Nkasi District was considered as a low potential area because it is very far from market centres and the transport infrastructure is generally poor.

Although extension officers were available in most of the survey villages, the proportion of farmers who selected certain varieties following recommendations from extension officers were generally negligible (Table 19). This raises questions on the role and effectiveness of the extension officers. Thus, extension service needs to be improved in order to positively guide farmers on where to get and how to select round potato varieties.

4.3.3 Results of the econometric model for variety selections

The determinants of variety choices among smallholder farmers were analysed by using the logistic regression model (Equation 25). The many varieties of round potato that were produced were divided into two categories. One category consisted of two varieties; *Kikondo* and *Arka*, which according to the market survey discussed in section 4.3, were the most preferred ones. Another category consisted of all other varieties as shown in Table 18. The aim was to determine the socio-economic factors for the market oriented variety selections. It was not the aim of this study to determine the adoption of certain improved varieties, which had been detailed by Namwata *et al*. (2010) but rather to determine whether farmers' selections of certain varieties was in accordance with the market preferences. According to Mafuru *et al*. (2007), quite often adoption studies invariably omit the market preferences (or market demand) in analysing the farmers' adoption or selection of certain crop varieties.

It was hypothesised that gender (SEX), age (AGE), education level (EDUC), selling price of the previous season (PRICE), ownership of a radio set (RADIO), ownership of a mobile phone (MOBILE), location of the farmer (LOCAT), and consultation with extension officers (EXT) would affect farmers' decision on round potato variety selections (Table 8). This was achieved by running the binary logistic regression model (25) using the Forward Stepwise (Likelihood Ratio) method as detailed in chapter three. Three statistically insignificant factors, namely, AGE, RADIO, and MOBILE were removed from the equation. Results were as shown in Table 20 and the detailed model output in Appendix 2.

Results showed that the estimated logistic model was significant in explaining smallholder farmers' variety selections. The log-likelihood ratio was highly significant (Table 20). Also, the Cox and Snell R-square was 0.314 and the Nagelkerke R-square was 0.418.

Higher values of these pseudo R-square indicate greater model fit (Hair *et al*., 2006). However, the Cox and Snell R-square is limited in that it cannot reach the maximum value of 1. Hence the Nagelkerke R-square, which ranges from 0 to 1 is often used (Hair *et al*., 2006). Although the Nagelkerke R-square was relatively high, Gujarat and Sangeetha (2007) argue that in binary regressand models, the goodness of fit is of secondary importance. What matters are the expected signs of the regression coefficients and their statistical significance.

Consultation with extension officers (EXT), location of the respondents (LOCAT), selling price (PRICE), education level (EDUC), and sex (SEX) were found to have a significant effect in explain farmers' variety selections. Farmers who consulted the extension officers were more than two times likely to choose round potato varieties in accordance with the market conditions than those who did not. It should be understood that in this study, the interest was to measure effect of consultation with extension officers rather than the access to such services as done by Kabungo (2008), Asrat *et al*. (2009), and Namwata *et al*. (2010). Farmers are said to have access to extension services when an officer is available at or at the nearby village. But the actual consultation happens when a farmer visits the extension officer or the vice versa and receives advise regarding production or marketing of a certain product. As discussed previously, access and actual consultation are two but different things because even where extension officers were available the proportion of respondents who sought their services was very low (Fig.7). Since results indicated that consultation with extension officer(s) is likely to influence farmers' variety selections in accordance with the market then the actual consultation between farmers and extension officers should be improved.

Table 20: SHT: Results of the variety selection model

Variable	Proxy parameter	Expected sign	Estimated coefficient	Std. Err.	Wald	Exp(α)
Constant	α_0	+/-	22.991**	4.482	26.310	9.656E9
SEX	α_1	+/-	1.031**	.265	15.162	2.803
EDUC	α_3	+	.157*	.062	6.380	1.171
LnPRICE	α_4	+/-	-2.444**	.455	28.830	.087
LOCAT	α_7	+/-	-1.968**	.277	50.614	.140
EXT	α_8	+/-	.970**	.253	14.670	2.637

Model summary	
-2 Log likelihood (-2LL)	497.944
LR chi2(5)	185.905
Prob > chi2	0.000
Cox & Snell R2	0.314
Nagelkerke R2	0.418

******significant at 1%; *****significant at 5%

With respect to location, farmers at Nkasi were less likely to select round potato varieties in accordance with the market preferences than their Mbeya/Njombe counterparts. As mentioned previously, Nkasi District was treated as a low potential district in terms of access to both input and output markets. The District did not have specialised traders from outside as such selling of the output was localised and limited to the roadsides (Plate 1). Also, incidences of producing mixed varieties were common at Nkasi District making the issue of rational selection irrelevant. Many farmers at Nkasi District knew of the round potato crop but less of the presence of the different varieties. Other studies, for example, Ahmed (1994), Omamo (1998), Smale *et al*. (2001), Gabagambi (2003), and Pingali *et al*. (2005) found similar results. For instance, Ahmed (1994), Omamo (1998), and Gabagambi (2003) explained location in terms of access to a reliable transport infrastructure. They found that distance to a reliable all weather roads has a significant but negative effect on the use of purchased inputs including those of improved seeds and access to output markets. On the other hand, Smale *et al*. (2001) and Pingali *et al*. (2005) explained location in terms of transaction costs. They argue that variations in locations affect the level of transaction cost and hence input use decisions.

Selling price of the previous season and education level had a significant effect on respondents' decision regarding variety selections. It is of interest to discuss the prices of the previous season rather than the current prices because when prices go up today, farmers cannot produce tomorrow that product of interest but rather wait till the next season. That means current prices guide what farmers may want to produce in the next season.

Respondents who spent more years in school were more likely to choose round potato varieties according to the market preferences than those with low level of education. This

is also consistent with other studies such as Lockheed *et al*. (1980), Phillips (1994), Luh (1995), Joshi and Bauer (2006), Hawassi (2006), and Nkumba (2007) which generally found that education level was one of the significant factors in variety selections. They found that farmers with higher levels of education preferred certain improved seed varieties.

In terms of gender, male farmers were 2.8 times more likely to select varieties according to the market conditions than female ones. Previous studies such as Kilima *et al*. (2010) and Namwata *et al*. (2010) found similar results where among other factors, being a male was positively and significantly associated with the adoption of improved technologies such as seed varieties. This could be due to the explanation given by Kaaria *et al*. (2007) and World Bank (2009) that in Africa, men are more involved with crops for the market than women who quite often produce for home consumption.

4.4 Profitability of Round Potato by Location and Varieties

Profitability analysis for round potato production was carried out using the GM analysis as in equation (10). The GM analysis was segregated by location i.e. according to the three Districts, Njombe, Mbeya Rural and Nkasi. Then using the econometric model in equation (12), an ANOVA from regression view point was carried out to determine the differences in GM by varieties. In this section, the results of the two analyses are presented and discussed.

4.4.1 Round potato profitability analysis by location

Round potato production in the study areas was found to be highly profitable as indicated by the GM in Table 21. As mentioned previously, the yield per unit of land was highest in Njombe followed closely by Mbeya Rural. However, the selling price was lowest in

Njombe. This is due to the fact that almost all farmers in Njombe produced the round potato at the same time, thus lowering their bargaining power and farm gate prices. Round potato production in Mbeya Rural was practiced throughout the year thus fetching higher prices especially at times when there was little or no production in Njombe in the months from August to January. The average selling prices per 100kg bag were TZS 17 000 in Njombe, TZS 22 000 in Mbeya Rural, and about TZS 26 000 at Nkasi. The high farm gate prices at Nkasi District were due to the lowest production in this area. However, because of higher yield per unit area, Njombe enjoyed the highest gross revenues.

Table 21: SHT: Round potato profitability analysis

S/N	Description	Mbeya Rural		Njombe		Nkasi	
		Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
1	Acres under round potato production	1.93	1.50	1.92	1.12	1.03	0.66
2	Total output (100 kg bags)	103.68	311.48	91.39	83.99	12.94	13.40
3	Output per acre (100 kg bags/acre)	33.13	21.70	43.96	17.26	11.74	6.92
4	Selling price (TZS per 100kg bag)	21 661.00	5 594.53	17 042.00	4 412.61	25 899.00	4 670.44
5	Gross Income (TZS/acre)	742 320.00	543 722.00	758 170.00	364 100.00	307 200.00	193 715.00
6	Seed buying (TZS per acre)	168 510.00	53 260.78				
7	Farm clearing (TZS per acre)	7 915.30	9 654.89	11 204.00	13 277.08		
8	Tillage (TZS per acre)	47 413.00	37 169.67	28 571.00	4 756.67	13 309.00	4 666.38
9	Sowing (TZS per acre)	30 276.00	9 199.18	24 608.00	5 151.63		
10	Weeding (TZS per acre)	34 010.00	11 673.61	31 260.00	10 907.80	18 245.00	7 444.21
11	Fertilisers (TZS per acre)	109 020.00	49 653.89	119 370.00	47 546.24		
12	Chemicals (TZS per acre)	17 644.00	12 138.33	25 101.00	10 519.09		
13	Spraying (TZS per acre)	14 012.00	5 834.19	12 888.00	4 376.80		
14	Harvesting and carriage (TZS per acre)	75 054.00	48 464.39	44 121.00	15 635.59	22 840.00	19 335.65
15	Total Operating Costs (TZS/acre)	338 670.00	231 779.00	284 420.00	83 502.29	51 695.00	23 416.17
16	**Gross Margin (TZS/acre)**	**458 210.00**	**454 244.00**	**489 600.00**	**358 418.00**	**262 550.00**	**193 183.00**
17	Return per shilling invested (16)/(15) (TZS)	1.35		1.72		5.08	
18	Return per bag harvested (16)/(3) (TZS)	13 829.75		11 137.96		22 370.00	

Operating costs varied by location as well. In Njombe District majority of respondents stored their own seed tubers for the next farming season while in Mbeya Rural, majority of respondents had to purchase seed tubers almost every other farming cycle. Also, at Nkasi District, majority of respondents did not buy the seed tubers and most of the farm-work was done by farmers themselves with only a few cases of hired labour. The use of inputs such as fertilisers and chemicals at Nkasi were virtually absent. Thus, highest operating costs were found in Mbeya Rural followed by Njombe. However, Njombe still had the highest GM per unit of land. As it can be seen from Table 21, both the return per shilling invested and the return per bag harvested were highest at Nkasi for the main reason that operating costs at this District were minimal because of low or non-use of inputs and hired labour. On the other hand, this implies that if best practices were adopted at Nkasi then it is likely that round potato production would be highly profitable there.

4.4.2 Results of the ANOVA model

The results of the ANOVA model from the regression view point equation (12) are given in Table 22 and the detailed model output in Appendix 3. Results showed that all varieties were profitable since $\beta_0 + \beta_i > 0$ for $i = 2,3,4,...,9$. However, significant differences existed in profitability among the round potato varieties.

Table 22: SHT: Results of the ANOVA model from regression viewpoint

Variety	Proxy parameter	Coefficient	Std. Err.	t
Arka	β_2	-107 157.30**	44 854.87	-2.39
Kagiri	β_3	309 989.30***	93 000.60	3.33
Kidinya	β_4	-183 788.50*	103 266.50	-1.78
Tigoni	β_5	133 267.00	107 609.50	1.24
Malita	β_6	-183 754.50***	67 003.15	-2.74
Msafiri/Mtega	β_7	-231 251.60***	73 656.99	-3.14
Sasamua/Baraka	β_8	-193 626.90*	107 609.50	-1.8
Mixed varieties	β_9	-220 923.40***	79 664.46	-2.77
_cons	β_0	484 899.60***	24 283.99	19.97

***Significant at 1%, **Significant at 5%, *Significant at 10%

The most profitable varieties were *Kagiri*, followed by *Tigoni*, *Kikondo* and *Arka*. The GM of the *Kikondo* variety was about TZS 484 900 as represented by β_0. This GM is quite comparable with that of TZS 489 600 in Table 21 for Njombe District, which produced *Kikondo* variety only. The GM of other varieties is found by taking $\beta_0 + \beta_i \text{ for } i = 2,3,4,...,9$. For instance, the mean GM of *Kagiri* was TZS 794 889, *Tigoni* (TZS 618 167), and *Arka* (TZS 377 743).

It was reported that *Kagiri* was sold in Zambia and Malawi where it was mostly preferred and fetched higher prices. However, not many farmers produced it as it was not very much preferred by the local consumers. *Tigoni*, the variety which was increasingly being popular because of comparable taste to *Kikondo* and higher yields was the second profitable after *Kagiri*. *Arka*, one of the oldest varieties was less profitable as compared to *Kagiri*, *Tigoni*, and *Kikondo*.

Given the empirical results in Table 22 above, it would have been expected that majority of round potato farmers would be producing *Kagiri*, which is the most profitable variety. However, Table 18 showed the contrary that only a very small proportion of farmers produced it. This is also contrary to the standard economic theory that farmers as maximisers of short run profits would grow such crops or crop varieties that promise to yield higher profits. This finding does not automatically imply that farmers are irrational. Results in Table 19 indicated that round potato farmers considered a number of other factors perhaps more important than profit. Indeed, profitable as it is production of *Kagiri* was risky because its major market was Zambia and Malawi as local consumers did not prefer it.

4.5 Commercial Orientation of Round Potato Farmers

In this section the extent to which round potato production was commercial/market oriented is presented and discussed. This was achieved by analysing the proportion of land allotted to round potato production and the extent to which production of the crop was oriented towards the market by using the commercialisation index (CI) model (27).

4.5.1 Proportion of land allotted to round potato production

Results in Table 23 show that land sizes under cultivation in the three districts were very small with the average of less than 7 acres. This is not surprising because it has often been reported that smallholder farmers in Tanzania farm on small and fragmented plots (Wolter, 2008a; Sokoni, 2008). For instance, Wolter (2008a) shows that land sizes for smallholder farmers in Tanzania ranged from about 2.0 to 7.5 acres (or about 0.9 to 3 hectares).

Table 23: SHT: Land ownership and acreage allocation for round potato and maize

District	Land ownership and crop allocation	Minimum	Maximum	Mean	Median
Njombe	Total land under cultivation (acres)	1.00	13.00	4.71	4.00
	Proportion of land under cultivation	.17	1.00	.82	-
	Land size under maize production (acres)	.50	6.00	2.17	2.00
	Land under round potato production (acres)	.25	7.00	1.99	2.00
	Land under round potato per total under cultivation	.08	.67	.42	.40
Mbeya Rural	Total land under cultivation (acres)	1.00	40.00	3.74	3.00
	Proportion of land under cultivation	.13	1.00	.96	-
	Land size under maize production (acres)	.50	10.00	1.69	1.00
	Land under round potato production (acres)	.50	40.00	2.63	2.00
	Land under round potato per total under cultivation	.10	1.00	.71	.67
Nkasi	Total land under cultivation (acres)	3.00	21.00	7.08	5.00
	Proportion of land under cultivation	.20	1.00	.71	0.70
	Land size under maize production (acres)	1.00	14.00	3.87	3.00
	Land under round potato production (acres)	.50	3.00	1.14	1.00
	Land under round potato per total under cultivation	.03	.75	.20	.17

From a commercial point of view, the average acreage under production was too small to provide any meaningful output for business purposes. However, in the theory of peasant economics, there appears to be an inverse relationship between farm size and productivity (Carter, 1984; Ellis, 1988). The gross output per unit of land for a small farm has been shown to be higher than that of a bigger farm. The proposition that Ellis (1988) develops is that small farms generally make more efficient use of resources than large farms, an argument which is similar to Schumacher (1989) who also advocates for small farms which involve mass participation. Although Philip (2009) has shown the contrary that productivity does not decrease with increasing farm size for sugarcane smallholder farmers it is still a point of concern. Sugarcane as used by Philip (2009) is a typical crop whereby the bigger the farm the more the output. The situation might be different for other crops such as round potato, which requires lots of inputs such as fertilisers and agrochemicals.

What is surprising, however, is the proportion of land that was allotted to round potato production. The proportion of land that was allotted to round potato production out of the total land under cultivation was as follows: 42% in Njombe; 67% in Mbeya Rural; and 20% at Nkasi.

Mbeya Rural had the highest proportion of land under round potato cultivation but its per capita land size was very small (Table 23). This is due to the fact that land in Mbeya Rural around the Mporoto area where most of the round potato was produced is characterised by mountain slopes and valleys making producers farm on very small and fragmented plots. Also, in this area maize, for instance, takes too long to be ready for harvest compared to Njombe and Nkasi districts. This makes round potato to be a potential crop around the Mporoto area. As opposed to Njombe and Mbeya Rural, the proportion of land under

round potato production at Nkasi was relatively small. This could be due to the remoteness nature of the district, which is very far from potential market centres with poor transport infrastructure. This makes farmers in this area to produce more of maize than round potato because maize does not require heavy inputs as compared to round potato. Also, maize can be stored for a longer time compared to round potato, which is highly perishable.

Although the total land sizes under cultivation were comparable to other studies, it was found that the proportion of 20% to 67% of land allotted to round potato production was high. This high proportion of land allotted to round potato is also consistent with the expectation that since round potato was considered as more profitable than maize then farmers would increasingly allocate more land to it. Therefore, this is an indication of movement towards commercialisation with respect to round potato production. This conclusion does not disregard the inverse relationship between farm size and productivity as discussed by Carter (1984) and Ellis (1988). However, the argument here is that commercial oriented farmers would allocate more acreage to a crop or a crop variety that subject to probabilities promises to yield higher profits.

The preceding discussion shows that respondents treated round potato as a commercial crop. Nonetheless, to be certain of the extent of commercialisation of the crop, the commercialisation index was established and discussed in the following sub-section.

4.5.2 Commercialisation index

Commercialisation index (CI) was calculated using equation (28). Results showed that CI for round potato was 86% in Njombe, 91% in Mbeya Rural, and 88% at Nkasi District (Table 24). On average about 88% of all round potato produce was being sold. The remaining output was either consumed or stored as seed tubers for the next season or both.

The CI of 88% as found in this study is surprisingly high. According to Strasberg *et al*. (1999) and Bekele *et al*. (2011), a crop commercialisation index greater than 50% signifies a commercial oriented farmer for a crop under consideration. Since the commercialisation index for this study is about 88% then round potato production is highly commercialised in the study areas. As mentioned previously, this means that farmers in the study areas consider round potato as a commercial crop.

Although no studies have assessed the commercialisation index of farmers in Tanzania, Nyikai (2003) argues that majority of smallholder farmers in Sub-Saharan Africa are neither purely subsistence nor purely commercial. They are either semi-commercial or semi-subsistence. Some farmers usually produce certain crops for home consumption and some specific crops for sale (Bekele *et al*., 2011). In this case the commercial orientation of farmers should be measured with reference to a specific crop rather than the farmer in general.

Given that only about 20% of all arable land is cultivated in Tanzania, then opportunities exist in terms of land expansion for round potato production (URT, 2009a). The current land holdings among famers are too small to provide for meaningful commercial outputs.

Table 24: SHT: Commercialisation index (CI) of round potato production

	Total output (100kg bags)		Amount consumed (100kg bags)		Amount stored (100kg bags)		Amount sold (100kg bags)		Commercialisation index	
District	Mean	Std dev	Mean	Std dev	Mean	Std dev	Mean	Std dev	Mean	Std dev
Njombe	91.4	84.0	0.5	1.2	10.6	10.7	80.6	79.1	0.864	0.135
Mbeya Rural	67.6	80.1	0.4	1.2	5.3	9.5	62.3	74.2	0.913	0.147
Nkasi	12.9	13.4	0.5	0.8	0.9	2.1	11.6	12.4	0.875	0.168
Total	57.1	74.8	0.5	1.1	5.5	9.2	51.3	69.2	0.884	0.152

4.6 Challenges of Round Potato Production in the Study Areas

Depth interviews were conducted with selected round potato farmers and agricultural research officers as described in chapter three. The focus of the interviews was especially on the challenges surrounding the round potato production in the study areas. This process was important because in a survey questionnaire one cannot get all the details and stories surrounding a particular problem of interest (Creswell, 2003; Kumar, 2011).

The many challenges that were identified in the interviews were summarised into seven themes: farming practices and attitudes of farmers; supply of improved and clean tubers; pests and diseases; storage facilities; marketing issues; farmers' associations; and credit facilities. In the following subsections, each of these seven themes is discussed in details.

4.6.1 Farming practices and attitudes of farmers

One of the major challenges in round potato production was the traditional farming practices where farmers do it as a routine activity rather than as a business. It was found that very little or no effort was made in improving both the production practices and the output. As a result, farmers received the lowest profit as opposed to what would have been possible with same existing resources and technology.

To illustrate the point, the case of Nkasi District is used. Nkasi, like many parts of Rukwa Region is naturally very fertile. Practically, farmers produce cereals and other crops without the use of inorganic fertilisers. This is partly due to the perception that inorganic fertilisers destroy soil fertility. Some of them use the organic manure especially in the maize fields. Outputs are usually enormous. However, with regard to round potato production, the case is different. Many farmers at Nkasi harvest the round potato which grew as volunteer plants. Although round potato sells at about TZS 24 000 per (100kg)

bag as compared to about TZS 17 000 per (100kg) bag of maize, no effort seemed to have been made to take advantage of market prices. Interestingly, not all smallholder farmers were trapped in the traditional farming practices. Mr. Mwampashi is a native of Mbozi District in Mbeya. He is a businessman and a farmer, who after some observations on round potato production decided to cultivate about eight acres at Kisula village in Nkasi District. He says "*I observed that farmers here do not use fertilisers or agrochemicals but harvested some considerable output. So, I was wondering what if some fertilisers and herbicides are used*?" He bought 36 (100kg) bags of seed tubers of the *Arka* variety from Mbeya for his eight acre farm and applied 8 (50kg) bags of inorganic fertilisers and some sprays. When the visit was made by the researcher he had already harvested about three acres and filled four trucks. He took the round potato to Sumbawanga and Mpanda where he sold at between TZS 35 000 to 45 000 per (100kg) bag as compared to the price of TZS 24 000 if sold at the village. Using the output from the three acres harvested, it was estimated that in total he would produce over 500 (100kg) bags. One stem would produce about one *sado (equivalent to a four litre tin or gallon)*. Plate 2 shows the amount of round potato that the researcher found from one stem just by tilling with fingers.

Plate 2: SHT: On farm round potato at Kisula Village in Nkasi District, Rukwa

The point that has to be made from the experience the experience of Mr. Mwampashi is that a lot can be done with existing resources and technology. What needs to change is the attitude of the farmers. This comprises of changing from farming as a routine activity to seriously taking farming as a business. Mr. Mwampashi applied only a very small amount of inputs in an organised farm and realised enormous outputs. His farm is already inspiring other farmers at Kisula village.

4.6.2 Certification and supply of improved and clean seed tubers

Apart from the small plots allotted for round potato production and the low or non-use of inputs, the poor output was due to unavailability of improved and clean seed tubers. In SHT, there was no institution that dealt with production and certification of clean seed potatoes. As such farmers had to recycle the same tubers from seasons to seasons. Recycling of the seed tubers was the main source of some deadly potato diseases. Round potato plants are said to carry many diseases such as bacterial, viral, and fungal diseases. Some of these diseases are passed through potato tubers. For instance, viral infections are persistent and their outbreaks may cause all stock to be destroyed.

Since the round potato production in SHT was increasingly being commercialised, certification and supply of clean seed tubers will reduce farmers' risks against the viral and fungal diseases and increase the availability of improved varieties at the same time. As it stands, there is a dearth of information on how to improve seed tuber quality and availability of improved round potato varieties.

The supply of improved tubers was not without a challenge. At Nkasi District, the UARC-Milundikwa Centre had once supplied some trial seed tubers to farmers in the neighbouring villages. However, farmers ate them perceiving that larger tubers were for

food while small sized tubers were for planting. There is a need, therefore, to know the farmers' attitudes and practices before a certain intervention is made.

4.6.3 Pests and diseases

Round potato is disease prone and is subject to tuber degeneration (Anderson, 1996). Indeed, diseases are the major problems threatening the increased production of round potato. As mentioned previously, there were bacterial, fungal and viral diseases that very much affect round potato production in SHT. The common ones were the late blight and bacterial wilt. Also, viral diseases, which are seed as well as soil born, were deadly ones since there was no specified agrochemical to treat them. Respondents referred to such disease as *Kinyaushi* or *UKIMWI wa viazi* (meaning Round Potato AIDS Virus) because it had no cure.

Kinyaushi is transmitted when the already affected tubers are used as seeds or when clean seed tubers are sown in a farm that has been infected by the disease. Thus, the only best way of avoiding or reducing the incidences of the disease is practicing crop rotation and the use of clean/unaffected tubers. But as discussed previously, there was no clear mechanism of testing for infected tubers and institutions for certifying and supplying clean tubers did not exist. Therefore, it is recommended that there is a need to strengthen the extension services to help farmers to conduct field inspection and on-farm detection of the disease.

4.6.4 Marketing

Marketing of round potato was one of the major challenges facing smallholder farmers in SHT. In SHT, marketing was dominated by middlemen who took charge of collecting, purchasing, and packing. These middlemen increased their margins by lowering producer

prices. Since producers or smallholder farmers were scattered with no farmer associations they practically had no say on prices. Quite often they have remained price takers. On the other hand poor prices have negative consequences to farmers because they result into low or non-use of inputs and poor crop husbandry practices. The low input use and the poor crop husbandry result into poor yields, which further trap farmers into the viscous circle of poverty.

The dominance of middlemen in the marketing of round potato did not only result into lower producer prices but also affects packaging. These middlemen pack the round potato in extended bags, called *Lumbesa*. While the standard weight of a bag of round potato was 100 kg, *lumbesa* was said to weigh between 120 to 150 kg (Kabungo, 2008). This means that for every 1 bag of round potato the farmer loses up to 50 kg. Recently, however, the government has been very strict on *lumbesa*. But middlemen and traders have also developed a different strategy. According to the depth interviews with farmers in Mbeya Rural, it was found that middlemen still bought in *lumbesa* from the producing villages. Later, they unpack and re-pack the bags into the standard weights so that they are not caught by the authorities. It was said that three *lumbesa* produce four normal standard weight bags.

Farmers did not own the bags for packing the round potato. Usually, they wait for traders or the middlemen to bring the empty bags. Harvesting was not done until the empty bags were brought. So, it was basically the traders who decided when a farmer had to harvest. In this regard, some needy farmers went begging to middlemen hence reducing their producer prices.

Another challenge relating to marketing was the absence of sorting and grading. When asked, why farmers do not sort and grade their produce, the response was surprising because it is the middlemen who are responsible for packing and whose commission was determined by the number of bags bought. One way of increasing the number of bags is not to sort because if they did then they will result into fewer numbers. So, it was interesting to find that middlemen discourage sorting so as to maximise their commission.

The dominance of middlemen and traders in round potato marketing seems to be common in East Africa. For instance, Goossens (2002) reports similar case in Rwanda while in Kenya, Kabira (2002) finds that middlemen and traders are seen as the necessary evils exploiting the producers yet helping them market the surpluses. Organising farmers into farmers' associations and helping them acquire the skills in marketing and post-harvest handling of round potato may be helpful in addressing some of the marketing challenges that they face.

Storage of round potato tubers is also another challenge relating to marketing. However, because of its importance, it is discussed in the following but separate sub-section.

4.6.5 Storage

Storage facilities for harvested round potato in SHT did not exist. As such farmers could not harvest the round potato and store for speculative purposes. Some farmers temporarily stored the round potato in heaps on the ground while waiting to pack (Plate 3). However, because of perishability of the round potato, this kind of storage was only for two to three days before noticeable signs of quality deterioration are observed.

Plate 3: SHT: Temporary round potato storage at Kimondo village in Mbeya Rural

Lack of storage facilities for round potato necessitates farmers to keep them in the fields until a trader shows an interest in buying them. This is the on-farm storage, which was common in Njombe and Nkasi Districts and some parts of Mbeya Rural. In some parts of Mbeya Rural where the soil is moist for most of the time the on-farm storage was not feasible. In these areas farmers had to harvest round potato as it matures, which lowered the farm gate prices.

Experience from Kenya indicates the presence of large potato refrigerated cold storage in areas of Nakuru District, where most of the round potato was produced (Kabira, 2002). Since the refrigerated cold storage requires a reliable supply of electricity, which remains to be a challenge even in urban centres of Tanzania then such storage facilities may not be feasible in SHT in the near future. However, there appears to be a possibility of

developing local storage facilities (G. Matata, M. Kitigwa, Personal Communication, 2010). In this regard, local technologies may be researched for constructing simple round potato storehouses for preserving tuber quality and extending product life.

4.6.6 Credit facilities

Access to credit facilities is an essential ingredient in agricultural production as it enables the low income producers to acquire farm inputs (Gabagambi, 2003). However, in this study it was found that the use of credit in agricultural production was almost negligible. Smallholder farmers had to raise capital from own savings or borrowing from friends and relatives. This is quite an obstacle for increased productivity because lack of agricultural capital limits farmers from purchasing farm inputs and improved crop varieties. They are also not able to hire more land or employ casual labour for their farm activities. The end result is that without the availability of affordable credit facilities smallholder farmers will continue to be small and to larger extent subsistence producers. Following the depth interviews, there appears to be two reasons for the low or non-use of credit in agricultural production among the respondents. The first one is the availability of financial institutions providing such credits and the second is the attitudes of borrowers towards such institutions.

It is well known that commercial banks and other microfinance institutions are very reluctant to lend to smallholder farmers because of associated risks and very small transactions (Gabagambi, 2003; Mori *et al*., 2009; Olomi *et al*., 2009). The reluctance of commercial banks and other microfinance institutions to lend to the rural community and small scale farmers led to the political landscape of advocating for the Savings and Credit Cooperative Societies (SACCOS). Most of the SACCOS were village based and were expected to provide credits to their members. However, most of the rural SACCOS do not

have adequate capital to provide loans to their members. Even when they do, the ability of smallholder farmers to repay has been very low. The SACCOS usually confiscate the properties including households' appliances and land of those who fail to repay the loans.

The confiscation of the properties of those who fail to repay has led to a negative attitude towards the SACCOS among smallholder farmers. In the discussion with farmers, some of them were heard as saying "If you want to be poor then borrow from SACCOS." This means that there remains a challenge of finding a best way of lending to the rural smallholder farmers.

4.6.7 Farmers' associations

The marketing and many of the already discussed challenges and others are mainly due to the absence of both informal and formal farmers' associations and/or cooperatives. Since smallholder farmers in rural areas are scattered with low production levels they lose the bargaining power and therefore become price takers. One of the things that respondents complained was lack of unity among themselves against the traders. For example, they said that if one farmer rejects to sell at a certain price then traders go to another person, who perhaps because of cash needs will agree with the traders' price. The lack of unity and the scatteredness of rural farmers and the absence of associations characterise what is called a trader model as opposed to the association or cooperative business model (Ortmann and King, 2007). The trader model of business, which is typically dominant among smallholder farmers in SHT is that farmers are scattered and cannot produce enough on individual basis. In this case they sell their produce to a trader who collects the products from different farmers to fill a truck, for example, and transport to markets. Fig.9a. describes the visualisation of the trader model in which the trader is at the centre and the individual farmers around him.

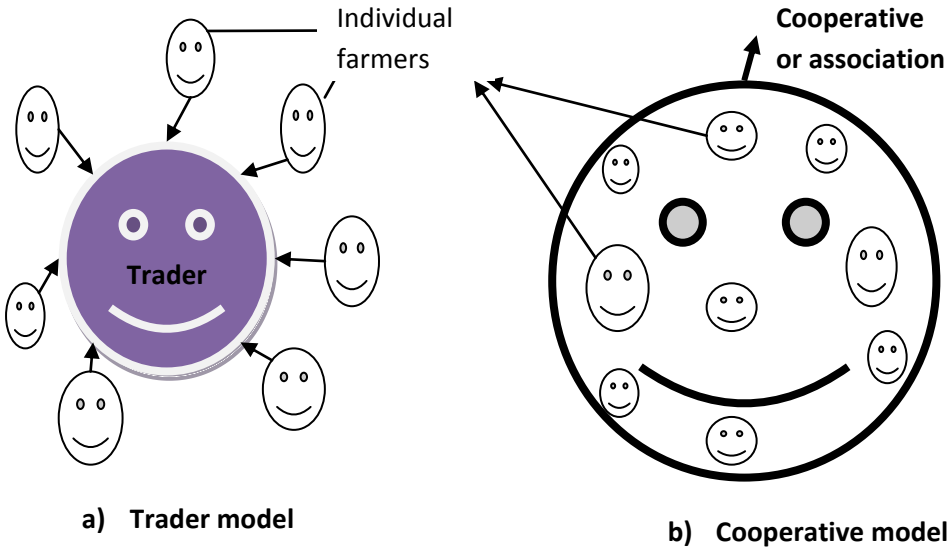

Figure 9: Trader versus Cooperative Models

In the trader model the trader is much more powerful than the individual farmers. The trader takes advantage of the immediate cash needs of the farmers and the absence of associations. The trader model can be characterised by the following features: setting the price (usually below market price) and the buying period of collection time; farmers do not know the consumers and market prices but the trader; individual farmers cannot produce enough, for example, to fill a truck of round potato and transport to market centres; and the possibility of credit to individual farmers is usually difficult.

The other model, which is less popular in SHT is the association/cooperative model in which farmers voluntarily organise themselves in associations or cooperative enterprise. Surber (2005) defines a cooperative as an autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through jointly owned and democratically controlled enterprise. Fig.9b. depicts the visualisation of the association/cooperative model.

In the association/cooperative model, individual farmers are within or inside the association/cooperative which shields them against the trader. Farmers have collective bargaining power and sell at market prices. The association/cooperative model is characterised by the following features:

- Increased volumes, improved quality and timing of services and deliveries to market (Poole and de Frece, 2010);
- Possibility for value added products (Henehan and Schmit, 2009);
- Increased bargaining power of the farmers with buyers through the cooperatives;
- Farmers know and sell at market prices;
- Associations/cooperatives provide support networks for smallholder farmers (Poole and de Frece, 2010);
- Associations/cooperatives may provide technical training and extension services (Ortmann and King, 2007);
- Associations or cooperatives can easily be linked to microfinance institutions and therefore provide credit to members;
- Associations/cooperatives simplify Fair Trade certification and therefore reach foreign markets (Surber, 2005);
- Associations/cooperatives simplify the removal of unnecessary middlemen.

Since the formation of farmers' associations or cooperatives can address many of the challenges facing them then one of the possible interventions would be to help farmers organise themselves in form of associations. The formation of associations will provide the needed protective environment for smallholder farmers (Hu *et al*., 2005; Eaton and

Meijerink, 2007; Ortmann and King, 2007; Valentinov and Baum, 2008; Henehan and Schmit, 2009; Poole and de Frece, 2010). Although the cooperative model is not without challenges, it has worked and is working even in developed countries such as the Netherlands, which has a very strong base of cooperative enterprises which are linked to cooperative banks. The model is also working in Mali and Burkina Faso in the mango industry. Fig.10. depicts the desired shift from trader to association/cooperative enterprise model.

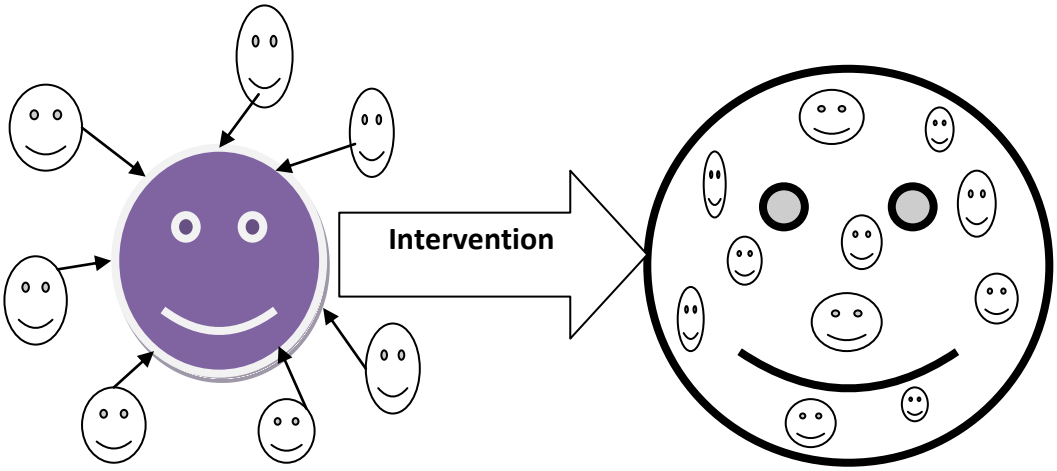

Figure 10: Desired intervention for association/cooperative formation

The intervention of organising and positioning farmers in agricultural supply chains will not only benefit them but also the health and overall performance of the economy (Hu *et al*., 2005). Looking for the best ways in which farmers can organise themselves (such as producer associations and cooperatives) will improve the market opportunities for them and at the same time overcome market imperfections such as availability of credit.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

This study was undertaken to investigate the market orientation status of round potato farmers in SHT. A market oriented farmer is expected to select round potato variety(ies) with higher profit potential and in accordance with market preferences. Such a farmer would also be expected to allocate land on the basis of profitability of crop variety. Nonetheless, other studies on the subject treated round potato as one variety while others assumed that market preference was not an important factor in adoption of production technologies such as improved variety(ies). As such, there was a dearth of knowledge on the market preferences for certain round potato varieties, farmers' criteria for selection of the round potato varieties they produce, and profitability of respective varieties. Moreover, the extent to which round potato production was oriented towards the market was not known.

The study sought to achieve the following four specific objectives:

i. To determine the market preferences for round potato varieties;

ii. To determine factors guiding farmers' selection for the round potato varieties they produce;

iii. To analyse the profitability of round potato by varieties at farmers' level;

iv. To analyse the extent to which round potato production is market oriented.

5.1 Conclusions

The findings of this study uncover a number of issues that are important for the general knowledge among researchers and professionals as well as for policy:

i) First, it has been clearly shown that *Kikondo* and *Arka* were the mostly preferred varieties by consumers and that there was a perception that colour of the round potato was associated with dry matter content. Red-skinned round potatoes were believed to have higher dry matter content than others. Thus, in order to match demand and supply, farmers and plant breeders alike should be aware of such market preferences;

ii) Second, factors such as education level, extension services, gender, location, and selling price have been shown to have significant influence on farmers' selection of varieties. Farmers who consulted the extension officers were 2.6 times more likely to choose round potato varieties in accordance with the market preferences than others while male farmers were 2.8 times more likely to choose varieties in accordance with markets than female farmers. In terms of location, farmers from Nkasi were less likely to select varieties in accordance with market preferences than their Mbeya/Njombe counterparts. Also, variety selection has been dictated more by the availability of seed tubers than the market. In some cases, the attempt of research centres to provide improved seed tubers failed because farmers ate them rather than sowing, perceiving that bigger tubers were for food while smaller ones were for seeds;

iii) Third, round potato production at farmers' level has been shown to be very profitable. *Kagiri* was found to be the most profitable variety but not many farmers produced it because they had their own criteria other than profit. However, the GM that farmers enjoyed was much lower than would have been possible with existing resources. The low GM accruing to farmers was a result

of among others the poor farming practices and attitudes of farmers, small and fragmented plots, low or non-use of inputs such as fertilisers and herbicides, availability of clean and improved tubers, marketing constraints as dominated by middlemen, lack of storage facilities, shortage of credit facilities, and absence of farmers' associations that would facilitate the marketing and access to markets and increase their bargaining power against traders;

iv) Finally, it has been shown that round potato production was highly commercialised as indicated by the commercialisation index. On average, about 88% of all round potato produce was sold. Also, the proportion of land allotted for the crop as compared to the total land under cultivation was high. The proportion of land allotted to round potato production as well as the commercialisation index showed that farmers in SHT produced the crop primarily for the market.

The findings presented above bring a number of policy and research issues. Therefore, in the following section, recommendations for both policy and further research are given.

5.2 Recommendations

It has been shown clearly that round potato has a very big potential of becoming one of the major food and commercial crops in Tanzania. Although the exact number of people who are employed or employing themselves in the round potato crop sub-sector is not known, undoubtedly many are benefiting from it. This includes farmers themselves, middlemen (majority being youth), traders, wholesalers, retailers, processors, and street chips and crisps vendors. Potential also exists for exportation to neighbouring countries such as Zambia, Malawi, DRC, and Burundi. Given this potentiality and in the light of the findings of this study a number of key policy issues are brought to surface. These issues include:

i) Findings showed that *Kikondo* and *Arka* were the mostly preferred varieties by consumers. Moreover, it was found that consumers associated colour of the round potato with the dry matter content. This implies that efforts are required on expansion of *Kikondo* and *Arka*. Also, breeders should work on qualities of these varieties and include consumer preferences as part of their breeding programme;

ii) Econometric results on variety selections showed that farmers who consulted the extension officers were more than two times likely to choose round potato varieties in accordance with the market preferences. However, the percentage of farmers who selected varieties as recommended by extension officers was very small. Even in villages where extension officers were present, the actual contact between them and farmers was very low. This does not only call for the government to continue to improve the extension services in those areas but also it calls for further investigation as to what might be wrong with current practices. This means that the role of the government is not only to send extension officers to villages but also to monitor their activities so as to achieve the intended objectives;

iii) Location was also found to be one of the significant factors for variety selection in accordance with the market demand. Farmers from high potential areas in terms of access to input and output markets such as Njombe and Mbeya Rural Districts were more likely to choose varieties in accordance with the market preferences than those from low potential areas such as Nkasi District. This calls for the continued improvement in terms of infrastructure especially the road networks;

iv) Gross margin and ANOVA analyses showed that round potato production was highly profitable in the study areas. However, the margins accruing to farmers were lower than would have been possible with existing resources and technology because of among other things: shortage of improved and clean tubers; diseases; lack of storage facilities; absence of farmers' associations; and the dominance of middlemen. It is recommended that the government should work to improve this situation. This may include: establishing institutions to develop, certify and supply improved and clean seed tubers; spearheading the process of organising farmers into associations to reduce the dominance of middlemen; and exploring and helping farmers to establish local storage facilities;

v) Finally, findings showed that round potato production was highly commercialised. A good proportion of farmers' land that was cultivated was allotted to round potato production and a bigger part of the produce was sold than kept for home consumption. Since round potato can serve both for food as well as for income, it is important that the government pays attention to this crop as well rather than focusing on major staples only. This attention may include provision of subsidies as well as facilitating farmers' access to both local and foreign markets. To this end, tailor made training and development programmes coupled with linking farmers with the market and programmes that inspire commercial oriented attitudes among farmers may be appropriate.

If promoted, the round potato sub-sector will generate jobs and incomes to farmers themselves, chips vendors, suppliers/distributors, processors and supermarkets and will ensure for food security. It is therefore important to study and promote a sustainable potato value chain that is essential for improving smallholder incomes.

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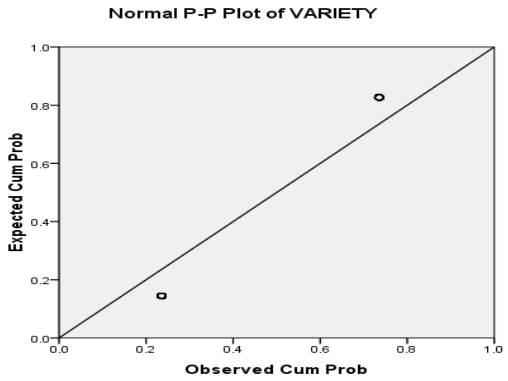
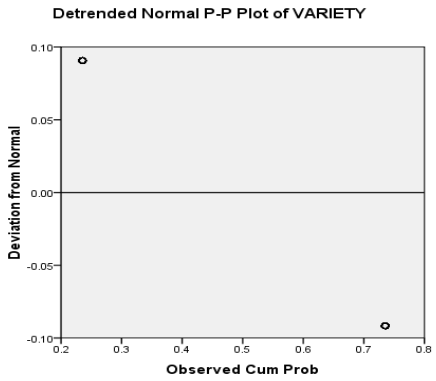
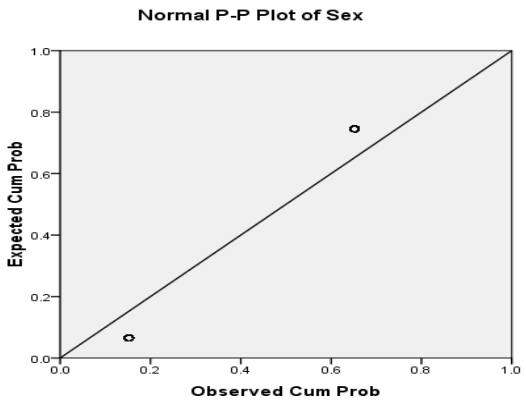
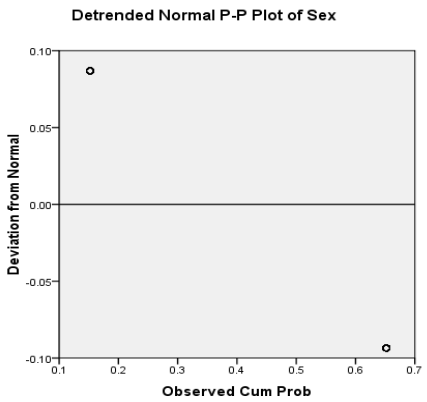
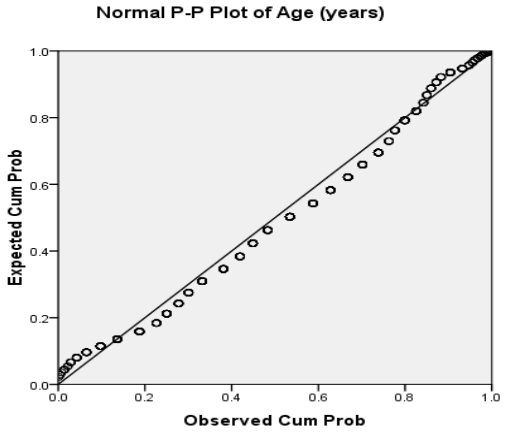
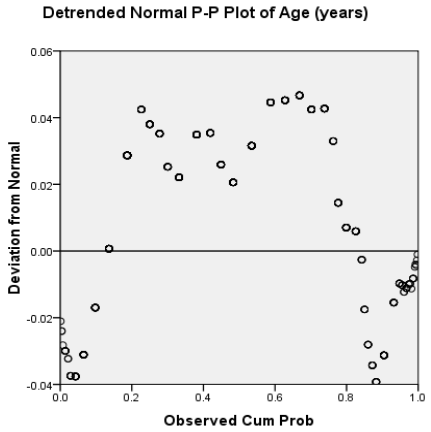
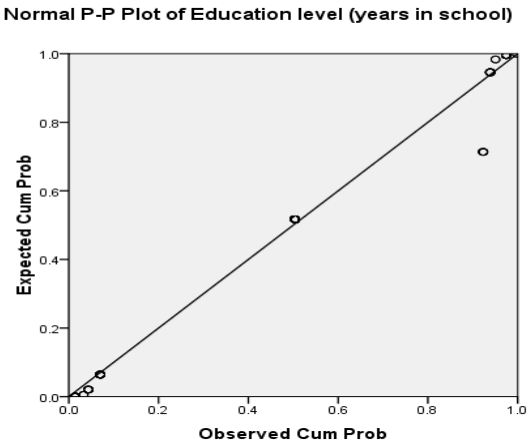
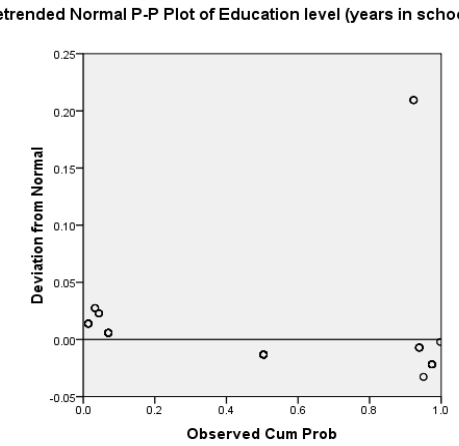
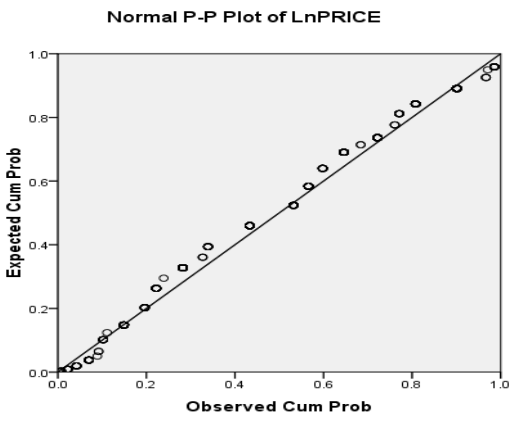
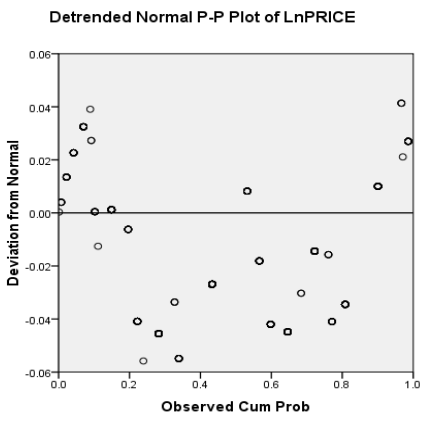
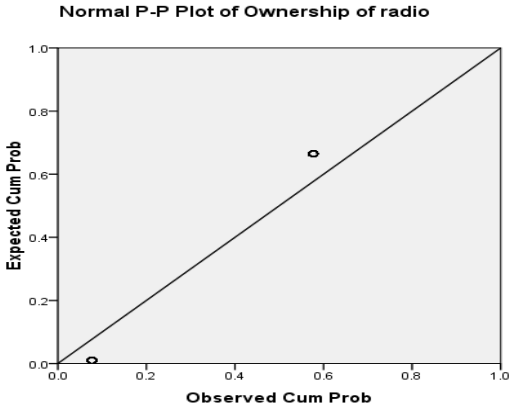
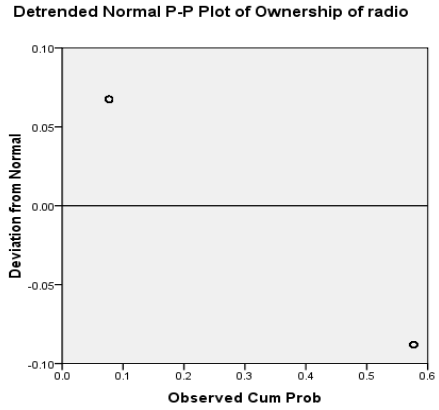
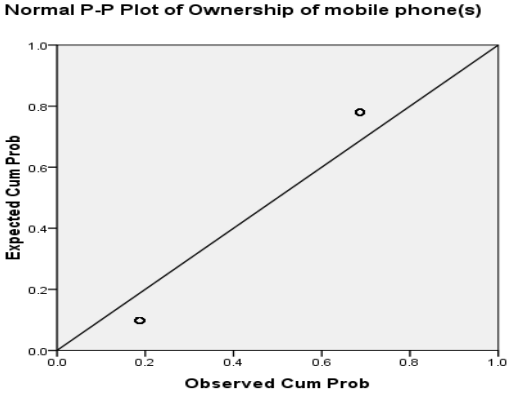
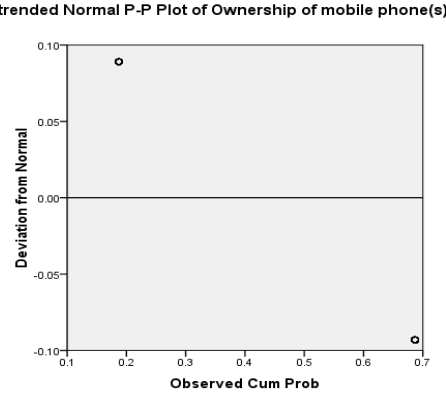
APPENDICES

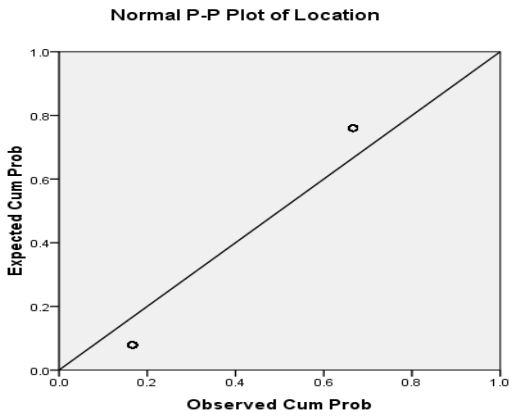
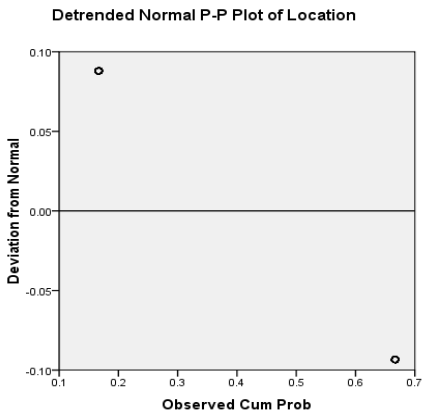
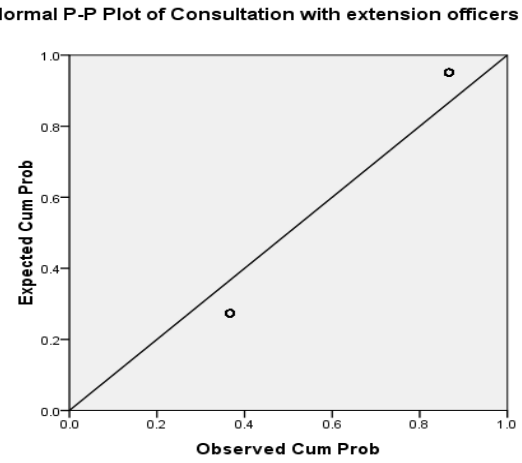
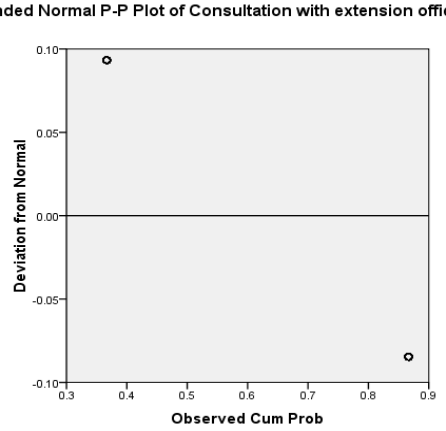
Appendix 1: Test for normality of logistics regression variables

Variable	Normal P-P Plot	Detrended Normal P-P Plot
VARIETY		

SEX	 Normal P-P Plot of Sex Expected Cum Prob Observed Cum Prob 0.0 0.2 0.4 0.6 0.8 1.0	 Detrended Normal P-P Plot of Sex Deviation from Normal Observed Cum Prob 0.10 0.05 0.00 -0.05 -0.10 0.1 0.2 0.3 0.4 0.5 0.6 0.7
AGE	 Normal P-P Plot of Age (years) Expected Cum Prob Observed Cum Prob 0.0 0.2 0.4 0.6 0.8 1.0	 Detrended Normal P-P Plot of Age (years) Deviation from Normal Observed Cum Prob 0.06 0.04 0.02 0.00 -0.02 -0.04 0.0 0.2 0.4 0.6 0.8 1.0

EDUC	 Normal P-P Plot of Education level (years in school) Expected Cum Prob Observed Cum Prob 0.0 0.2 0.4 0.6 0.8 1.0	 Detrended Normal P-P Plot of Education level (years in school) Deviation from Normal Observed Cum Prob 0.25 0.20 0.15 0.10 0.05 0.00 -0.05 0.0 0.2 0.4 0.6 0.8 1.0
PRICE	 Normal P-P Plot of LnPRICE Expected Cum Prob Observed Cum Prob 0.0 0.2 0.4 0.6 0.8 1.0	 Detrended Normal P-P Plot of LnPRICE Deviation from Normal Observed Cum Prob 0.06 0.04 0.02 0.00 -0.02 -0.04 -0.06 0.0 0.2 0.4 0.6 0.8 1.0

RADIO		
MOBILE		

LOCAT	 Normal P-P Plot of Location Expected Cum Prob Observed Cum Prob 0.0 0.2 0.4 0.6 0.8 1.0	 Detrended Normal P-P Plot of Location Deviation from Normal Observed Cum Prob 0.10 0.05 0.00 -0.05 -0.10 0.1 0.2 0.3 0.4 0.5 0.6 0.7
EXT	 Normal P-P Plot of Consultation with extension officers Expected Cum Prob Observed Cum Prob 0.0 0.2 0.4 0.6 0.8 1.0	 Detrended Normal P-P Plot of Consultation with extension officers Deviation from Normal Observed Cum Prob 0.10 0.05 0.00 -0.05 -0.10 0.3 0.4 0.5 0.6 0.7 0.8 0.9

Appendix 2: Estimation of the binary logistic regression model

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	494	96.9
	Missing Cases	16	3.1
	Total	510	100.0
Unselected Cases		0	.0
Total		510	100.0

a. If weight is in effect, see classification table for the total number of cases.

Categorical Variables Codings

		Frequency	Parameter coding (1)
Location	Nkasi	168	1.000
	Njombe/Mbeya	326	.000
Consultation with extension officers	Otherwise	360	1.000
	Yes	134	.000
Ownership of radio	Otherwise	74	1.000
	Yes	420	.000
Ownership of mobile phone(s)	Otherwise	182	1.000
	Yes	312	.000
Sex	Female	141	1.000
	Male	353	.000

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	SEX(1)	10.647	1	.001
		AGE	.586	1	.444
		EDUC	3.869	1	.049
		EXT(1)	2.616	1	.106
		RADIO(1)	.173	1	.677
		MOBILE(1)	5.065	1	.024
		LnPRICE	94.566	1	.000
		LOCAT(1)	108.329	1	.000
	Overall Statistics		163.756	8	.000

Block 1: Method = Forward Stepwise (Likelihood Ratio)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	113.834	1	.000
	Block	113.834	1	.000
	Model	113.834	1	.000
Step 2	Step	36.581	1	.000
	Block	150.415	2	.000
	Model	150.415	2	.000
Step 3	Step	15.839	1	.000
	Block	166.254	3	.000
	Model	166.254	3	.000
Step 4	Step	12.959	1	.000
	Block	179.212	4	.000
	Model	179.212	4	.000
Step 5	Step	6.693	1	.010
	Block	185.905	5	.000
	Model	185.905	5	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	570.016[a]	.206	.275
2	533.435[b]	.262	.350
3	517.596[b]	.286	.381
4	504.637[b]	.304	.406
5	497.944[b]	.314	.418

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

b. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			VARIETY		Percentage Correct
			0	1	
Step 1	VARIETY	0	135	101	57.2
		1	33	225	87.2
	Overall Percentage				72.9
Step 2	VARIETY	0	163	73	69.1
		1	44	214	82.9
	Overall Percentage				76.3
Step 3	VARIETY	0	167	69	70.8
		1	50	208	80.6
	Overall Percentage				75.9
Step 4	VARIETY	0	163	73	69.1
		1	57	201	77.9
	Overall Percentage				73.7
Step 5	VARIETY	0	165	71	69.9
		1	55	203	78.7
	Overall Percentage				74.5

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	LOCAT(1)	-2.210	.228	93.803	1	.000	.110
	Constant	.801	.120	44.723	1	.000	2.228
Step 2[b]	LnPRICE	-2.488	.441	31.868	1	.000	.083
	LOCAT(1)	-1.597	.249	41.236	1	.000	.202
	Constant	25.358	4.367	33.721	1	.000	1.030E11
Step 3[c]	SEX(1)	.997	.259	14.826	1	.000	2.709
	LnPRICE	-2.378	.446	28.487	1	.000	.093
	LOCAT(1)	-1.788	.263	46.208	1	.000	.167
	Constant	24.061	4.417	29.676	1	.000	2.815E10
Step 4[d]	SEX(1)	1.018	.263	14.937	1	.000	2.767
	EXT(1)	.878	.247	12.600	1	.000	2.407
	LnPRICE	-2.379	.456	27.210	1	.000	.093
	LOCAT(1)	-1.984	.274	52.505	1	.000	.137
	Constant	23.503	4.514	27.110	1	.000	1.611E10
Step 5[e]	SEX(1)	1.031	.265	15.162	1	.000	2.803
	EDUC	.157	.062	6.380	1	.012	1.171
	EXT(1)	.970	.253	14.670	1	.000	2.637
	LnPRICE	-2.444	.455	28.830	1	.000	.087
	LOCAT(1)	-1.968	.277	50.614	1	.000	.140
	Constant	22.991	4.482	26.310	1	.000	9.656E9

a. Variable(s) entered on step 1: LOCAT.

b. Variable(s) entered on step 2: LnPRICE.

c. Variable(s) entered on step 3: SEX.

d. Variable(s) entered on step 4: EXT.

e. Variable(s) entered on step 5: EDUC.

Model if Term Removed

Variable		Model Log Likelihood	Change in -2 Log Likelihood	df	Sig. of the Change
Step 1	LOCAT	-341.925	113.834	1	.000
Step 2	LnPRICE	-285.008	36.581	1	.000
	LOCAT	-288.848	44.262	1	.000
Step 3	SEX	-266.717	15.839	1	.000
	LnPRICE	-274.976	32.357	1	.000
	LOCAT	-284.550	51.504	1	.000
Step 4	SEX	-260.295	15.954	1	.000
	EXT	-258.798	12.959	1	.000
	LnPRICE	-267.758	30.879	1	.000
	LOCAT	-282.072	59.508	1	.000
Step 5	SEX	-257.063	16.182	1	.000
	EDUC	-252.319	6.693	1	.010
	EXT	-256.586	15.228	1	.000
	LnPRICE	-265.365	32.786	1	.000
	LOCAT	-277.504	57.065	1	.000

Correlation Matrix

		Constant	LOCAT(1)	LnPRICE	SEX(1)	EXT(1)	EDUC
Step 1	Constant	1.000					
	LOCAT(1)	-.525	1.000				
Step 2	Constant	1.000					
	LOCAT(1)	.317	1.000				
	LnPRICE	-1.000	-.332	1.000			
Step 3	Constant	1.000					
	LOCAT(1)	.313	1.000				
	LnPRICE	-1.000	-.324	1.000			
	SEX(1)	-.021	-.269	.011	1.000		
Step 4	Constant	1.000					
	LOCAT(1)	.308	1.000				
	LnPRICE	-.999	-.311	1.000			
	SEX(1)	-.017	-.266	.005	1.000		
	EXT(1)	.016	-.240	-.050	.045	1.000	
Step 5	Constant	1.000					
	LOCAT(1)	.319	1.000				
	LnPRICE	-.994	-.317	1.000			
	SEX(1)	-.031	-.275	.013	1.000		
	EXT(1)	.012	-.238	-.065	.061	1.000	
	EDUC	-.001	-.025	-.101	.053	.177	1.000

Variables not in the Equation

			Score	df	Sig.
Step 1	Variables	SEX(1)	19.272	1	.000
		AGE	.026	1	.873
		EDUC	2.319	1	.128
		EXT(1)	14.623	1	.000
		RADIO(1)	1.522	1	.217
		MOBILE(1)	.085	1	.771
		LnPRICE	34.477	1	.000
	Overall Statistics		68.306	7	.000
Step 2	Variables	SEX(1)	15.412	1	.000
		AGE	.121	1	.727
		EDUC	4.431	1	.035
		EXT(1)	12.770	1	.000
		RADIO(1)	.344	1	.558
		MOBILE(1)	.065	1	.799
	Overall Statistics		36.062	6	.000
Step 3	Variables	AGE	.375	1	.540
		EDUC	4.356	1	.037
		EXT(1)	12.871	1	.000
		RADIO(1)	.099	1	.754
		MOBILE(1)	.045	1	.833
	Overall Statistics		21.178	5	.001
Step 4	Variables	AGE	.756	1	.385
		EDUC	6.513	1	.011
		RADIO(1)	.010	1	.921
		MOBILE(1)	.728	1	.393
	Overall Statistics		8.860	4	.065
Step 5	Variables	AGE	1.913	1	.167
		RADIO(1)	.041	1	.839
		MOBILE(1)	.351	1	.553
	Overall Statistics		2.375	3	.498

Appendix 3: Estimation of ANOVA model from regression viewpoint

Source	SS	df	MS	Number of obs	416
				F(8, 407)	5.71
Model	5.52E+12	8	6.90E+11	Prob > F	0.000
Residual	4.92E+13	407	1.21E+11	R-squared	0.101
				Adj R-squared	0.083
Total	5.47E+13	415	1.32E+11	Root MSE	350000

Gross Margin	Coef.	Std. Err.	t	P>t	Beta
Arka	-107157.30	44854.87	-2.39	0.017	-0.119
Kagiri	309989.30	93000.60	3.33	0.001	0.159
Kidinya	-183788.50	103266.50	-1.78	0.076	-0.085
Tigoni	133267.00	107609.50	1.24	0.216	0.059
Malita	-183754.50	67003.15	-2.74	0.006	-0.133
Msafiri/Mtega	-231251.60	73656.99	-3.14	0.002	-0.152
Sasamua/Baraka	-193626.90	107609.50	-1.8	0.073	-0.086
Mixed varieties	-220923.40	79664.46	-2.77	0.006	-0.133
_cons	484899.60	24283.99	19.97	0.000	.

Appendix 4: Farmers' survey questionnaire

FARMERS' SURVEY IN NJOMBE, MBEYA RURAL AND NKASI DISTRICTS FOR THE STUDY "**ROUND POTATO PRODUCTION IN SOME SOUTHERN HIGHLANDS DISTRICTS OF TANZANIA: MARKETS, VARIETY SELECTIONS, AND PROFITABILITY**"

Dear Respondent,

Thank you for your interest in this survey. The study is aimed at assessing the production of round potatoes by varieties and specifically the available varieties, factors guiding choices for certain varieties, markets for respective varieties and profitability. Your participation in this study is voluntary. It will take about 45 minutes to complete this survey. You may choose to skip some of the questions, and to quit participation at any stage. All information that you provide will be handled with strict confidentiality. Only the researcher of this study has access to the answer sheets.

By returning this survey you agree that the collected data can be used for scientific research. If you have any questions concerning this survey, please, do not hesitate to contact the researcher, Mr. H. Mpogole (0713 492528). Please, return the questionnaire to the enumerators as soon as you complete.

Thanking you again for participating in this survey.

A. Identification Variables

1. Questionnaire No. _____
2. Date _____ Day _____ Month _____Year
3. Village _____
4. Ward _____
5. Division _____
6. District _____
7. Region _____
8. Name of respondent (*optional*)_____ _____
9. Telephone No.(*optional*) _____ _____

B. Socio-economic characteristics of the respondent

10. Sex _____
11. Age (in years) _____
12. Marital status

    1 = Married
    2 = Single
    3 = widow/separated
13. Education level _____(years in school)
14. Respondent's role in the family

    1= Head 2= other

15. Main occupation

    1 = Farming

    2 = Non-farming

16. Off-farm income generating activities

    1= Employment

    2= Business

    3= other (*specify*) _____

17. Family size of the respondent _____

18. Family members under 15 years of age _____

19. Family members of 15 years of age and above _____

20. Total farmland owned by the respondent _____ (acres)

21. How did you acquire most of your land?

    1= inherited

    2= bought

    3= hired

    4= other (specify) _____

22. If you were to buy that land today, how much would it cost? _____ (TZS)

23. How much of your farmland is under cultivation currently? _____ (acres)

24. How many acres are used for round potato production? _____ (acre

C. Farm characteristics

25. Please, complete the table below regarding the types of crop you produced in 2009, size of land allocated to each one and the outputs

Crop	Land size (acres)	Output (100 kg bags)	Amount sold (100kg bags)	Price per 100 kg bag	Amount consumed	Amount stored
Round potato						
Maize						
Beans						
Wheat						
Sunflower						

26. What guides you in determining the size of land for a particular crop?

    1= profitability

    2= food security

    3= cost of production

    4= availability of seeds

27. Did you buy staple food for family consumption in 2009?

    1= Yes

    2= No

28. If, yes, how much food of each type did you buy? (Please, complete the table below)

Type of food crop bought	Amount (100 kg bags)	Price per 100 kg bag
Maize		
Rice		
Potatoes		
Beans		

D. Round potato varieties and profitability

29. What is the main reason for growing round potatoes?

    1= Profitability

    2= Food security

    3= other reason(s) _____

30. How many round potato varieties do you know? Please, mention them

    _____

    _____

31. What variety(ies) did you grow in 2009 season? Please, mention them

    _____

32. Did you mix two or more varieties in the same plot? _____ Yes _____No

33. What is the main reason for growing such variety(ies):

S/N	Reasons	Tick (√) for a relevant reason
1	High selling price for the variety	
2	High yielding variety	
3	Most demanded in the market	
4	Most available variety in our area	
5	Resistance to pests and diseases	
6	Availability of seed tubers	
7	Recommended by extension officers	
8	It is good for home consumption	
9	Common practice	
10	Other reasons (*please, mention them here*)	

34. Do you know the usage (e.g. table, industry, chips, crisps) and markets of the variety(ies) you produce?

    1= Yes

    2= No

35. If yes, please, describe the variety(ies), usage and their respective markets in the table below

Variety	Usage	Markets

36. From where did you get the seeds?

    1= own reserve
    2= bought from seed agents
    3= bought from neighbours

37. Are there seed agents/shops at your village?

    1= Yes
    2= No

38. If, No, how far are such services available? _____ (distance in approx. km)

39. What is the price of such seeds per 100kg bag? _____ (TZS)

40. Is the price different for different seed varieties?

    1= Yes
    2= No
    3= Don't know

41. For how long can the round potatoes you grow remain in the field after maturity? _____ months.

42. How do you store the seed potatoes?

    1= on farm/field
    2= warehouse/store
    3= buys seed potatoes every farming season

43. How do you store the table potatoes?

1= on farm/field

2= warehouse/store

44. What is the average price if sold on season season? TZS _____ per bag

45. What is average price if sold off season? TZS _____ per bag

46. If you grow more than one variety, please, complete the table below

Variety	Acreage	Seeds (100kg bags)	Fertiliser (50kg bags)	Chemical (litres/kg)	Other costs (TZS)	Output (100kg bags)	Price per 100kg bag

E. Fertiliser and agrochemical inputs

47. Did you use fertilisers in round potato production?

1= Yes

2= No

48. If, Yes, which type of fertiliser did you use?

1 = DAP/TSP/CAN

2= Minjingu

3= Organic

4= Other (specify) _____

49. What are the reasons for you choosing the type of fertilisers you are using?

1= Low price

2= the only available

3= results into highest yield

4= subsidised by the government

50. Amount of fertiliser used per acre _____ (100kg bags)

51. Are the inorganic fertilisers available at your village?

1= Yes

2= No

52. If, No, from how far can you obtain the fertilisers? _____ (distance in approx. km)

53. What is the transport cost per 100kg bag from such source? _____ (TZS)

54. Price of fertiliser per 50kg bag in the 2009 season as sold from the nearest source (please, complete the table below)

S/N	Name of fertiliser	Price per 50kg bag (in TZS)
1	DAP	
2	TSP/NPK	
3	CAN	
4	UREA	
5	Minjingu	
6	Other (mention)	

55. Do you use agrochemicals to control pests and diseases such as late blight and bacterial wilt?

    1= Yes

    2= No

56. If, Yes, are such agrochemicals available at your village?

    1= Yes

    2= No

57. If, No, from how far can you obtain them? _____ (distance in approx. km)

58. What is the corresponding transport cost? _____ (TZS)

59. How many litres of each type required per acre? (Please, complete the table below)

Chemical type/name	Litres per acre	Price/litre	Total acres applied with chemicals

F. Labour input

60. What is the total cost of production per acre you incurred in the 2009 farming season? (*Please, complete the table below*)

Operation	**Total costs (TZS)**
Land clearing	
Tillage	
Seed buying	
Sowing	
Weeding and pesticide application	
Fertilisers	
Harvesting	
Carriage from field to loading place	
Other relevant costs	

61. What kind of tool or equipment did you use in 2009 farming season?

    1= hand hoe

    2= oxen

    3= tractor

62. If used hand hoe or oxen, then indicate the reasons for not using a tractor?

    1= expensive

    2= not available at the village or nearby

    3= no passable road to reach to the farm/field

    4= not suitable for potato production

63. If used a tractor, who owns it?

    1= myself

    2= hired

64. If hired, how much did you pay per acre? _____ (TZS)

65. What is the comparable price per acre if used oxen? _____ (TZS)

G. Extension and other agricultural services

66. Have you ever consulted the extension officer regarding farming activities?

    1= Yes

    2= No

67. Is there an extension officer at your village?

    1= Yes

    2= No

68. If no extension officer at your village, which village you know is such officer available? _____ (village)

69. How far is that village from yours? _____ (approx. km)

70. Did you use credit (in cash or in kind) in farming activities in the 2009?
    1= Yes

    2= No

71. If Yes, how much credit did you use?

Nature of credit	Amount (TZS)	Purpose/crop(s)	Credit terms
Cash			
In kind			

H. Marketing and Market Information

72. Did you sell round potatoes in the 2009 season?

    1= Yes
    2= No

73. Who set the selling price?
    1= myself
    2= trader/middlemen
    3= bargaining
74. Do you know where traders sold the round potatoes they bought from you or from your village?

    1= Yes
    2= No

75. If, Yes, do you know the market prices where traders sold the round potatoes?
    1= Yes
    2= No

76. If, Yes, what are the sources of information?
    1= Traders
    2= Friends/neighbours
    3= Radio/TV
    4= Newspaper
    5= others (specify) _____

77. When do you sell your round potatoes?
    1= immediately when matures
    2= when in need of cash
    3= when buyers/traders ask
    4= when others are selling
    5= when price is maximum

78. What is the method of selling your round potatoes?
    1= in 100kg bags
    2= on farm per acre

79. How far is your farm from (all weather) paved road? _____ (km)

80. How long does it take if you were to talk to the nearest paved road? _____ (hours)

81. How much does it cost to carry 100kg bag to the nearest paved road? _____ (TZS)

82. How far is your farm from nearest market centre? _____ (km)

83. How much does is it cost to carry 100kg bag to nearest market centre? _____

    (TZS)

I. Miscellaneous Information

84. Are you a member of a cooperative group (or association)?
    1= Yes
    2= No
85. Do you possess the following items? (*Please, tick as appropriate*)

Radio	Ox-plough	Car	Motor cycle	Bicycle	Iron sheet roofed house	Tractor/ power tiller	Ox-cart	Mobile phone

86. Which problems do you consider to be the most pressing in round potato production? Please rate them in a scale of 5 in the table below, where 1 means very less pressing problem and 5 means most pressing

	1	2	3	4	5
Shortage of markets					
Shortage of fertilisers					
Shortage of agrochemicals					
Pests and diseases					
Shortage of land					
Distance from a paved road					
Distance to market centres					
Lack of extension services					
Lack of improved seeds					
Perishability of round potatoes					

87. If you can recall, please, indicate your round potato production since 2005

Year	Variety produced	Acreage	Output (100kg bags)	Price per 100kg bag
2005				
2006				
2007				
2008				
2009				

88. What do you consider as the opportunities for round potato production at your area?

_____

89. What do you consider as the challenges/problems for round potato production at your area? _____

Thank you

Appendix 5: Market Survey Questionnaire

MARKET SURVEY FOR THE STUDY "**ROUND POTATO PRODUCTION IN SOME SOUTHERN HIGHLANDS DISTRICTS OF TANZANIA: MARKETS, VARIETY SELECTIONS, AND PROFITABILITY**"

Dear Respondent,

Thank you for your interest in this survey. The study is aimed at assessing the markets for different types of round potato varieties produced in the Southern Highlands of Tanzania. Your participation in this study is voluntary. It will take about 20 to 25 minutes to complete this survey. You may choose to skip some of the questions, and to quit participation at any stage. All information that you provide will be handled with strict confidentiality. Only the researcher of this study has access to the answer sheets.

By returning this survey you agree that the collected data can be used for scientific research. If you have any questions concerning this survey, please, do not hesitate to contact the researcher, Mr. H. Mpogole (0713 492528). Please, return the questionnaire to the enumerators as soon as you complete.

Thanking you again for participating in this survey.

1. City/Town ----------
2. Street ----------
3. Market name/Hotel/Restaurant/Processor ----------
4. Designation of the respondent: Manager (-----); Owner Manager (-------); Seller(------); Chips vendor (-----); Other (-------) *specify*)_____
5. Gender of respondent: Male (------); Female (------)
6. Age of respondent (in years) ----------
7. Education level: No formal education (------); Primary education (------); Secondary education (------); Certificate/Diploma (------); University/Postgraduate (-------)
8. Nature of business: Wholesaler(-----); Retailer(-----); Hotel/Restaurant(-----); Chips kiosk(-----); Processor(-----); Other(-----) (*specify*) _____
9. Volume of round potato handled per week ---------- (100kg bags)

10. Variety(ies) of round potato handled:

S/N	Variety	Amount per week (100kg bags)**
1	Kikondo/Njombe (CIP 720050)	
2	Arka	
3	Kagiri	
4	Kidinya	
5	Tigon	
6		
7		
8		

(****Tick/check the variety if does not know amounts*)

11. What are the sources of round potatoes you sell/process?

S/N	Variety	Source
1		
2		
3		
4		
5		

12. What factors do you consider when buying the round potatoes you sell/process? (*Please rank the factors in the table below by checking the appropriate boxes*).

S/N	Factors	Very important	Important	Somehow important
1	Price			
2	Variety			
3	Customer preferences			
4	Storability/perishability			
5	Shape			
6	Colour			
7	Taste			
8	Production source/location			
Others				

13. Is there seasonality in the availability of different types of varieties? Yes(----); No (---)

14. In case of seasonality, can you explain which varieties come at what time?

S/N	Variety	Season
1		
2		
3		
4		

15. What are your round potato customers? (----------)Retailers; (----------)Processors; (----------)Hotel/restaurants; (--------)Individuals; (-------)Other (*specify*) _____

16. Which variety is mostly preferred by your customers? (*Name the most preferred variety(ies)*) ----------

17. What are the general qualities or characteristics of round potatoes that customers like? (*Please, tick/check in the table as appropriate*)

S/N	Factors	Very important	Important	Somehow important
1	Size			
2	Colour			
3	Shape			
4	Taste			
5	Dry matter content			
6	Suitability for chips			
7	Suitability for boiling			
8	Peeling			
9	Production source/location			

18. Does the selling price differ by varieties? Yes (--------); No (---------)

19. If, YES, what are the average prices for each variety? (*Please, fill in the table*)

Variety	Source	Price/100kg bag

20. From your experience, is the demand for round potato being met? Yes (----); No (-----)

21. If, NO, at what time of the year is the demand mostly not met? _____

22. Any specific things that you think farmers should do regarding round potato production? ----------

23. Any other interesting things worth sharing about round potatoes? ----------

Thank you