RURAL AND URBAN HOUSEHOLD DEMAND ANALYSIS FOR CASSAVA IN DAR ES SALAAM AND COAST REGION, TANZANIA

BASIL MSUHA

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA

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ABSTRACT

Cassava is one of the most important root and tuber crops mostly grown for food in Tanzania, though in Africa, it is a marginalized crop in food policy debates burdened with the stigma of being an inferior food. This study examined the major factors that drive changes in cassava consumption pattern across income groups and consumer characteristics among urban and rural households to inform food policy formulation. The study, among other things, sought to provide evidence on whether or not cassava had become a normal food commodity in selected urban and rural households. Special attention was also given to the question of whether household social demographic characteristics had any significant effect on cassava consumption. Cross sectional household data were used to estimate single equation demand models by employing Working-Leser Engel model through the use of OLS method. Cassava expenditure elasticity was estimated for selected urban and rural areas across different income groups to test Engel's law. Descriptive analysis was used to identify the most preferred form of cassava product among consumers. The results revealed that boiled cassava is the most preferred product in the study areas. The empirical evidence failed to reject the hypothesis of no relationship between household's preferences and income levels thus lead to the conclusion that the household's preferences to cassava products is independent of their income levels, whether low, middle or high income, almost all households bought a particular cassava product based mainly on their own assessment of the taste. The study provided empirical evidence to reject the hypothesis of no difference in mean household expenditure and cassava budget share between urban and rural households in the study areas and lead to a conclusion that monthly average total households expenditure was different in

the two study locations and households in Dar es Salaam spent more on cassava than households living in Coast Region. Evidence from this study did not support the hypothesis that cassava is an inferior food commodity, analysis showed that fresh cassava expenditure elasticity in all areas under the study was positive, though inelastic, suggesting that cassava is a normal food commodity, it is a necessity good for life. The results provide convincing evidence that demand for cassava will continue to rise as income increases. Thus, it is short sighted to consider cassava solely a subsistence crop and inferior food. The study provided empirical evidence to reject the hypothesis that none of demographic and social-economic characteristics (age, gender, education and household size-AE) had significant effect on cassava consumption. They were all identified as the principal determinants of cassava expenditure in all of the consumer locations. The magnitudes and directions of influence of these variables were mixed, some hade positive while some had negative influence. Based on the finding of the study, recommendations have been made to help improve the cassava sub sector in urban and rural areas.

DECLARATION

I Basil Msuha do hereby declare to the Senate of Sokoine University of Agriculture that, this dissertation is my own work and it has not been submitted or concurrently being submitted for higher degree award in any other University.

24/10/2016

Basil Msuha **Date**

(MSc. Candidate)

The above declaration is confirmed by:

Prof. D. Gabagambi **Date**

(Supervisor)

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DEDICATION

This work is dedicated to my parents who laid down the education foundation for my present academic achievement. May Almighty God bless them to live long and prosper.

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AE	-	Adult Equivalents
AfDB	-	African Development Bank
AIDADS	-	An implicit Additive Demand System
AIDS	-	Almost Ideal Demand System
CBB	-	Cassava Bacterial Blight
CBSD	-	Cassava Brown Streak Disease
CGE	-	Computable General Equilibrium
CGM	-	Cassava Green Mite
CMB	-	Cassava Mealy Bug
CMD	-	Cassava Mosaic Disease
DSM	-	Dar es Salaam
FAO	-	Food and Agriculture Organization
FAOSTAT	-	Statistics Division of FAO
HH	-	Household
HHS	-	Household Size
IFAD	-	International Fund for Agricultural Development
IFPRI	-	International Food Policy Research Institute
IITA	-	International Institute of Tropical Agriculture
LA/AIDS	-	Linear Approximate version of the AIDS specification
LDCs	-	Least Developed Countries
LEM	-	Laboratory of Economics and Management
LLI	-	Log-Log Inverse
MSE	-	Mean Squared Error

NBS	-	National Bureau of statistics
OECD	-	Organisation for Economic Co-operation and Development
OLS	-	Ordinary Least Squares
PORALG	-	President's Office Regional Administration and Local Government
QES	-	Quadratic Expenditure System
QUAIDS	-	Quadratic Almost Ideal Demand System
SARD-SC	-	Support to Agricultural Research for Development of Strategic Crops in Africa
SLQ	-	Semi-Logarithmic Quadratic function
SSA	-	Sub-Saharan Africa
TEX	-	Total household Expenditure
TZS	-	Tanzania Shillings
URT	-	United Republic of Tanzania
VIF	-	Variance Inflation Factor

CHAPTER ONE

1.0 BACKGROUND AND PROBLEM STATEMENT

1.1 Background Information

Cassava was first introduced to the Africa continent, close to the mouth of the Congo River by Portuguese explorers and traders from Brazil in the course of the 16th and 17th centuries. From there it was disseminated by Africans, to many parts of Sub-Saharan Africa over a period of two to three hundred years (FAO and IFAD, 2005). Now, it is one of the most widely grown staple crops in Sub-Saharan Africa. Total production in Sub-Saharan Africa is estimated to be more than 140 million tones, which is greater than any other crop in the continent (FAOSTAT, 2016). Approximately 75 percent of Africa's cassava output is harvested in Nigeria, the Democratic Republic of Congo, Ghana, Tanzania and Mozambique.

In Tanzania cassava production is second to maize and more than 1.3 million households are engaged in production of the crop in the country in an area over 860 000 hectares producing about 5 million tonnes (FAOSTAT, 2016; NBS, 2012). On the demand side, it has been estimated that the total use of roots and tubers in developing countries is projected to increase by 232 million tonnes to 635 million tonnes by 2020 and cassava's share of the increase is estimated to be 44 percent (Scott *et al.*, 2000).

On the basis of current projections, it is expected that by 2020, over 60 percent of global cassava production will be in sub-Saharan Africa, where the crop will be a favoured source of cheap carbohydrates and will also continue to serve as a food

security crop (FAO and IFAD, 2005). Besides, as urbanization in Africa continues, more people in cities and towns will purchase their food rather than grow it themselves. This will continue to give smallholder farmers a source of income from cassava. However, the resulting gain in poverty reduction and greater food security from cassava will depend in part on an integrated set of research and development outputs that take into account both production and marketing.

1.2 Problem Statement and Justification

Despite the speculations about the growing demand for cassava, the crop is facing a lot of challenges such as lack of supply chain structures for the commercialization of cassava products, high cost of production versus low yields as well as production orientation towards subsistence and not commercialization (Akinnagbe, 2010). In addition, its production is constrained by many factors including genetically low yielding potential of local varieties, existence of abiotic stress factors (low soil fertility, drought and weed infestations) and biotic stresses that include susceptibility of the commonly grown varieties to major diseases and pests such as cassava mosaic diseases, Cassava Brown Streak Disease (CBSD), Cassava Bacterial Blight (CBB), Cassava Green Mite (CGM), Cassava Mealy Bug (CMB) and Nematodes (Mkamilo and Jeremiah, 2005). On the market side, among other things the demand structure of the crop as a major source of food and cheap carbohydrates in most developing countries has not been ascertained (Tsegai and Kormawa, 2002).

In order to address these challenges, several researches on cassava are being implemented, however, most of these research efforts have been directed much on the supply side including developing high yielding, early maturing and disease

resistant varieties (Mkamilo and Jeremiah, 2005; Onyemauwa, 2010). Researchers such as IITA among others have been working on providing a more constant flow of cassava planting materials and breeding of cassava for ecological adaptation and resistance to pests and diseases. Researchers have also been working to get a better understanding of the physiology of cassava (IITA, 2016). Research work on cassava demand and consumption has not drawn the attention of researchers to the same degree as its agronomy and genetics (Tsegai and Kormawa, 2002).

The crop has generally been neglected in policy-decisions related to research on marketing; demand and consumption (FAO and IFAD, 2005, Nweke, 2002). It has been marginalized in food policy debates and burdened with the stigma of being an inferior commodity. Many food policy analysts consider cassava as an inferior commodity (Nweke, 2004). Not much research has been done to examine the major factors that drive changes in cassava consumption patterns across income groups among urban and rural households to inform food policy formulation. Instead, there is a generalized perception by many food policy analysts that the crop is an inferior food with an assumption attached to it that its per capita consumption will decline with increasing per capita income (Nweke, 2004).

Based on this background, this study intended to evaluate the demand structure for the crop by examining among other things the major factors that drive changes in cassava consumption patterns across income groups and consumer characteristics in urban and rural households. The research output is important to industry participants especially policy makers, producers, traders, exporters and consumers.

The study output will inform future policy direction in the food sector by opening up cassava consumption to a broader consumer base and enhance more effective participation of producers, processors, traders, and other entrepreneurs in cassava sub-sector. Beside, the demand studies output provide necessary information on the linkages between consumption and production (Kormawa and Akoroda, 2003). Nevertheless, the future increases in cassava consumption will depend on how well cassava is prepared into food forms, preferred by consumers (FAO and IFAD, 2005).

1.3 Research Objectives

1.3.1 Overall objective

The overall objective of this study is to analyse the household demand pattern for cassava in urban and rural areas of Dar es Salaam and Coast Regions.

1.3.2 Specific objectives

The following specific objectives were pursued in this study;

i. To identify the most preferred cassava products among households in the study area,
ii. To analyze household expenditure and cassava budget share among urban and rural households in the selected study areas
iii. To estimate the income elasticity of demand for fresh cassava in selected urban and rural areas; and
iv. To determine the determinants of demand for cassava among urban and rural households in the selected study areas.

1.3.3 Research hypotheses

The overall study was guided by the following research hypotheses

i. There is no relationship that exists between households preferences to cassava products and their income levels,

ii. There is no difference in mean household expenditure and cassava budget share between urban and rural households in the selected study areas,

iii. Cassava is an inferior food commodity in the selected urban and rural areas,

iv. None of demographic and social-economics characteristics (age, gender, education, household size and income) have influence on cassava demand.

1.4 Structure of the Dissertation

The dissertation is divided into five chapters including this introductory chapter which presents background information of the study, problem statement and justification, research objectives and hypotheses. Chapter two presents the status of cassava production trend and consumption in Africa and in Tanzania context. The theoretical and empirical review of literature on food demand studies is also provided whereby in theoretical part; the theoretical and conceptual framework underpinning the study is examined, theoretical issues and concepts about the subject matter are also reviewed. On the empirical part, the empirical literature in food demand studies in Tanzania and other developing countries with special attention to studies on cassava demand is reviewed. While chapter three presents the methodology used in the study focusing on description of the study area, research design, sampling procedures and sample size, data required for the study and method of collection, assurance of data quality, data handling and analysis and analytical framework.

Chapter four presents the major findings of the study, emphasis is placed on the objectives and hypothesis of the study and chapter five provides the conclusion and recommendations based on the study finding.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview

This chapter presents the status of cassava production trend and consumption in Africa and in Tanzania context. The theoretical and empirical review of literature on food demand studies in general and cassava demand is also provided. In the theoretical part, theoretical and conceptual framework underpinning the study is examined, theoretical issues and concepts about the subject matter are also reviewed. On the empirical part, the empirical literature in food demand studies in Tanzania and other developing countries with special attention to studies on cassava demand is reviewed.

2.2 Cassava Production Trend and Consumption in Africa

2.2.1 Cassava production trend

In the early 1960s, Africa accounted for 40 percent of world cassava production and Brazil was the world's leading cassava producer. However, thirty years later in the early 1990s, Africa produced half of the total world cassava output and Nigeria replaced Brazil as the leading producing country globally (FAO and IFAD, 2005). In 2007 more than 200 million tons of cassava were produced worldwide, of which Africa accounted for 52% (IITA, 2016). About seventy five percent of Africa's cassava output is harvested in Nigeria, Democratic Republic of Congo, Ghana, Tanzania and Mozambique (FAOSTAT, 2016). Table 1 provides cassava production volumes for major cassava producing countries in Africa for the period between 2007 and 2014.

Table 1: Cassava producing countries in Africa with their production volume for the period between 2007 and 2014 (metric tonnes)

Year	Nigeria	Ivory Coast	Congo	Ghana	Tanzania	Mozambique
2007	43 410 000	2 342 158	1 140 100	10 217 930	5 198 934	4 959 260
2008	44 582 000	2 531 241	1 196 300	11 351 100	5 392 358	4 054 590
2009	36 822 250	2 262 170	1 231 000	12 230 600	5 916 440	5 670 000
2010	42 533 180	2 306 839	1 148 500	13 504 086	4 547 940	9 738 066
2011	46 190 248	2 359 015	1 150 000	14 240 867	4 646 523	10 093 619
2012	50 950 292	2 412 371	1 200 000	14 547 279	5 462 454	4 099 000
2013	47 406 770	2 436 495	1 250 000	15 989 940	4 755 160	4 303 000
2014	54 831 600	4 239 303	1 296 660	16 524 000	4 227 590	5 114 750
Total	**366 726 340**	**20 889 592**	**9 612 560**	**108 605 802**	**40 147399**	**48 032 285**
Average	**45 840 793**	**2 611 199**	**1 201 570**	**13 575 725**	**5 018 425**	**6 004 036**
Rank	**1**	**5**	**6**	**2**	**4**	**3**

Source: FAOSTAT (2016)

From Table 1 it is evident that, the leading producer for the period between 2007 and 2014 is Nigeria with an average of over 45.8 million tonnes, followed by Ghana which is producing over 13.6 million tonnes, Mozambique producing 6.0 million tonnes, Tanzania (5.0 million tonnes), Ivory Coast (2.6 million tonnes) and Democratic Republic of Congo with 1.2 tonnes.

Two forces explain this dramatic growth. First, demand for cassava has expanded because of rapid population growth and increased poverty thus, encouraging consumers to search for cheaper sources of calories. Second, the supply of cassava has expanded because genetic research and better agronomic practices have boosted cassava yields, especially in Ghana and Nigeria (FAO and IFAD, 2005). Figure 1 provides cassava production volumes for major cassava producing countries in Africa for the period between 2007 and 2014.

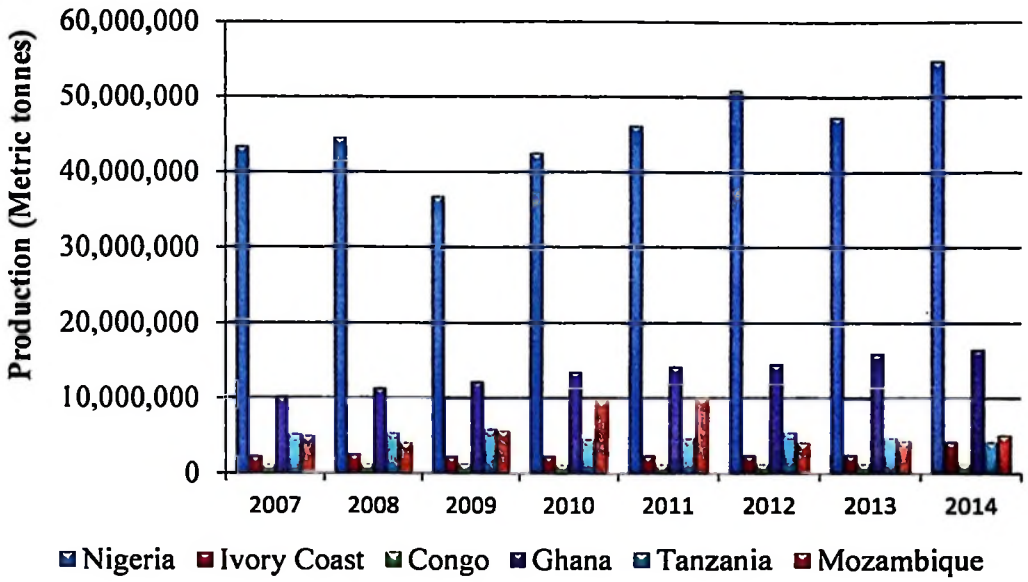

Figure 1: Cassava production trends for the most cassava producing countries in Africa for the period between 2007 and 2014

2.2.2 Cassava consumption

Cassava in Africa is used almost exclusively for consumption as food (FAO and IFAD, 2005). Nearly every person in Africa eats around 80 kilograms of cassava per year and it is estimated that 37% of dietary energy comes from cassava whereby Democratic Republic of Congo is the largest consumer of the product in Sub-Saharan Africa (SSA), followed by Nigeria (IITA, 2016). It is in Sub-Saharan Africa where cassava per capita consumption is high (101 kg/year) (FAOSTAT, 2008). In Latin America and Caribbean the consumption per capita is lower (21 kg/year) however, in Brazil cassava continues to be a principle staple food and average per capita consumption is 41 kg/day (FAOSTAT, 2008).

The large increase in total cassava consumption in Africa is due to a significant increase in per capita consumption in countries such as Ghana and Nigeria where

cassava is produced as a cash crop for urban consumption. The availability of cassava in a convenient food form, such as gari played a major role in the increase in the per capita cassava consumption in Ghana and Nigeria. Future increases in cassava consumption in other African countries will depend on how well cassava is prepared into food forms, which make an alternative to wheat, rice, maize and sorghum to urban consumers (FAO and IFAD, 2005).

2.2.3 Income elasticity of demand for cassava

The income elasticity of demand measures the percent of change in the quantity of a commodity purchased (consumed) by consumers in response to one percent change in their incomes (Lipsey and Crystal, 1999). According to Sadoulet and de Janvry (1995) a negative income elasticity of demand means that the quantity of the commodity purchased by consumers will decline with rising incomes. A zero percent income elasticity of demand means that the amount of the commodity demanded will be unchanged with rising incomes. An income elasticity of demand between zero and one percent implies that a one percent increase in incomes will cause consumers to increase the amount of the commodity they are willing to purchase although by less than one percent. Finally, an income elasticity of demand of more than one percent implies that market demand is very high for the commodity. Scholars and policy-makers who dismiss cassava as an inferior good assume that the income elasticity of demand for cassava is negative (FAO and IFAD, 2005).

2.2.4 Rural and Urban household expenditure in Tanzania

The Household Budget Survey (HBS) conducted by NBS (2014) indicated that the total average monthly per capita consumption expenditure for both food and non-food in Tanzania was slightly over TZS 300 000, out of which, about TZS 100 000 was spent on food by a household on average. According to NBS (2014), in 2011/12 the computed food budget share (including cassava) in Tanzania Mainland was 56.4 percent and the computed food budget share for Dar es Salaam, other urban areas and rural areas were 43.6 percent, 50.4 percent and 62.0 percent respectively. It can be deduced from this figures that people who lived in Dar es Salaam spent more on non-food items such as kerosene, charcoal, transport, health, education, housing, clothing and recreation than the population living in other urban areas. However, the population in rural areas spent more on food than on non-food items as indicated in Table 2 below.

Table 2: Monthly average households expenditure in Tanzania Mainland, 2011/12 (TZS)

Area	Food Consumption Monthly	Non-Food Consumption Monthly	Total Consumption	Food Ration (%)	Non-Food ration (%)
Other Urban Areas	179 299	176 321	355 620	50.4	49.6
Rural Areas	169 368	103 589	272 957	62.0	38.0
Dar es Salaam	239 493	310 433	549 926	43.6	56.4
Tanzania Mainland	**178 301**	**138 079**	**310 380**	**56.36**	**43.64**

Source: NBS (2014)

2.3 Theoretical Perspectives

2.3.1 Theoretical framework

The study is underpinned by theory of consumer behaviour and demand. In consumer theory and demand, individuals as units of consumption are viewed as attempting to maximize their utility (or satisfaction) from consumption of goods given their tastes and preferences and subject to a budget constraint, determined by their income, prices, and prices of other goods (Ekelund and Ault, 1995). Therefore for given tastes and preferences individual consumer food demand, or purchases, is a function of income and prices. However, for a group of consumers like a household, the demand function for individual consumers is extended to include demographic characteristics (age, race-ethnicity, schooling, and other variables) besides prices and income for capturing unobserved information on consumers' tastes and preferences (Chern *at el.*, 2003; Lipsey and Crystal, 1999).

Consumer's demand gives the number of units of a particular product that the consumer would choose to buy at each possible price over a specified period of time (Ekelund and Richard, 1995). The demand functions are based on the assumption that consumers seek to maximize their utility (or satisfaction) from the n goods (in this case cassava) given their tastes and preferences and subject to a budget constraint, determined by their income (in this case per capita income), price of the good of concern, and prices of other goods.

As it was mentioned earlier, extending the demand function for individual consumers to a group of consumers like household requires the inclusion of certain household and socio-cultural factors, including household size, age, gender, educational

background, occupation, and religious affiliation which is useful for capturing unobserved information on consumers' tastes and preferences (Chern *et al.*, 2003).

2.3.2 Consumer demand theory and econometric models for demand analysis

According to Ferris (1998) the empirical analysis of consumer behaviour is not completely an application of the science of economics, but it also entails the artful eye of an econometrician. The author argues that the estimation of demand or expenditure models involves the application of econometric and mathematical tools for estimating single equations and by estimating systems of equations. This argument is consistent with Chern *et al.* (2003) who pointed out that an application of the theory of the consumer requires a specific model and in general, econometric studies of demand include both single equations and systems of demand equations. The demand functions can be generalized for a consumer or a household buying "n" goods as:

$$q_i = q_i(p_1, p_2, \ldots p_j, \ldots p_n, I),\ i = 1, 2, \ldots, n \quad \ldots\ldots(1)$$

Where q_i is the quantity demanded; p is the price of commodities, the subscript i denotes the commodities; and I is income. The "n equations" can be estimated by single equations or by systems of equations. Equation (1) is estimated in a budget share form. Extending the demand function for individual consumers to a group of consumers in most empirical applications requires the inclusion of demographic variables besides prices and income (Chern *et al.*, 2003).

2.3.2.1 Single equation model

Single equation estimation involves estimating either one equation in the model, or two or more equations in the model separately. Single equation Engel curves has mostly been employed in estimating the demand functions and elasticities. Since the seminal work of Engel who studied the expenditure patterns of Belgian households in Germany, the estimation of Engel curves demand functions and Engel elasticities has occupied the central position in most household expenditure studies. The excellent review for that matter is presented by Brown and Deaton (1972) as well as Sadoulet and de Janvry (1995).

Prais and Houthakker (1971) did a comprehensive review and performed estimations of demand using the following Engel functional forms; linear, hyperbolic, semi-logarithmic, double logarithmic, and logarithmic reciprocal. All these forms were shown to have some advantages over the other forms for some of the goods or for part of the range of the relationship. They concluded that the widely used double logarithmic and semi-logarithmic forms performed better than other forms in terms of goodness of fit (Prais and Houthakker, 1971).

According to these scholars, a major concern in the estimation of Engel functional model is that the functional form used should be consistent with observed consumer behaviour. The Engel functional form should be able to represent luxuries (commodities whose consumption increases more than proportionally with income), necessities (commodities whose consumption increases less than proportionally with income), and inferior goods (commodities whose consumption decreases as income increases) as shown in Table 3 below.

Table 3: Categorization of goods according to the signs and magnitudes of elasticities

Categorization with respect to the income elasticity	Elasticity (η)	Categorization with respect to the own-price elasticity	Elasticity (E_{ii})	Categorization with respect to the cross-price elasticity	Elasticity (E_{ij})
Inferior good	$\eta < 0$	Non-Giffen good	$E_{ii} < 0$	Gross substitutes	$E_{ij} > 0$
Neutral good	$\eta = 0$	Giffen good	$E_{ii} > 0$	Gross complements	$E_{ij} < 0$
Normal good	$\eta > 0$				
i. Necessity	$0 < \eta < 1$				
ii. Luxury	$\eta > 1$				

Source: Sadoulet and de Janvry (1995)

In addition to that, Engel functional form should allow the same commodity to be a luxury for the poor but a necessity for the rich. Based on these criteria, the semi-logarithmic form performs quite well (Prais and Houthakker, 1971). This form is able to represent necessities, luxuries, and inferior goods, and allows the income elasticity to vary with income levels, the form is presented as follows:

$$q_i = a + b \ln y_i \quad \text{.....(2)}$$

The choice of the functional form should not only be based on practical criteria of goodness of fit, but also on principles of demand theory (Houthakker, 1957). The principle of adding-up requires that consumers do not spend more than their income. This principle places some restrictions on the demand elasticities of each goods, known as Engel's and Cournot's equations. Simply put, these equations state that changes in income and prices determine changes in the composition of the budget constraint but leave its value unchanged.

One functional form that satisfies adding-up, and that is able to represent closely consumer behaviour is Working-Leser functional form. This model was originally proposed by Working (1943) and elaborated by Leser (1963) that is why it is known as the Working-Leser model. This model states that the budget share of given item is a function of logarithm of the total expenditure. Simply, the model relates the commodity budget shares to the logarithm of per capita expenditure. It is presented as follows:

$$w_i = a_i + b_i \ln y \quad \text{.....(3)}$$

Equation three (3) above is the Working-Leser model where w_i is the share of total expenditure on food and *lny* is the natural log of total monthly expenditure. Other explanatory variables are added to increase the explanatory power of the model (Mhlongo and Daniels, 2013). A setback to Working-Leser model is that, necessities and luxuries are represented by different curves and this requires estimating curves for different income levels (Wan, 1996). This setback is eliminated by including a quadratic term of the natural log of expenditure in the model. Once a quadratic term (square of the log of expenditure) is introduced in the model the problem of misspecifications is also minimised (Fagiolo, 2001).

The Working-Leser model (Equation 3) satisfies the adding-up condition (which states that when the budget share of one commodity increases, another share must be reduced to maintain the budget constraint of the household) provided that the sum of the parameters a_i estimated over all commodities in the household budget is equal to

one, and that the sum of the parameters b_i is equal to zero ($\sum a_i=1$, $\sum b_i=0$). It allows for luxuries, necessities and inferior goods and for elasticities to vary with income. Finally, the form is linear in the logarithm of expenditure, and is easily estimated by ordinary least square (OLS) equation by equation, with the adding-up restrictions being automatically satisfied.

Since most studies in developed economies and developing have found evidence of non-linear budget shares for a large number of goods (Banks *et al.*, 1997). More recent research on Engel curves has focused on the estimation of the Working-Leser equation using polynomials in the expenditure term (by adding quadratic or cubic terms) and non-parametric or semi-parametric methods. Unlike the standard parametric Working-Leser form, these methods allow expenditure elasticities to vary in any direction for the same good over the entire range of household expenditure (ibid).

2.3.2.2 System of demand equations

System of demand (complete demand system) involves estimating two or more equations in the model jointly. It involves the simultaneous estimation of complete demand systems containing demand equations for every commodity groups (Al-Habashneh and Al-Majali, 2014). The major advantage of system estimation is that it uses more information, and therefore results in more precise parameter estimates. However, the major disadvantages are that it requires more data and is sensitive to model specification errors. The opposite is true for single equation estimation. During the last two decades, consumer demand analysis has moved toward system-

wide approaches. Numerous algebraic specifications of demand systems now exist, including the linear and quadratic expenditure systems, the Rotterdam model, Translog models and the Almost Ideal Demand System (AIDS) and the Linear Approximate version of the AIDS specification (LA/AIDS) (Taljaard *et al.*, 2004).

The first person to apply theory consistently to define and modify demand equations was Stone (1954), who estimated price and income elasticities for 48 categories of food consumption from British data. Further attempts to impose structure on demand equations were made by Stone (1954), who developed the linear expenditure system, and by Theil (1965) and Barten (1969), who developed the Rotterdam model, which could be used to test the theory. In the 1970s and 1980s, more emphasis was placed on flexible functional forms, developed from utility or cost functions. The translog model was developed by Christensen *et al.* (1975) and the Almost Ideal Demand System (AIDS) was developed by Deaton and Muellbauer (1980) in the late 1970s and it was seen as the most recent major breakthrough in demand system generations.

The AIDS and Rotterdam models have gained prominence in demand analysis, especially in the field of agricultural economics. Thus, in a comparatively short time since the AIDS was introduced, it has been widely adopted by agricultural economists, to the point that it now appears to be the most popular of all demand systems (Alston and Chalfant, 1993).

According to Buse (1994) between 1980 and 1991 the Deaton and Meulbauer paper was cited 237 times in the Social Science Citation Index and in agricultural economics, 23 of 25 papers chose the LA/AIDS estimation for estimating demand functions (ibid).

Yu *et al.*, (2004) compared different demand systems used for projecting world food demand that are rank two, with the 'optimal' rank three demand systems; mainly An implicit Additive Demand System (AIDADS) and the Quadratic Almost Ideal Demand System (QUAIDS). Some of the properties that a desired demand system should have are; non-negativity of budget shares, predicted shares on the interval [0,1] and Engel flexibility. Table 4 summarises the comparison and different properties of these demand systems.

Yu *et al.*, (2004) in their comparison of different rank two demand systems to the AIDADS system using a multiregional CGE model, they calibrated four CGE models with the same data in 1985 and simulate income and population growth to 2020 assuming that factors adjust in order to maintain prices unchanged. The authors find that rank two demand systems tend to overestimate consumption and food income demand elasticities with respect to the AIDADS system.

Cranfield *et al.*, (2003) estimate different demand systems for 64 countries and 113 commodities and evaluate their sample and out of sample predictions. They find AIDS and QUAIDS to better fit the data, and to a lesser extent QES. Concretely, they find that QUAIDS systems are better in the context of simulations where price

variation may be important. During the 1980s and 1990s, these models, with extensions, were used to estimate demand for food products, and more complex flexible forms were also developed. However, the emphasis was still on the price and income effects, and the approach was frequently the modelling of the representative consumer using time-series data (Gustavsen, 2004).

The working- leser model became more popular since Deaton and Muellbauer (1980) proposed the almost ideal demand system (AIDS), which collapses to the working-leser for cross sectional data (Al-Habashneh and Al-Majali, 2014).

Since, the study on rural and urban household demand analysis for cassava in Dar es salaam and Coast Region in Tanzania uses survey data on cross sections of households which do not contain observations in price variations (Brown and Deaton, 972), the principal analytical model adopted is the Working-Leser Engel functional form and the exact specification it use is what is known as semi-logarithmic quadratic functional (SLQF) form of the Engel equation. Survey data on cross sections of households have typically been used to study Engel relationships because the observed price variation is generally not meaningful or informative for estimating demand response to changes in prices of goods of constant quality (Chern *et al.*, 1993; George and King, 1971).

Although, it has also been argued that prices may vary by region because of variations in supply and quality and that, by disentangling supply-induced price variation from quality-induced price variation, meaningful elasticities of demand with respect to price can be estimated using cross-sectional data (Cox and

Wohlgenant, 1986). Thus, increasingly, cross-sectional data are being used to estimate price elasticities (as well as income elasticities) by making use of the abundant information available about household characteristics and socioeconomic and demographic variables.

Table 4: Comparison of different demand systems

Demand system	Budget share form	Properties according to Yu *et al.*, (2004) and Cranfield *et al.*, (2003)
Linear Expenditure System (LES) Stone, (1954)	$w_{it} = \frac{p_{it}\gamma_{it}}{y_t} + \beta_i\left(1 - \frac{p_t'\gamma}{y_t}\right)$	• Rank two demand system • Limited Engel flexibility- constants marginal budget shares over all income levels, income increases without a bound, average budget shares converge monotonically towards one, and food demand increases monotonically with income
Quadratic Expenditure System (Howe *et al.*1979)	$w_{it} = \frac{p_{it}\gamma_{it}}{y_t} + \beta_i\left(1 - \frac{p_t'\gamma}{y_t}\right) + \left(\frac{p_{it}\gamma_{it}}{y_t} - \beta_i\frac{p_t'\delta}{y_t}\right)\prod_{i=1}^{n}\left(\frac{p_{it}}{y_t}\right)^{-2\beta_i}\left(1 - \frac{p_t'\gamma}{y_t}\right)^2$	• Rank two demand system • Limited Engel flexibility- produces Linear Engel curves
Almost Ideal Demand System (Deaton and Muellbauer 1980)	$w_{it} = \alpha_i + \sum_{i=1}^{n}\ell_{it}\ln(p_{it}) + \beta_i\ln\left(\frac{y_t}{P_t^*}\right)$	• Rank two demand system • Limited Engel flexibility- produces Linear Engel curves and budget share predictions may lie above unity
Quadratic Almost Ideal Demand System Banks *et al.* 1997)	$w_{it} = \alpha_i + \sum_{i=1}^{n}\ell_{it}\ln(p_{it}) + \beta_i\ln\left(\frac{y_t}{P_t^*}\right) + \lambda_i\left(\prod_{i=1}^{n}p_{it}^{\beta_i}\right)^{-1}\left[\ln\left(\frac{y_t}{P_t^*}\right)\right]^2$	• Rank three demand system • High Engel flexibility – allows non-linear Engel curves and for goods to be luxury at low income levels and normal at high expenditure level • Budget shares predictions may lie outside the [0,1] interval
An Implicit Direct Additive Demand System (Rimmer and Powell 1996)	$w_{it} = \frac{p_{it}\gamma_{it}}{y_t} + \frac{\alpha_i + \beta_i\exp(u_t)}{1+\exp(u_t)}\left(1 - \frac{p_t'\gamma}{y_t}\right)$	• Rank three demand system • High Engel flexibility- marginal budget shares are non-linear on income/expenditure, • Budget shares constrained to the interval [0,1]

2.3.3 Household composition and aggregation

There exists a vast literature regarding the aggregation of individual living standards into household living standards, two broad issues arise in this literature-the issue of household size and issues relates to household composition (Woolard and Leibbrandt, 1999). Thus, a three adult household is unlikely to have equivalent consumption requirements to a household with one adult and two young children. A household has to be aggregated into a number of adult equivalents (ibid).

Therefore, in order to account for differences in household size and composition, total household consumption has to be divided by the number of adult equivalents and adjusted to take into account economies of scale (Deaton and Muellbauer, 1980). Correct estimation of Engel curves should be performed using expenditure per adult equivalents rather than per capita expenditure, because the use of the latter has the effect of overestimating food expenditure by households of larger size (Deaton, 1997).

According to this scholar, there are two reasons for why per capita expenditure is inappropriate for the estimation of Engel curves. First, children in developing countries consume proportionally more food than adults. For example, consumption by infants is likely to consist mainly of food among poor families. As a result, for the same level of per capita expenditure, larger households spend more on food. Households of different size have different Engel curves and the shape of the curve may be biased if household size is correlated with income. The solution to this problem is to divide household expenditure by units of adult equivalents using appropriate equivalence scales, rather than by household size.

Equivalence scale reflects the fact that there are scale economies in an household. There are collective goods which are consumed by everybody and private goods which are consumed specifically by one individual (Woolard and Leibbrandt, 1999). The equivalence scale depends on the proportion of collective versus private goods in the household. For example, a TV set is used by all household members and adding a new member to the family adds in terms of the welfare enjoyed by the family but not in terms of costs. Similarly, the fire used for cooking consumes the same fuel whether the food is prepared for four or for five people. Again, there is no standard methodology for estimating economies of scale in consumption (Woolard and Leibbrandt, 1999). There are several methodology adopted in OECD statistics including dividing household expenditure by the square root of household size, rather than by household size (OECD, 1982; 2008; 2011).

The choice of a particular equivalence scale depends on technical assumptions about economies of scale in consumption as well as on value judgements about the priority assigned to the needs of different individuals such as children or the elderly (Lanjouw and Ravallion, 1995). Thus, in this study we use adult equivalence scale defined by National Bureau of Statistics in Tanzania (2009) in its 2007 Household Budget Survey (HBS) as shown in Table 5 below.

Table 5: Adult Equivalence Scale

Age Groups	Sex	
	Male	Female
0-2	0.40	0.40
3-4	0.40	0.48
5-6	0.56	0.56
7-8	0.64	0.64
9-10	0.76	0.76
11-12	0.80	0.88
13-14	1.00	1.00
15-18	1.20	1.00
19-59	1.00	0.88
60+	0.80	0.72

Source: NBS, (2009)

2.4 Empirical Perspectives

Using data from Belgian surveys of 199 working class families, Engel (1857) studied how households expenditures on food vary with income in his article entitled "The relations of production and consumption in the Kingdom of Saxony" as cited in Perthel (1975). On pages 28 and 29 he wrote: "The poorer a family, the greater the part of total expenditures must be spent on food". By this sentence, later was referred to as the Law of Engel. He found that food expenditures are an increasing function of income and of family size, but that food budget shares decrease with income (Perthel, 1975).

In their analysis of the food consumption of Japanese households and econometric analysis of Japan's food demand structure Chern *at el.* (2003) applied various single-equation model including the Working-Leser model which was estimated by ordinary least squares (OLS). Empirical results from the 11 major food items show that the expenditure elasticity of rice is positive and close to one. The study shows that the Japanese meat consumption pattern has become Westernized.

By using household expenditure survey 2004/05, John *at el.* (2009) applied the Heckman two-step procedure with the Working-leser and other functional forms to conduct the Engel curves analyses. The empirical results exhibit the same observations as laid down in the Engel's law. All the estimated expenditure elasticities of demand for food away from home were less than unity. Thus, this study verified that the notion of Engel's law can be extended to food away from home in Malaysia.

Al-Habashneh and Al-Majali (2014) used six functional forms of Engel curves in estimating the household expenditures in Jordan. The estimated results of the linear, the double-log, the semi-log, the hyperbolic and the log-reciprocal forms fitted into the data very well for most of the commodity groups for the pooled and urban data. The finding of the study indicated that the family size does not affect the demand for the Vice, Housing, Transportation and Health Commodity groups. On the other hand, the family size for the other groups is significantly different from zero which suggests that family size affect the demand for these commodity groups.

In examining the most important determinants of the demand for cassava in Nigeria Tsegai and Kormawa (2002) employed almost ideal demand system to estimate the parameters of the regression. The results indicate that cassava is a price inelastic food and the expenditure elasticity is positive, though inelastic. They concluded that cassava is fast changing from an inferior food to a necessity.

Chongela *at el.* (2014) employed the almost ideal demand system (AIDS) to estimate the consumer demand system of agri-food in Tanzania. The empirical results revealed that households' food budget share was 60% on average per month. The own price elasticity of demand for aggregated agri-food was inelastic (0.86). Income elasticity of demand for aggregated agri-food was 0.96. Moreover, inelastic demand of own price elasticity of agri-food products informed the government intervention in terms of agri-food price stabilization policies and programmes.

Ndanshau (2001) employed log-linear Engel functional form to provide an empirical evidence on the applicability of the Engel's law in Tanzania. The analysis is based on a micro-survey data of peasant households in Northern Tanzania. Both statistical and econometric analyses demonstrate that household size and income significantly and positively determine expenditure on food and some other consumption items, depending on the area of the study. The age of the household is established to have no significant influence on expenditure on food, but only on other consumption items investigated. The study has also established that education has no significant influence on any expenditure items of the sampled households.

Handa and Mlay (2006) used the Engel curve with Working-Leser functional form specification to analyse the food consumption patterns, seasonality and market access in Mozambique. Results revealed the high (nearly unitary) income elasticity for basic staple foods among poor (bottom quintile) rural households. They concluded that for the households, even the most basic products such as cassava have unitary income elasticity, verifying what development agencies and government officials have also recognized, which is that the food security situation of this group is precarious.

Gale and Huang (2007) estimated demand for food quantity and quality in China. They used the log-log-inverse (LLI) form of the Engel equation, which allows the income elasticity to vary with income. Based on their findings they concluded that rapid income growth is changing the structure of Chinese food expenditure, a development that has important implications for China's agricultural and food sector and for international trade in agricultural products. As household incomes rise, consumers demand not only a greater quantity of food, but also higher quality. The demand for quantity diminishes as income rises, and the top tier of Chinese households appear to have reached a saturation point in quantity consumed of most food items. Most additional food spending by high-income consumers is spent on higher quality foods and meals in restaurants. This is reflected by increased attention to food safety; demand for processed foods; patronization of restaurants and other foodservice establishments; increased shopping in supermarkets, convenience stores, and other modern retail shops; and consumption of a wider variety of non traditional foods.

Ezemenari *at el.* (1998) studied a consumption patterns and expenditure elasticity of demand for food staples in rural Africa with a focus on cassava growing area. In their analysis they found that the income elasticity of demand estimates for cassava products was positive at all income levels. For some cassava products, the income elasticity of demand was above one. For example, in Nigeria, it was surprising to discover that the income elasticity of demand for gari was significantly higher than that of maize at all income levels. Among high-income urban households, the income elasticity of demand for gari was also higher than that of rice. In Ghana, the income

elasticity of demand for cassava (all products combined) was higher among urban than rural households. These estimates provide convincing evidence that cassava has a strong market demand in the all study countries.

A study on socio economic survey conducted by Cock (1985) in Indonesia entitled "Cassava: new potential for a neglected crop" showed that the per capita consumption of fresh cassava tends to increase at minimal increases in income level, but stabilizes or decreases at higher income levels. A similar result has been observed by FAO (1990) in Brazil and Ghana where in Brazil the elasticity of demand for cassava were positive at low income levels and decreases at higher income levels, and in Ghana there were no further tendency for the consumption to increase as per capita income increases to levels above subsistence.

In addition, empirical studies have shown that household characteristics such as age, gender, educational level and household size are among the personal and household characteristics that influences household consumption patterns. Frost and Sullivan (2004) on their study on food group consumption patterns from childhood to young adulthood found that at the age of ten, the percentage of children consuming vegetables, breads/grains, poultry, mixed meats, desserts, fruit/fruit juice, candy and milk was significantly higher than the percentage consuming those food groups in young adulthood.

Ndanshau (2001) pointed out that, it is not arguable that both high birth rates and the "traditional social welfare system" render the number of dependents to increase with the age of the household, and as a result, increases household expenditure on consumption items, especially that of food items. This study attempted to disaggregate the data according to age profile to examine how age differences can influence the cassava consumption patterns in urban communities of coast region.

In a study to examine the effect of educational level on consumption in South Africa Bobby (2004) found that an increase in educational level resulted to an increase in percent per capita expenditure for all expenditure categories which were put under investigation. Other studies have also found education to have negative influence on the tastes and preferences of the household (Kapunda, 1988).

In their study on commercialization of food consumption in rural China Gale *et al* (2005) reveled that, larger households were found to spend more on non-food items. In a study on effects of socio demographic and economic factors on food expenditure Sdrali (2006) found that household size was a significant and positive factor in food expenditure; the findings were consistent with the results of Cage (1989) in his study on spending differences across occupational fields and Kalwij *et al.* (1998) in their studies on household commodity demand and demographics in the Netherlands. In both cases food expenditure were found to be positively related to increases in the number of household.

However, on the other hand, Houthakker (1957) found a negative relationship between household size and food consumption. Such a mixed effect of household size on food consumption which is supported by empirical studies on food demand has led scholars to conclude that, household size does not have a clear effect or direction of influence on food expenditure share.

Houthakker (1957), in his study titled "an international comparison of household expenditure patterns, commemorating the centenary of Engel's Law" he found a negative relationship between household size and household food expenditure. He explained that, the coefficient of household size in the model represent a combination of two effects; specific and income effect. The specific effect results from the increase in the "need'' for various commodities when family size increases, he pointed out that, the increase in "need" is usually less than proportional to the increase in size because of the economies of scale in large households.

On an "income" effect, an increase in family size makes people relatively poorer. Although, for example, an increase in family size may increase a household's "need" for clothing, the simultaneously arising "need" for more food may force it to spend less for clothing on balance. Houthakker (1957) concluded that, if "specific effect" is stronger than "income effect", the coefficient of household size will be positive, otherwise it will be negative. Thus, it is no surprise that all the empirical studies do not converge as far as the relationship between household size and the consumption of specific food commodities are concerned.

2.5 Conceptual Framework

The demand for cassava in Tanzania can be divided into household demand and industrial demand. This study is concerned with the household demand for fresh cassava. The household demand, or purchases of cassava and cassava products is a function of price of cassava, prices, of other goods and household and socio-cultural factors which are included to capture unobserved information on consumers' tastes and preferences. The personal and household characteristics of interest in this study were age, education, gender and household size (which was adjusted to adult equivalents scale). The relationship between household demand for cassava and cassava products and the variables indicated above is illustrated in Figure 2. The direction of the arrows illustrates the cause-effect or explanatory variable – dependent variable relationship.

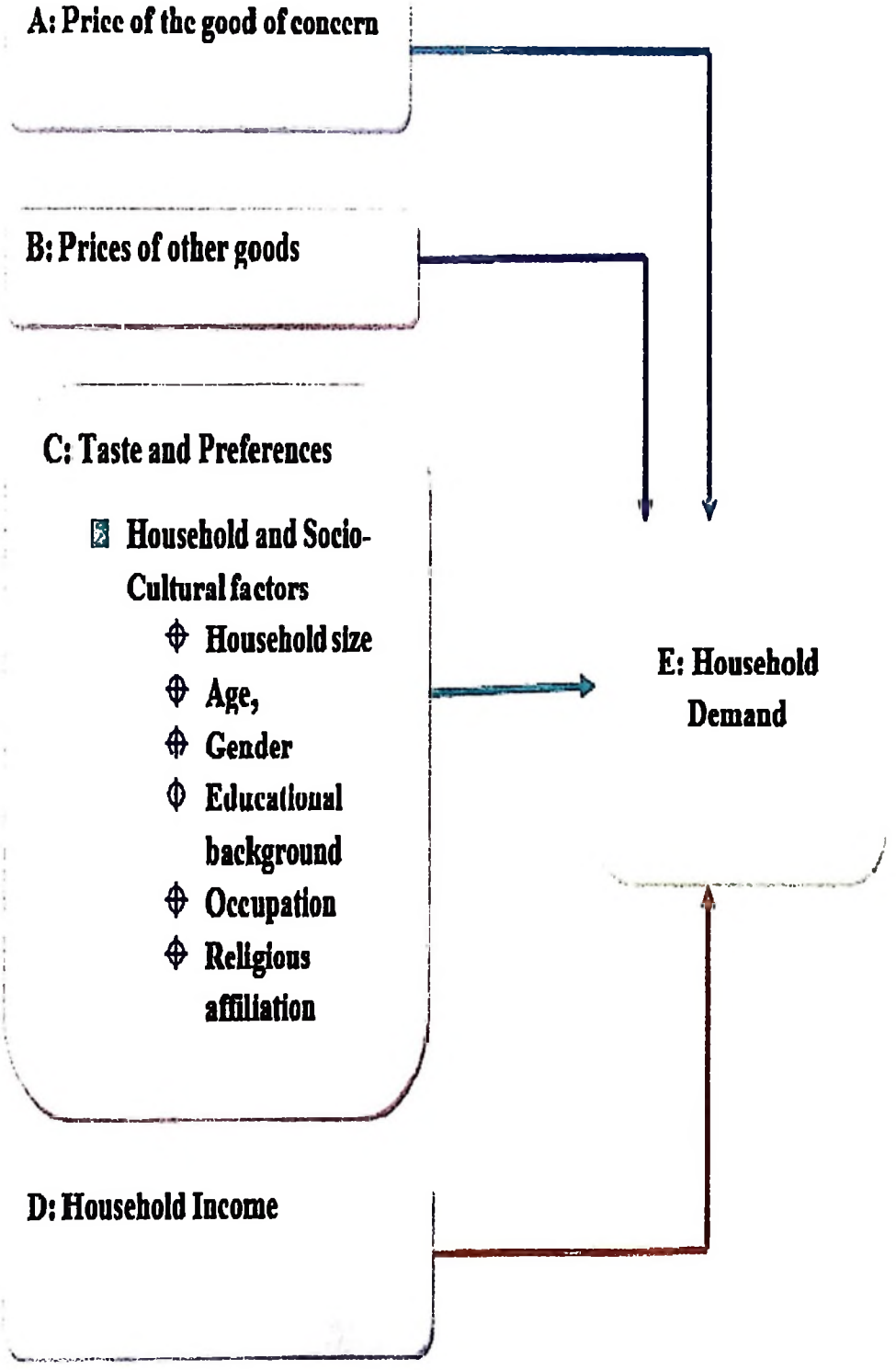

Figure 2: The conceptual framework

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

The study was conducted in Dar es Salaam and Coast Region. Dar es Salaam, is purely consuming urban center whereas Coast Region, serve as both cassava producing and consuming rural area. The selection is based on the fact that Coast Region is among the most cassava producing and consuming region (Mkamilo and Jeremiah 2005). Dar es Salaam is the major market for cassava and it is a metropolitan city where most of the cassava produced in various regions is consumed.

3.1.1 Dar es Salaam City

Dar es Salaam City is located between latitudes 6°36 'and 7° South and longitudes 33°33' and 39° East. It is bordered by the Indian Ocean on the East and by the Coast Region on the other sides. Administratively, the city is divided into three municipalities namely namely Ilala, Kinondoni and Temeke (Figure 3). The municipalities are divided into 10 Divisions, which are subdivided into 93 Wards, 448 Mitaa (URT, 2014).

Dar es Salaam is the commercial city of the country; it is one of the fastest growing cities in Africa. According NBS (2016) the City has a population of 4 364 541 with a total of 1 083 381 private households. Sixty five (65) percent and 35 percent of households were headed by males and females respectively. The Population of Dar es Salaam is growing at a rate of 5.6 percent annually, representing an increase of

about 75 percent over the 10 ear period since 2002. At the current growth, the population of Dar es Salaam re ion will double in the next 12 years. Dar es Salaam has no rural areas (NBS, 2016).

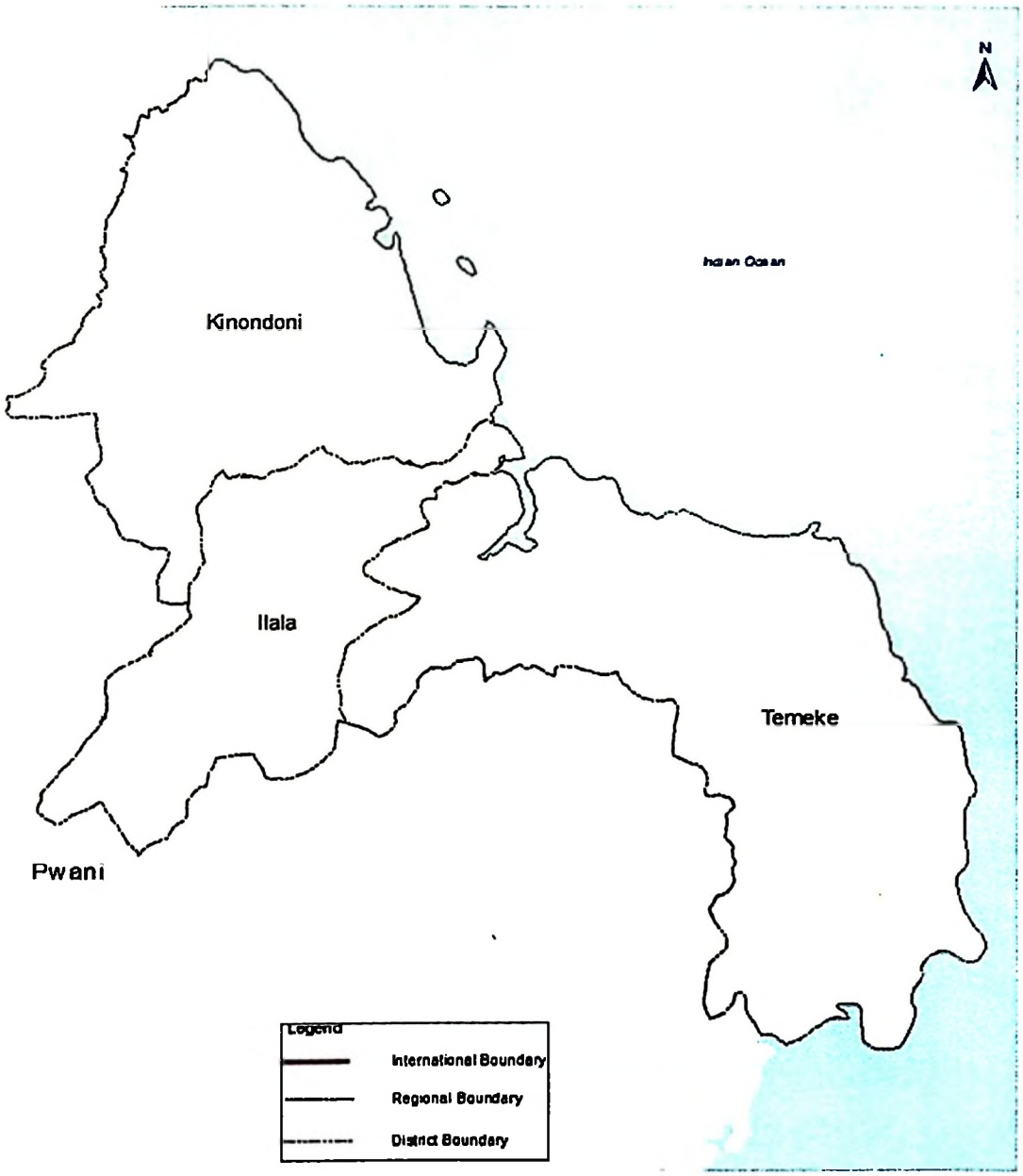

Figure 3: A Map showing location of Dar es Salaam City in Tanzania Mainland
Source: URT, (2014)

3.1.2 Coast Region

Coast Region is located in the middle eastern side of Tanzania Mainland, between latitudes 6° and 8° south of equator and longitudes 37°30' and 40° east of Greenwich (see Map 1). It borders Dar es Salaam Region and Indian Ocean in the East, Tanga region in the North, Lindi in South and Morogoro region in the West (URT, 2015). Administratively, the Region is divided into six districts, which include Bagamoyo, Kibaha, Kisarawe, Mafia (an island in Indian Ocean) Mkuranga and Rufiji; as well as seven Local Government Authorities (LGAs) namely Kibaha Town, Kibaha, Bagamoyo, Kisarawe, Mafia, Mkuranga and Rufiji (Figure 4). It is also divided into 26 Divisions ('Tarafa"), 125 Wards ("Kata"), 417 Villages ("Vijiji"), 73 Streets ("Mitaa") and 2 039 Hamlets ("Vitongoji") (URT, 2015).

According to NBS (2016) Coast Region had a population of 1.1 million in 2012 with a total of 254 810 private households. One third (31 percent) of households in Coast Region were headed by females. The Population of Coast Region is growing at a rate of 2.2 percent annually, representing an increase of about 24 percent over 10 year period since 2002. At the current growth, the population of Coast Region will double in the next 32 years. Coast Region population is predominantly rural with 67 percent of total population living in Rural Areas (NBS, 2016).

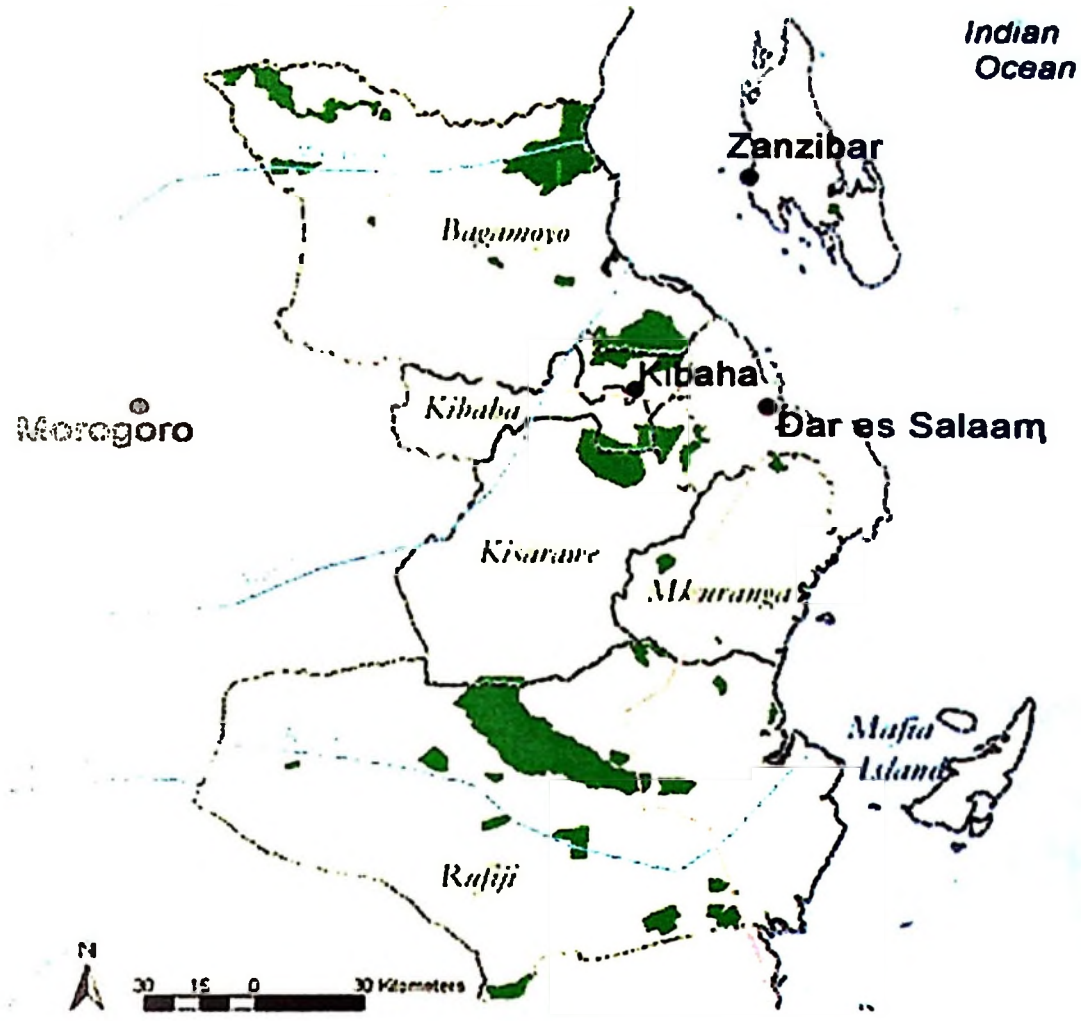

Figure 4: A Map showing location of Coast Region in Tanzania Mainland
Source: URT, (2015)

3.2 Research Design

A cross-sectional research design was used in this study due to its advantage of allowing data to be collected at a single point in time and cost effectiveness. The design is suitable for a descriptive study as well as for determination of quantitative relationship between variables (Bailey, 1998).

3.3 Sample Size and Sampling Procedures

The sampling units for this survey were the households in Dar es Salaam and Coast Regions. A two-stage sampling method and a combination of stratified, systematic and simple random sampling techniques were used to select respondent households. In the first stage, two regional administrative areas; Dar es Salaam representing urban areas and Coast Region representing rural areas were purposively selected to reflect the most cassava producing and consuming areas. In the second stage, two local government authorities (Ilala in Dar es Salaam and Mkuranga in Coast Region) were randomly selected and stratified into low, medium, and high income areas with the help of the local government authorities (Municipal and District Councils) in the respective study areas. Within each income stratum, a systematic random sampling technique was employed to select respondent houses. The houses selected through the systematic random procedure were visited and household heads were interviewed.

A total of 100 households each from Dar es Salaam and Coast Region respectively at 10 percent level of precision were selected for the study, constituting a total sample of 200 households (Table 6). The sample size in each case was determined using the sample size determination formula by Yamane (1967) as indicated below.

$$n = \frac{N}{1 + N(x)^2} \quad \text{.....} \quad (4)$$

Whereas;

n Is the sample size

x Is the level of precision

N Is the population size, which is 1 083 381 and 254 810 households in Dar es Salaam and Coast Region respectively (NBS, 2013). The target population was all households in Dar es Salaam and Coast Region.

Table 6: Selected households for the study by income groups

Location	Low income areas	Middle income areas	High income areas	Sample size
Dar es Salaam	Malapa	Mchikichini	Kisutu	
	Vingunguti	Tabata	UpangaWest	
	Kiwalani	Segerea	Upanga East	
Sub-Total	14	56	30	100
Coast Region	Msufini	Bigwa	Kimanzi	
	Mlale	Kitonga	Mwalusembe	
	Mantanzi	Mwanambaya	Vikindu	
Sub-Total	69	11	20	100
Grand-Total	83	67	50	200

3.4 Data for the Study and Method of Collection

The set of data collected consists of data on personal and household characteristics of interest (age, education, gender and household size which was later transformed into adult equivalence scale), different forms of cassava products preferred by household and per capita household expenditure. The household expenditure data were used as a proxy for household income because of the measurement and problems of the income data in LDCs (Adkins, 1976; Boateng *et al.*, 1992; Ostby, 1968).

The methods of conducting household surveys have been discussed extensively in the literature (Neter, 1970). The two major methods in use are (i) the personal interview, whereby an enumerator asks a household members to recall expenditures made during a given reference period, and (ii) the diary method, where the respondent is asked to record, usually daily expenditures in an account book. Under the personal interview method, respondents are asked to recall their expenditures for

a one-month, three months, six months and sometimes one-year period. In this study, the personal interview method was used. Data were collected in October, 2015.

3.5 Assurance of Data Quality

To ensure data quality, various strategies were used from the preparatory phase until the data analysis. First, during the preparatory phase, draft questionnaires were sent to various resource persons based on their areas of specialty. The aim was not only to obtain their opinions on the guides and questionnaires (length, content, aspects that can be added or deleted), but also to obtain their perception on the concordance between the questions and field realities. This gave an allowance to make improved version, which were then used to train the interviewers.

Second, all enumerators were trained before the field work. Indeed, the administration of the questionnaires was made possible with the help of six (6) enumerators who had Bachelor in Rural Development (4) and Bachelor in Agricultural Economics and Agribusiness (2) with some years experience in socio-economic data collection. The enumerators were given a one-day training session during which they were introduced to the purpose of the study and its scope. They were then taken through the questionnaires: each question was read and explained, and the idea behind the question stressed. The training also enabled the translation of some key questions into the local languages (Swahili) and resulted in an appreciation of the complications they present, at the same time removing ambiguities where necessary.

Third, after the training of the enumerators, questionnaires were pre-tested before being used. The pre-test took place in Morogoro urban areas, which is not among the research areas. During this pre-test, each enumerator was asked to interview two household, to record all problems encountered and the time spent for each household. After the pre-test, a small meeting was conducted which allowed to take relevant improvements into account.

Fourth, during the quantitative data collection phase, regular field visits to each enumeration area to inspect the survey was done and validation exercise was performed which consisted of going into the sampled households and asking the household's head some questions from the questionnaire. The objective was to ensure that the enumerators had actually conducted the survey with the household and to verify the consistency of the responses with those obtained by the enumerator. In addition, during the quantitative data collection phase, to avoid mistakes, we went through every completed questionnaire in order to ensure that it was not partially completed. The purpose was also to detect and correct errors as soon as possible. When these occurred, the enumerator was asked to go and see the household.

The final household response rate is in reference to the original households selected. A total of 200 original sample households (out of 200) were interviewed with a final response rate of 100 percent.

3.6 Data Handling and Analysis

After the fieldwork, the questionnaires were checked and codified. In recognition that every dataset contains some errors and every analyst experiences a rite of passage in wasting days drawing wrong conclusions because the errors have not been first rooted out. Data cleaning was conducted in two steps; detection and then correction of errors in a data set once errors were detected. Under detection, descriptive statistics by variable to show the mean prevalence of a variable was conducted by; looking at minimum and maximum values for descriptive statistics; looking at means, median, and standard deviation; and looking for likeliness of a value in terms of z-score.

The three-sigma rule of thumb (68–95–99.7 rule) was used to test for outliers and normal distribution. The rule says that if the population of a statistical data set has a normal distribution (the data are in the bell shaped curve) with population mean and standard deviation then following conditions are true; approximately 68% of the observations lie within 1 standard deviation of the mean; approximately 95% lie within two standard deviation of the mean; and approximately 99.7% lie within 3 standard deviations of the mean (Dai and Wang, 1992). In applied practice, confidence intervals are typically stated at the 95% confidence level. However, when presented graphically, confidence intervals can be shown at several confidence levels, for example 90%, 95% and 99% (Dai and Wang, 1992). Therefore a z-score between -2 and +2 was considered.

Once errors were detected, they were handled appropriately so that data could be analyzed without losing their integrity or robustness. Descriptive analysis were conducted using Statistical Package for the Social Sciences (SPSS) version 16 and further analysis were carried out using STATA software version 13.

3.7 Analytical Framework

The principal analytical tool used is the Engel curve, which relates budget shares devoted to various food groups (in this case cassava), to total household per capita expenditures and other household characteristics such as demographic composition. The reason attached to its selection is as recommended by Brown and Deaton (1972) that in those situations where all we have are cross-sectional data from household which do not contain observations in price variations, we are limited to the estimation of Engel curves. In addition, survey data on cross sections of households have typically been used to study Engel relationships because the observed price variation is generally not meaningful or informative for estimating demand response to changes in prices of goods of constant quality (Chern, Huang and Lee 1993; George and King, 1971).

Various forms of Engel relationship have been widely investigated, but yet no single representation has found general acceptance (Brown and Deaton, 1972; Lesser, 1963). In the current analysis the semi-logarithmic quadratic functional (SLQF) form of the Engel equation is used.

The first reason for choosing this algebraic specification is related to the characteristics of the survey data, the type of commodity studied and the expected magnitudes for the income elasticity to be estimated (Hassan and Johnson, 1997). The second reason attached to its selection is the fact that, it allows the income elasticity to vary with income and it has been shown to give a satisfactory description in most food studies (Prais and Houthakker, 1971).

The third reason is its ability to represent inferior, necessity and luxury properties of the good under the study. In addition, it satisfy the adding-up criterion. Indeed, despite that the specified Engel functional form satisfy the adding-up criterion, this was not a concern since we did not estimate a complete demand system (Gale and Huang, 2007). The specification start with what is commonly known as the Working-Leser Engel functional form, as presented in equation (5) below;

$$w_i=\alpha+\beta_i \log(exp)+\mu_c \quad \ldots\ldots(5)$$

Quadratic term (square of the log of expenditure) is added as proposed by Banks *et al.* (1997) to minimize the problem of Heteroscedasticity and allowing the model to represent inferior, necessity and luxury properties of the good under the study. Indeed, we add other explanatory variables (household characteristics) to increase the explanatory power of the model and problem of misspecifications (Fagiolo, 2001). The empirical specification of the model is presented in equation (6) below while description of explanatory variables and their expected sign of influence is presented in Table 7.

$$w_c=\alpha+\beta_1 \log(exp)+\beta_2 \log(exp)^2+\beta_3 hhs+\beta_4 edu+\beta_5 age+\beta_6 gender+\mu_c \quad (6)$$

Where;

w_c	Budget share devoted for fresh cassava,
exp	Household total per capita consumption expenditures (TZS),
hhs	Household size and composition (adjusted to adult equivalents scale)
edu	Number of years of formal education completed by household head
age	Age of the household head in years
Gender	Gender of household head
α and β_s	Parameters to be estimated, and
μ_c	Is a random error term

Using equation (6), the total expenditure elasticities can be derived using the formula in (7) below (Deaton *et al.*, 1989).

$$E_i = 1+[\partial w_c / \partial \log (exp)]/w_c = 1+[\beta_1+2*\beta_2 \log(exp)]/w_c \quad (7)$$

Table 7: Explanatory variables and their expected sign of influence

Variable	Variable Descriptions	Expected sign of influence
Per capita expenditure	Monthly Per capita household consumption expenditure in Tanzanian shillings (TZS)	-
Household size	Number of people living together under the same roof and eating from the same pot (adjusted to adult equivalents scale)	+
Education	Number of years of formal education completed by the household head	-
Age	Age of the household head in years (0= <35 years, 1= Otherwise)	+
Gender	Gender of household head (0= Male, 1= Female)	+

Although there are several factors that could influence consumers decision to purchase cassava and its products, in this study four factors were considered; per capita household expenditure which was used as a proxy for household income, household head characteristics focusing on age, gender, educational level and household size. It is noteworthy that prices are central in the theory of the consumer behaviour but in this study have been ignored because we used cross-sectional data from household which did not contain observations in price variations as recommended by Brown and Deaton (1972). This is also a common approach adopted in the previous studies on the Engel's law (Kapunda, 1983; 1988; Ndanshau, 2001). Per capita household expenditure was used as a proxy for household income because of the measurement and problems of the income data in LDCs (Adkins, 1976; Boateng *et al.,* 1992; Ostby, 1968).

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Demographic and Socio-Economic Profile of Respondents

Characteristics of respondents have important social and economic implications towards consumption patterns (Gary and Kotler, 2000). In this regards, set of personal and household characteristics of interest namely age, gender, educational level and household size (AE) have been examined and presented in this section. Table 8 shows the distribution of respondents by selected personal and household characteristics described below.

4.1.1 Gender

About 69% of all households interviewed were male-headed. This is a reflection of the national situation where majority (66.6%) of households in Tanzania is male-headed (NBS, 2016). In Dar es Salaam, more than 67% of the households were male-headed. However, in Coast Region females formed the majority (69%) of household heads.

4.1.2 Age

In all study areas (urban and rural), the middle aged consumers (35 - 60 years age group) formed the majority in the sample. For the pooled sample, this group of consumers constituted 46% and consumers below 35 years constituted 42%. Only 13% of consumers is aged 65 years and above. Table 8 show household distribution by age groups.

4.1.3 Educational level

Majority (61%) of the pooled sample had attained primary education, while 28% attained secondary education and 9% had attained university education and others. Further analysis indicates an adult literacy rate of 98%. This finding is close to that of National Bureau of Statistics (2016) of the United Republic of Tanzania which reported adult literacy rate of 78 percent which was higher in urban areas (92%) than in rural areas (71%). This was an increase from 69% in 2002 to 78% in 2012 (NBS, 2016).

4.1.4 Household size (number of adult equivalents)

Household size was transformed into units of adult equivalents to give appropriate weights to persons of different ages and sexes (Deaton and Muellbauer., 1980). This was achieved using appropriate equivalence scales defined by National Bureau of Statistics in Tanzania (2009) in its 2007 Household Budget Survey (HBS). Majority (61%) of household in the pooled sample had 3.1 to 4.5 units of adult equivalents. The figure is close to that of National Bureau of Statistics (2016) of the United Republic of Tanzania which reported average household size was 3.9 persons per household in Dar es Salaam and 4.2 persons per household in Coast region.

4.1.5 Household income

Income level in the study was defined as cash income earned or received by households. Mean monthly per capita expenditure was used as a proxy for income. The 2011/12 HBS revealed that the total average monthly per capita consumption expenditure for both food and non-food in Tanzania was TZS 316 380 (NBS, 2014).

Based on the analysis of per capita expenditure figures in 2011/12 HBS the households in the study areas were put in three main income groups (low income, Middle income and high income household) as shown in Table 13. It could be deduced from Table 13 that households in the middle income category formed majority (42%) of the pooled sample; low income households formed about 34% of the pooled sample; and 25% were in the high income group. Further analysis indicates that in Dar es Salaam 14% of respondents was in the low income group compared to 69% of respondents who was in the low income group in Coast Region and 30% of respondents was in the high income group in Dar es Salaam while in Coast Region high income group formed 20% of the respondents.

Table 8: Household Distribution by demographic and socio-economic characteristics

Consumer characteristics	DSM		COAST REGION		POOLED SAMPLE	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Gender						
Male	67	67	71	69	138	69
Female	33	33	29	31	62	31
Total	**100**	**100**	**100**	**100**	**200**	**100**
Age (Years)						
<35	38	38	45	45	83	41.5
35- 60	43	43	49	49	92	46
>60	19	19	6	6	25	12.5
Total	**100**	**100**	**100**	**100**	**200**	**100.0**
Educational level						
No formal education	2	2	3	3	5	2.5
Primary education	53	53	69	69	122	61
Secondary education	34	34	22	22	56	28
University education and Others	11	11	6	6	17	8.5
Total	**100.0**	**100.0**	**100.0**	**100.0**	**200.0**	**100.0**
Number of adult equivalents						
<3.1	29	29	14	14	43	21.5
3.1 to 4.5	58	58	61	61	119	59.5
>6.5	13	13	25	25	38	19
Total	**100**	**100**	**100**	**100**	**200**	**100**
Household income (TZS)						
Low Income [< 316,380]	14	14	69	69	83	42
Middle Income [316,380 – 500,000]	56	56	11	11	67	34
High Income [> 500,000]	30	30	20	20	50	25
Total	**100**	**100**	**100**	**100**	**200**	**100**

4.2 Household Preferences for Cassava and Cassava Products

The results in a pooled sample revealed that 80.5% of household consumed cassava and 19.5% did not. This finding implies that most of households interviewed in the study areas consumed cassava. This finding is consistent with the results of NBS (2012) survey which revealed that in Tanzania cassava production is the second to

maize and more than 1.3 million households in the country are engaged in cassava production. Table 8 provides the distribution of respondents according to household cassava consumption in the study areas.

It is evident from Table 9 that cassava consumption is higher in Dar es Salaam (83%) compared to Coast Region which is 78% of total households. Probably this is because Dar es Salaam is the major market for cassava from Coast region and other producing regions of Tanzania.

Table 9: Cassava consumption in the study area

Cassava Consumption	DSM		COAST REGION		Pooled Sample	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Households who consumed cassava	83	83	78	78	161	80.5
Households who did not consume Cassava	17	17	22	22	39	19.5
Total	**100**	**100**	**100**	**100**	**200**	**100**

The cassava products mostly consumed in the two study areas were found to include raw cassava (fresh roots), boiled, futali/mseto, stiff porridge, fried/chips and other forms (Appendix 1). Table 10 below provides the distribution of respondents according to their most preferred cassava products in the study area.

Table 10: Household distribution by most preferred cassava product and location

Preferred form	DSM		COAST REGION		Pooled Sample		Rank
	Freq.	Percent	Freq.	Percent	Freq.	Percent	
Raw cassava	5	6	1	1.3	6	3.7	6
Boiled	53	63.9	30	38.5	83	51.6	1
Futali/Mseto	17	20.5	9	11.5	26	16.2	2
Stiff Porridge	6	7.2	16	20.5	22	13.7	3
Fried/Chips	1	1.2	10	12.8	11	6.8	5
Others	1	1.2	12	15.4	13	8.1	4
Total	**83**	**100**	**78**	**100**	**161**	**100**	

Boiled cassava ranked first as the most preferred cassava product. About 51.6% of households in the pooled sample preferred to consume cassava in the boiled form. In two of the urban and rural areas considered in this study, majority (at least 38.5%) of households preferred boiled cassava to the other processed forms. Futali/mseto ranked second as the most preferred cassava product. About 16.2% of households in the pooled sample preferred to consume cassava in the form of futali/mseto. This is where cassava is mixed with other food staff such as sweet potatoes and/ irish potatoes or magimbi (native language) and boiled together and eaten as stand-alone side dish. It could be deduced from the table that in Dar es Salaam, futali/mseto was also ranked second in the preferred form to boiled cassava, consumed by almost 20.5% of the households.

However, in Coast Region, stiff porridge (Ugali) was the second preferred form of cassava consumed by 20% of the households. Stiff porridge (Ugali) ranked third as the preferred cassava product. About 13.7% of households in the pooled sample preferred to consume cassava in the form of stiff porridge (Ugali). Other forms of cassava ranked fourth in the preference. About 8.1% of households in the pooled

sample preferred to consume cassava in other forms. This was mentioned as mixing maize meal with cassava flour to enhance taste and acceptability, roasted cassava and smoked cassava.

However, it should be noted that, the forms in which cassava is consumed (raw cassava, boiled, futali/mseto, stiff porridge (ugali), fried/chips and other forms) are prepared from the form in which cassava is purchased by households, it can be raw cassava or cassava flour. The flour can be high quality cassava flour (HQCF) or flour from traditionally dried cassava roots. Figure 5 below shows the distribution of households in the study areas according to forms of cassava used when preparing cassava food.

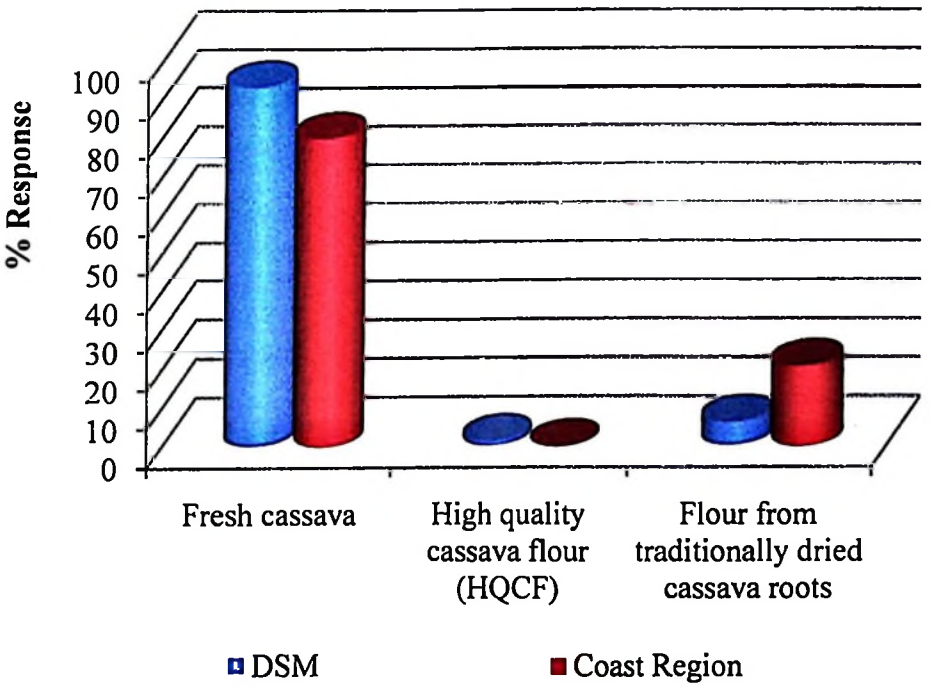

Figure 5: Household distribution by forms of cassava used when preparing cassava food - Pooled sample

The above finding is consistent with Sewando *et al.* (2011) who found that cassava marketing that take place in local markets is mostly for fresh cassava, or locally processed grits without much value addition despite availability of marketing opportunities for value added products such as cassava flour (HQCF) and cassava chips for animal feed.

It is worth noting that, boiled cassava was not normally consumed alone. There was a number of complements, the commonest being tea. This is a clear indication that boiled cassava is a substitute of bread and other foodstuffs that go together with tea. A high percentage of respondents, about 52% of households in the pooled sample indicated that they consume boiled cassava and this is mainly for breakfast and is consumed together with tea.

However, it could be deduced from the findings that, most consumers in the study area did not have any unique recipes they knew of or used when preparing cassava for consumption. The few (less than 21% as indicated in figure 5) who had some recipes mentioned the usual traditional methods of preparation, an indication that there was very little innovation. The implication of this finding is that, there is a room for enhancing consumption of cassava through development of various recipes to increase acceptability, break the monotony and broaden the use of cassava products.

Following a Chi-square test of independence conducted, the test results failed to reject the null hypothesis of independence at 1% level of significance, it means that

the data provide little or no evidence that the null hypothesis is false. The Implication of this result is that cassava preference and income level is not related. Whether low, middle or high income, almost all households bought a particular cassava product based mainly on their own assessment of the taste. Figure 6 depicts the relationship between the most preferred cassava products and income level.

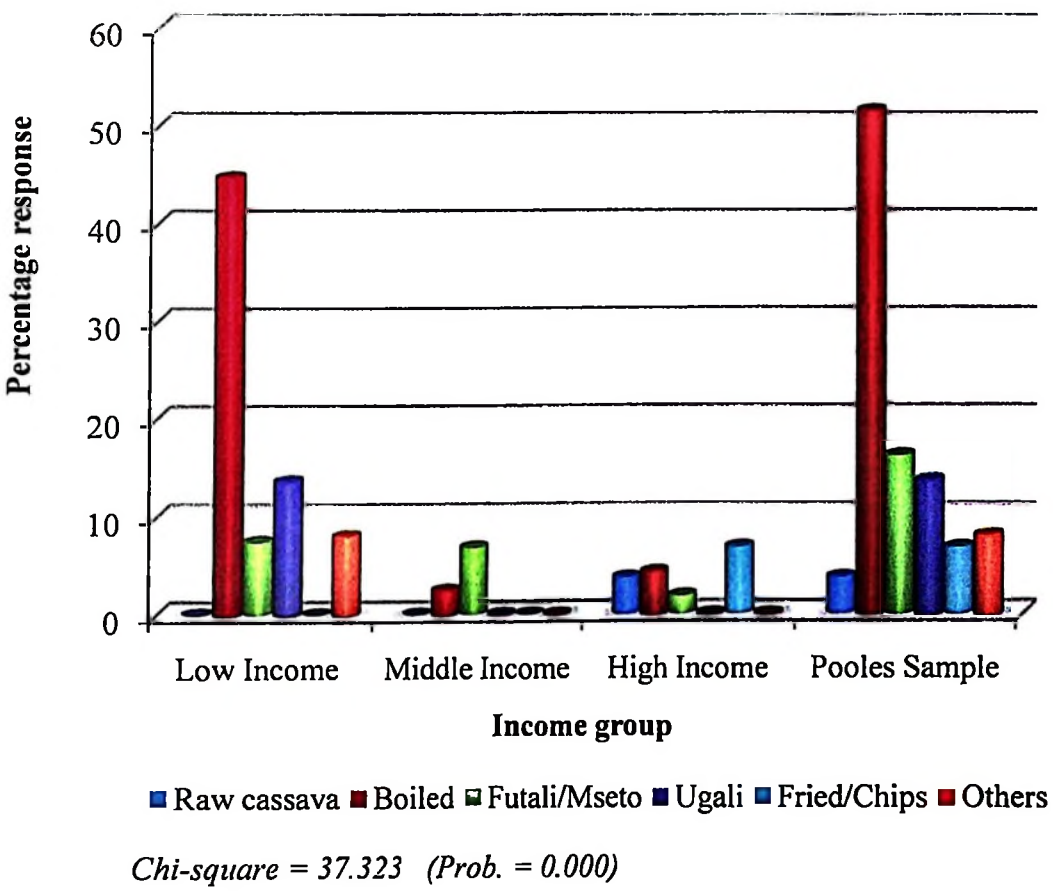

Figure 6: Preference for cassava products according to income –all consumer locations

4.3 Household Expenditure Pattern and Cassava Budget Share Analysis

4.3.1 Household food and non food expenditure

One of the principal indicators used to measure living standards of a population is the food budget share, which is measured by the proportion of expenditure on food consumption to total expenditure and is given in percentage (NBS, 2014).

The study finding revealed that the total average monthly per capita consumption expenditure for both food and non-food was TZS 435 960 for a pooled sample. Out of which, an amount of TZS 251 743 was spent on food by a household on average, therefore the computed food ratio is 57.7 percent. The computed food ratios for Dar es Salaam and Coast Region were 43.5 and 53.8 percent respectively. On the other hand the computed non-food ratios for Dar es Salaam and Coast Region were 56.5 and 46.2 percent respectively. From this finding, it could be deduced that people who lived in Dar es Salaam spent more on non-food items than the people living in Coast Region.

Table 11: Monthly average households' per capita consumption expenditure on food and non-food in TZS by category and Location

Item	DSM (Urban)	COAST REGION (Rural)	Pooled Sample
Monthly household per capita consumption expenditure (TZS)	563 952	282 597	435 960
Monthly food per capita consumption expenditure (TZS)	245 459	152 042	251 743
Monthly non-food per capita consumption expenditure (TZS)	318 493	130 555	184 217

Two-sample t test (total household consumption), $t = 6.2991$; Pr ($|T| > |t|$) = 0.0000

Following the two-sample t test (t = 6.2819, df = 198) conducted to determine if mean total household expenditures in the two study areas were equal, the null hypothesis was rejected at 5% level of significance. Implying that monthly average households' expenditure on food and non-food items was different in the two study locations and thus people who lived in Dar es Salaam spent more on food and non-food items than the people living in Coast Region.

4.3.2 Household cassava expenditure analysis

Cassava budget share refers to the proportion of household food budget spent on cassava. With regards to budget shares allocated to cassava, it may be evident that households in Dar es Salaam spent a higher proportion of their budget (3.75%) on cassava as compared to households in Coast Region who spent 2.63% of their food budget on cassava. However, for a pooled sample the total budget allocated for cassava was about 3 percent as indicated in Table 12 below. Following the two-sample t test conducted to determine if mean household cassava expenditures in the two study areas were equal, data provided strong evidence that the null hypothesis is false. The p-value was less than the pre-specified alpha level ($P < 0.05$). Implying that households in Dar es Salaam spent more on cassava than households living in Coast Region. The implication of this finding is that, as income increases, total food spending (in this case cassava) also increases, although the increase is smaller than the increase in income. This pattern is consistent with Engel's law, which states that as income increases, food spending also increases but the proportion of income devoted to food declines.

Table 12: Monthly average households' cassava expenditure shares by consumer location (figures in percentages)

Item	DSM	COAST REGION	Pooled Sample
Cassava Ratio	3.75	2.63	2.91
Total Food Ratio	43.52	53.80	57.74
Non-Food Ratio	56.48	46.20	42.26

Two-sample t test (cassava expenditure share), t = 2.2399; Pr (|T| > |t|) = 0.0265

This finding is close to that of National Bureau of Statistics (2014) of the United Republic of Tanzania for households' budget surveys of 2011/2012 which reported a total average monthly per capita expenditure of TZS 316 380 for both food and non-food, with computed food ratios of 43.7 percent for Dar es Salaam and 62.0 percent for rural areas in Tanzania Mainland. In addition to that households' food budget shares declined from 71.08% in the 1st deciles to 54.76% in 9th decile which were consistent to incomes increase. Pointing out that people living in Dar es Salaam spent more on non-food items such as kerosene, charcoal, transport, health, education, housing, clothing and recreation than the people living in other urban areas.

This finding is also close to Chongela *et al.* (2014) who analyzed consumer demand system of agri-food in Tanzania and empirical results revealed that households' food budget share was 60% on average per month. Roots and starches (cassava fresh, cassava dry, cassava flour, round potatoes, sweet potatoes, yams, cocoyam, cooking bananas /plantains and other starches) had a budget share of 8.41%. It is also consistent with Cochrane and D'Souza (2015) who used food basket approach in measuring access to food in Tanzania and reported expenditure shares on the basket

of 15 food groups made up 57 percent of total food expenditures in Dar es Salaam and cassava budget share accounted for 0.3 percent.

4.4 Estimated Household Cassava Demand Models and their Determinants

The models in this study were estimated using the Ordinary Least Squares (OLS) Method. Diagnostic procedures were conducted to check how well some of the assumptions of multiple linear regressions are satisfied. A diagnostic approach to check for multicollinearity after performing regression analysis was conducted by computing and displaying the variance inflation factor (VIF) and the white test was conducted to detect the presence or absence of heteroskedasticity as explained in subsections that follows. The models expressed cassava budget share as a function of log of per capita household expenditure, log of per capita household expenditure squared, household size (AE), gender and educational level of household head. The results of regression estimates are shown in Table 13 and 14.

4.4.1 Estimated model for the determinants of cassava expenditure in Coast Region (rural areas)

The F-statistics for the budget share model was significant at the one (1) percent level, implying that the independent variables, jointly, were important determinants of cassava consumption patterns in urban areas under study (Table 13). Therefore, the hypothesis that none of the explanatory variables was related to cassava consumption pattern was rejected.

The coefficient of determination for the budget share model was 0.8233, implying that 82% of the variation in cassava budget share was explained by changes in the independent variables combined. The root mean squared error (Root MSE) which is the standard deviation of the regression was very low, less than one (0.213), indicating that the estimated budget share model was a better predictor of cassava expenditure.

To detect the presence or absence of heteroskedasticity, diagnostic test was conducted (white test). The test, test the null hypothesis that the variance of the residuals is homogenous. If the p-value is very small, we would have to reject the null hypothesis in favor of alternative hypothesis that the variance is not homogenous. On the other hand, when the probability is large, we would fail to reject the null hypothesis of constant variance (White, 1980). Following the tests for heteroscedasticity (Appendix 4) conducted, the results failed to find any evidence for heteroscedastic residuals (both at 1% and 5% level of significance), implying that variance of the error terms was similar across observations (homoscedasticity).

The tolerance statistic and/or variance inflation factor (VIF) which is a measure of collinearity were used to test for multicollinearity in the estimated model (Collinearity Diagnostics). Tolerance statistic measures the proportion of variance in the independent variable that is explained by the other independent variables in the model. Variance inflation factor (VIF) is simply the reciprocal of tolerance. Usually, there are as many tolerance coefficients as there are independent variables. The higher the inter-correlation of the independent variables, the more the tolerance will approach zero. As a rule of thumb, if tolerance is less than 0.20, a problem with

multicollinearity is indicated (Hair *et al.*, 1995). When tolerance is close to zero there is high multicollinearity of that variable with other independents variables and the beta coefficients will be unstable. The more the multicollinearity the lower the tolerance statistic and the higher the standard error of the regression coefficients.

In fact, the utility of VIF, as distinct from tolerance, is that VIF specifically indicates the magnitude of the inflation in the standard errors associated with a particular beta weight that is due to multicollinearity. For example, a VIF of 5 implies that the standard errors are larger by a factor of 5 than would otherwise be the case, if there were no inter-correlations between the predictor of interest and the remaining predictor variables included in the multiple regression analysis. Therefore, when VIF is high there is high multicollinearity and instability of the beta coefficients.

Greene (2012) pointed out that since non-experimental data will never be orthogonal to some extent multicollinearity will always be present. However various recommendations for acceptable levels of VIF have been published in the literature, most commonly, a value of 10 has been recommended as the maximum level of VIF (Gujarati, 2003; Hair *et al.*, 1995; Kennedy, 1992). However, a recommended maximum VIF value of 5 (Rogerson, 2001) and even 4 (Pan and Jackson, 2008) have also been recommended in the literature. VIF values equal to or greater than recommended values suggest a multicollinearity problem; therefore the estimated coefficients (β_s) may no longer be an unbiased estimators; also because of the strong interrelationships between the independent variables it is difficult to disentangle their separate effects on the dependent variable without violating the *ceteris paribus*

assumption and the significant variables may appear to be insignificant (i.e., a Type II error)

It may be seen from Table 13 that the tolerance statistics and VIF values of all the explanatory variables were greater than 0.20 and less than 4.0 respectively. These collinearity statistics indicate that there was low incidence of multicollinearity among the explanatory variables implying that the estimated parameters were stable and reliable. In the light of the above statistical and econometric criteria, the estimated model was regarded as the best and the impact of the independent variables in that model were therefore, discussed.

Table 13: Regression model estimates for Coast Region (rural areas)

Independent Variable	Coefficient(β_s)	Standard error (s.e)	t-statistic	Tolerance Statistic	VIF
Age (0= <35, 1= Otherwise)	0.0398	0.011	3.62**	0.541	1.848
Gender (0= Male, 1= Female)	0.3870	0.215	1.80**	0.92	1.087
Number of years in school	-0.6453	0.1285	-5.02**	0.469	2.132
Adult equivalents	0.0784	0.0392	2.00*	0.881	1.135
Log of per capita household expenditure	-0.9911	0.2784	-3.56**	0.528	1.894
Log of per capita household expenditure squared	0.0144	0.0037	3.89**	0.782	1.277
Constant	0.258	0.4526	0.57**		
R-squared	0.8233				
F-statistics	58.72 (0.000)				
Root MSE	0.213				

*Prob > F in parenthesis; ***= Significant at P < 0.001** = Significant at P < 0.01, * =Significant at P < 0.05*

It may be seen from the table that age of the household head, gender of household head, educational level, and per capita expenditure were significant in the budget share model at the 1% level while that of household size and decomposition were significant at 5% level.

The model results in Table 13 show that, the coefficient of age of household head has a significant positive relationship with cassava share at 1% level. This finding is consistent with a *priori expectation.* The results suggest that an increase in age of the household head is associated with an increase in budget share allocated to fresh cassava, *ceteris paribus.* This finding indicates that holding other factors constant, the households headed by younger people (<35 years old) consumed less amount of cassava as compared to households headed by aged people (>35 years old). This positive effect of the household age on cassava consumption could be attributed to the gradual increase of the household size as the household head becomes older. The finding agrees with Blisard (2001) who found that all food categories under study except for vegetables, sugar and sweets were found to have statistically significant cohort effects; younger cohorts were observed to spend less than older cohorts.

The model results indicated that, in rural areas under the study female headed households allocated a larger proportion of their food budget to cassava than male headed households. This finding is consistent with a priori expectation. This was probably due to the fact that female headed households were more than twice as big as those headed by males, thus average number of persons per household in female headed households was 7.1 compared to 3.0 for male headed households (NBS,

2016). However, the finding is consistent with Hopkins *et al.* (1994) in their analysis on women's income and household expenditure patterns in Niger and Hoddinott and Haddad (1995) who studied the influence of female income share on household expenditures in Ivory Coast. In both cases they documented a positive relationship between the female headed households and food expenditure in their studies. It is established that by culture or custom, females are entrusted with household food security issues and as such when they are in control at the household level, expenditure on food tends to go up.

From Table 13 it is evident that educational level is found to have a significant negative effect on cassava budget shares in the rural areas under the study. This finding is not consistent with a priori expectation; this difference could probably attributed to the fact that, the higher education is usually associated with well-paid jobs and high income levels. Since it is established that fresh cassava expenditure decreases with increase in income, therefore it is not surprising that the highly educated household in the study areas spend less on fresh cassava. However, the finding is consistent with Kapunda (1988) who found negative influence of education on food tastes and preferences of the household.

The model results indicated a positive relationship between units of adult equivalent and household cassava consumption. The results suggest that, one additional member in the household would increases cassava budget share by 0.0784 ratio, *ceteris paribus*. Thus, for larger households that needed to satisfy their cassava requirements there was a need to buy larger quantities of cassava and by so doing they increased

their expenditure on cassava. This finding agrees with Gale *et al.* (2005) and it is also consistent with the findings by Cage (1989), Kalwij *et al.* (1998) and Sdrali (2006) who also found a positive relationship between household size and food expenditure.

Per capita household expenditure was used as a proxy for household income. It is evident from Table 13 that income was found to be negatively related to household cassava budget share. This is consistent with Engel's law which posits that as household income increases, food spending also increases but the proportion of income devoted to food declines. For low income households who are more meticulous about survival, an increase in income results in an increase in household budget allocated to food (in this case cassava). However, for high income households, a further increase in income will most likely be directed away from food purchases, *ceteris paribus*. Thus, consumption increases proportionally with income for the poor and the middle classes, but then falls again for the rich.

4.4.2 Estimated model for the determinants of cassava expenditure in DSM (urban areas)

The F-statistics for the budget share model was significant at the one (1) percent level, implying that the independent variables, jointly, were important determinants of cassava consumption patterns in urban areas under study (Table 16). Therefore, the hypothesis that none of the explanatory variables was related to cassava consumption pattern was rejected. Therefore, the hypothesis that none of the explanatory variables was related to cassava consumption pattern was rejected. The coefficient of determination for the budget share model was 0.737, implying that

74% of the variation in cassava budget share was explained by changes in the independent variables combined. The root mean squared error (Root MSE) which is the standard deviation of the regression was very low (less than one), indicating that the estimated budget share model was a better predictor of cassava expenditure.

Following the test for heteroscedasticity diagnostic (white test Appendix 4), the results failed to find any evidence for heteroscedastic residuals (both at 1% and 5% level of significance), implying that variance of the error terms was similar across observations (homoscedasticity). The collinearity statistics in the table (tolerance and VIF) showed that there was a reasonably low level of multicollinearity among the independent variables in the model, implying that the estimated parameters were stable and thus could be used to draw inferences.

Table 14: Regression model estimates for Dar es Salaam (urban areas)

Independent Variable	Coefficient (β_s)	standard error (SE)	t-values	Tolerance Statistic	VIF
Age (0= <35, 1= Otherwise)	0.0614	0.0093	6.60**	0.429	2.333
Gender (0= Male, 1= Female)	-0.7552	0.2476	-3.05**	0.729	1.372
Number of years in school	-0.0663	0.0272	-2.44**	0.728	1.373
Adult equivalents	0.1505	0.0397	3.79*	0.485	2.064
Log of per capita household expenditure	-0.968	0.4137	-2.34**	0.434	2.304
Log of per capita household expenditure squared	0.0313	0.0141	2.22**	0.474	2.111
Constant	0.556	0.3519	1.58**		
R-squared	0.737				
F-statistics	86.92 (0.000)				
Root MSE	0.285				

*Prob > F in parenthesis; ***= Significant at P < 0.001** = Significant at P < 0.01, * =Significant at P < 0.05*

It may be evident from the table that age of the household head, gender of household head, educational level, and per capita expenditure were significant in the budget share equation, at least, at the 5 percent level.

Similar to the finding in the Coast Region model and consistent with a priori expectation, the coefficient of age of household head has a significant positive relationship with cassava share at 1% level.

This finding indicates that, holding other factors constant, the households headed by younger people (<35 years old) consumed less amount of cassava as compared to households headed by aged people (>35 years old). This positive effect of the household age on cassava consumption could be attributed to the gradual increase of the household size as the household head becomes older.

The model results indicated that, unlike the model for Coast Region (rural areas) discussed earlier, in Dar es Salaam (urban areas) male headed households allocated a larger proportion of their food budget to cassava than female headed households. This could be attributed to the fact that 65 percent of households in Dar es Salaam region were headed by males in addition, male headed households had higher incomes than female-headed households (NBS, 2016).

Similar to the finding in the Coast Region model and consistent with a priori expectation, educational level of household head was found to have a negative effect on cassava budget share in Dar es Salaam, the effect was significant in the aggregate model at the 1% level. The results imply that the less educated household head in

Dar es Salaam spent more on fresh cassava than the highly educated. This could be attributed to the reason that less educated households had relatively larger household sizes compared to their highly educated counterparts. This finding is in consonance with previous research by Kapunda (1988) on consumption patterns in Tanzania, were he found education to have negative influence on tastes and preferences of the household. In regard to cassava this finding congruous with Tsegai and Kormawa (2002) in Nigeria who found that, one year increase in the education of household head, decreases the share of cassava tuber by 3.5 per cent other things being equal. The coefficient of adult equivalent was significant at the 5% level, indicated a positive effect on household cassava budget share, again this is consistent with a priori expectation. The results suggest that a one more household member in the family would increases cassava budget share by 0.1505 ratio, *ceteris paribus.* This is because the more members of the household are; the more food is needed to feed each person. This result is in agreement with Tsegai and Kormawa (2002) who found a positive relationship between household size and budget share of cassava tuber in Nigeria. Their findings revealed that, one more household member in the family increases budget share of cassava tuber by 0.3%. The positive effect of household size on cassava consumption is consistent with other studies which considered food as a composite commodity (Sadrali, 2006; Burger *et al.*, 2004).

Similar to the finding in the Coast Region and consistent with a priori expectation, per capita household expenditure which was used as a proxy for household income was found to have a negative effect on cassava budget share in Dar es Salaam, the effect was significant in the model at one percent level. Implying that cassava consumption increases proportionally with income for the poor and the middle

classes, but then falls again for the rich. This is consistent with Engel's law which states that as household income increases, food spending also increases but less than proportionally with income. This is consistent with Bennett's law which posits that households switch from less to more expensive calorie consumption as their incomes increases (Hoddinott and Yohannes, 2002). The finding also concur with economic theory which has been established that low income households spend a higher proportion of total household budget on food than high income households (Chern *et al.*, 2003; Nicholson, 1992).

4.5 Cassava Expenditure Elasticity

Fresh cassava expenditure elasticity in the study areas for low, middle and high income groups in the two consumer locations considered in the study (urban and rural areas) was computed (Table 17). It could be inferred from the results that for low income households, cassava expenditure elasticity ranges from a low figure of 0.382 in Coast Region to a high figure of 0.905 in Dar es Salaam. For the middle income households, cassava expenditure elasticity ranges between a low figure of 0.343 in Coast Region and a high figure of 0.809 in Dar es Salaam. For the high income group, however, expenditure elasticity was found to lowest (0.271) in Coast Region and somehow low (0.764) in Dar es Salaam.

It could be seen from the finding that expenditure elasticity for each of the consumer location decreases with increasing income level. Thus, low income households are more responsive to changes in household income as opposed to high income households as far as cassava budget share is concerned. The reason attributed to this

phenomenon is related to that pointed out by Chern *et al* (2003) that, for the reasons of survival, low income households tend to increase their food budget shares than high income households following increases in household income. This pattern suggests that poor households spend a greater proportion of their income on food consumption relative to wealthier households (Engel's Law).

Table 15: Fresh cassava expenditure elasticity by consumer location and income group

Rural/Urban Households	Expenditure elasticity by income groups		
	Low income	Medium income	High income
Rural households (Coast Region)	0.382	0.343	0.271
Urban households (DSM)	0.905	0.809	0.764

Expenditure Elasticity was evaluated using the formula provided in equation (7), coefficient estimates based on the estimated models for urban and rural households and relevant mean expenditure

However, in terms of magnitude, it may be observed from the table that the expenditure elasticity is lowest in Coast Region, thus, for low income households a 10% increase in household income (expenditure) will warrant 3.8% increase in cassava budget share. This could be attributed to the reason that rural households depend on relatively cheaper farm food, in addition, a significant proportion of rural cassava consumption is self-produced thus with increasing income, consumers may shift from cheap staples to costly food items like eggs, milk, fish and meat. This finding support Bennett's law which posits that households switch from less to more expensive calorie consumption as their incomes increase (Hoddinott and Yohannes, 2002).

In Dar es Salaam, cassava expenditure elasticity is greater than in Coast Region, thus, for low income households a 10% increase in household income (expenditure) will warrant 9.1% increase in cassava budget share, implying that households in Dar es Salaam respond more to income changes than households in Coast Region with respect to household cassava budget shares.

In all areas, although not consistent with the prior expectation, expenditure elasticity show positive sign, though inelastic, thus expenditure elasticity does not exceed unit ($0 < \eta < 1$), suggesting that cassava is a normal food commodity, it is a necessity good for life. In addition, it implies that an increase in household income will cause household cassava budget share to increase. Thus, a one percent increase in income will cause consumers to increase the amount of fresh cassava they are willing to purchase although by less than one percent.

The implication of this finding is that, as income increases, spending in cassava (fresh cassava) also increases, although the increase is smaller than the increase in income. This pattern is consistent with Engel's Law, in his article entitled "the relations of production and consumption in the Kingdom of Saxony" as cited in Perthel (1975) were he found that, as income increases, food spending also increases but the proportion of income devoted to food declines. In that regard, the economist Houthakker (1957) stated that, "Of all the empirical regularities observed in economic data, Engel's Law is probably the best established."

The finding is consistent with Cock (1985) who found that per capita purchases of fresh cassava roots tend to increase as the income level increases and then remain stable at higher income levels in Indonesia and similar results were observed in Brazil, where the income elasticity of demand for fresh cassava was found to be positive (ibid).

The finding also concur with Nweke *et al.* (2002) and Nweke (2004) who reported positive income elasticities of demand for fresh root cassava in Sub-Saharan Africa, with values of 1.24 in Nigeria, 0.79 in Tanzania and 0.95 in Uganda. This is also consistent with Tsegai and Kormawa (2002) who used the AIDS model to estimate the cassava demand elasticity in Northern Nigeria and reported expenditure elasticity of 0.73 and 0.26 for low and high income groups respectively. Similar to that, Handa and Mlay (2006) in their analysis of food consumption patterns, seasonality and market access in Mozambique reported unitary expenditure elasticity for cassava. Nevertheless, it is consistent with Alderman (1990) who used World Bank Living Standards Surveys data to estimate the income elasticity of demand for cassava in Ghana. The estimate for cassava was significantly greater among the urban households (1.46) than among rural households (0.73) and among the urban households, the estimate for cassava was about the same as the estimate for rice (1.50) but significantly greater than the estimate for maize (0.83). In addition, the income elasticity of demand estimates for cassava products were found to be positive at all income levels.

It could be inferred from these finding that, cassava has as much market demand potential and provide convincing evidence that demand for cassava will continue to

rise as income increases. This witness that it is fast changing from an inferior food to a necessity and it is short sighted to consider cassava solely a subsistence crop and inferior food. Thus, we concur with Scott *et al.* (2000) that roots and tubers (including cassava) in developing countries is projected to increase by 232 million tonnes to 635 million tonnes by 2020 of which cassava's share of the increase is estimated to be 44 percent.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

This study analyzed urban and rural demand for cassava in Dar es Salaam and Coast Region regions taking into account differences in preferences across income groups and household demographic factors. The study, addressed the central theme on how and to what extent does household cassava consumption vary across different groups of consumers located in different urban and rural sitting.

The study was motivated by the need to provide an accurate analysis of cassava consumption pattern in urban and rural areas and provide demand behavioral parameters that will inform industry participants for food policy formulation related to cassava and enhance a more effective participation of producers, processors, traders, and other entrepreneurs in cassava sub-sector.

Predictions of changes in consumer expenditure as a result of changes in income and household socio-demographic characteristics were the key information for this study and econometric analyses were used to estimate them empirically. The study estimated single equation demand models for urban and rural sitting as a basis for future decisions on food policies related to cassava.

The study was underpinned by the theory of consumer behaviour and demand due to the fact that, the theory provides a useful theoretical framework for analysing food consumption. In the basic setting, income, prices, and preferences which are shaped

by household socio-demographic factors are the factors that determine food demand. However, the study had a survey data on cross sections of households which did not contain observations in price variations.

In order to choose a suitable model for demand estimation, a detailed review of the body of literature on theoretical and applied demand functions (single equation and systems of equation) for consumer behaviour analysis was carried out. Comparative assessment led to the selection of the Working-Leser Engel functional form because of its flexibility, theoretical consistency and ability to depict non-linear Engel curve and its widely application in situation where data do not contain observations in price variations. Effort was made to estimate the semi-logarithmic quadratic functional (SLQF) form of the Engel equation.

The descriptive analysis examined the structure of food expenditure pattern for food and non-food items in selected urban and rural households, however, special emphasis was placed on the differences in cassava budget shares across income groups and other socio-demographic characteristics of household heads. Cassava expenditure elasticity for the selected urban and rural households in the various income groups which reflect this economic behaviour were also investigated in this study.

The most preferred cassava product in urban and rural households was found to be boiled cassava followed by futali/mseto, stiff porridge (ugali) and others forms such as mixing maize meal with cassava flour to enhance taste and acceptability, roasted

cassava and smoked cassava. However, it is worth noting that, boiled cassava was not normally consumed alone. There was a number of compliments, the commonest being tea. This is a clear indication that boiled cassava is a substitute of bread and other foodstuffs that go together with tea. The study supported the hypothesis of independence between cassava product preference and income level at 1% level of significance. Whether low, middle or high income, almost all households bought a particular cassava product based mainly on their own assessment of the taste.

The study showed that average monthly household food expenditures are lowest in Dar es Salaam and highest in Coast Region. Households who lived in Dar es Salaam spent more on non-food items than the people living in Coast Region. For the pooled sample, 57.7% of total household budget was spent on food. While households in Dar es Salaam their food budget share formed 43.5% of total household budget, households in Coast Region spend 53.8% of their total household budget on food.

On average, out of 58% share of monthly expenditure on food, households spent 3% on cassava. Cassava budget share was higher in Dar es Salaam (3.8%) and lower in Coast Region (2.6%). The principal determinants of cassava expenditure in all the consumer locations were identified to include, age of household head, gender, household size, educational level and household income, they were all significant at 1% level with exception of household size which was found to be significant at 5% level. However, it is noteworthy that prices are also central in the theory of the consumer behaviour but in this study were ignored because the data used were cross-sectional and did not contain price variations.

For low income households, cassava expenditure elasticity ranges from a low figure of 0.382 in Coast Region to a high figure of 0.905 in Dar es Salaam. For the middle income households, cassava expenditure elasticity ranges between a low figure of 0.343 in Coast Region and a high figure of 0.809 in Dar es Salaam. For the high income group, however, expenditure elasticity was found to be lowest (0.271) in Coast Region and somehow low (0.764) in Dar es Salaam.

Therefore, in terms of magnitude, it is observed that the expenditure elasticity is lowest in Coast Region and highest in Dar es Salaam. In all areas under the study, expenditure elasticity show positive sign, though inelastic, suggesting that cassava is a normal food commodity, it is a necessity good for life. Generally, fresh cassava expenditure elasticity was found to be higher for low income households as compared to high income households in all study areas.

5.2 Conclusions

This section provides the conclusions of the study in the light of the specific objectives stated and hypotheses tested. The first specific objective was to identify the most preferred cassava products among households in the study area which was governed by the hypothesis that there is no relationship that exists between households' preferences to cassava products and their income levels. The results have revealed that boiled cassava is the most preferred product in the study areas. The study supported the null hypothesis and lead to the conclusion that households preferences to cassava products is independent to their income levels, whether low, middle or high income, almost all households bought a particular cassava product based mainly on their own assessment of the taste.

The second objective was to analyze the demand pattern for cassava in urban and rural households in the study areas and the hypothesis tested in this objective was that there is no difference in mean household expenditure and cassava budget share between urban and rural households in the selected study areas. The study provided empirical evidence to reject the above hypothesis and lead to a conclusion that monthly average total households' expenditure was different in the two study locations and households in Dar es Salaam spent more on cassava than households living in Coast Region.

The third objective was to estimate the income elasticity of demand for fresh cassava in selected urban and rural areas. The hypothesis tested was that cassava is an inferior food commodity in the selected urban and rural areas. The hypothesis was rejected following the empirical evidence that in all areas, fresh cassava expenditure elasticity showed positive sign, though inelastic suggesting that cassava is a normal food commodity, it is a necessity good for life. The results provide convincing evidence that demand for cassava will continue to rise as income increases. Thus, it is short sighted to consider cassava solely a subsistence crop and inferior food.

The final objective was to determine the effect of personal and household characteristics on cassava demand and the hypothesis tested in this objective was that age, gender, education and household size (AE) have no influence on cassava demand. The study provided empirical evidence to reject the hypothesis that none of the explanatory variables was related to cassava consumption pattern. They were all identified as the principal determinants of cassava expenditure in all the consumer

locations. The magnitudes and directions of influence of these variables were mixed, some hade positive while some had negative influence.

5.3 Recommendations

From the finding of the study, the following recommendations are made to improve the performance of the cassava sub sector and food consumption at the household level in urban and rural areas

5.3.1 Cassava production and distribution

Based on fresh cassava expenditure elasticity which is positive in the study areas implies that with increasing income the consumption of cassava will increase in these areas, *ceteris paribus*. Policy should, therefore, focus on measures to improve the production of cassava at the producing areas and enhance sustainable productivity of the crop in the country through improved cassava production. This could be enhanced by promoting wide use of quality planting materials of improved cassava varieties, develop and disseminate improved cassava varieties with dual resistance to Cassava Brown Streak Disease (CBSD) and Cassava Mosaic Disease (CMD) and with desirable end users root quality.

In addition to production, policy measures should also be directed to its distribution to the consuming urban areas. This will prevent the possibility of any escalation in cassava prices as consumers' income improves. Such possible price escalation if happen could have negative nutritional effects especially on poorer households since cassava is highly consumed by low income households. Improved cassava

distribution system could be enhanced through improving road network leading to the hinterlands where cassava is produced. This would partly reduce and/or even out prices of cassava and make them affordable in urban areas. This will not only increase household consumption of cassava but will also reduce the seasonal excess and spoilage that are experienced in major cassava producing regions in Tanzania during the harvest season. Improved road network will reduce cassava transportation cost, increase competition, reduce marketing margins, and in this way can directly improve farm incomes and private investment opportunities in the sector.

5.3.2 Improvement in household income

It has been observed that expenditure elasticity for each of the consumer location decreases with increasing income level. Implying that consumption increases proportionally with income for the poor and the middle classes, but then falls again for the rich. Thus, low income households spend a greater proportion of their income on food consumption relative to wealthier households. It is therefore recommended that household income levels in urban and rural areas for low and middle income earners should be improved through job creation to empower households to meet not only their cassava needs but their total household food requirements.

Besides, income elasticity less than one ($\eta < 1$) suggest that interventions of Tanzanian government in terms of income support policies should be done by increasing the incomes of lower and middle class income earners in rural and urban areas as consumers' economic stimulus package to increase normal food consumption.

5.4 Suggestions for Future Research

Future research should focus on the potential demand for processed products from cassava in urban and rural areas as well as the profitability of cassava processing businesses. This is important for any policy that aims at adding value to the crop. Future research should also focus on the effect of seasonality on household demand for cassava and other root crops. This will help in modeling out a comprehensive food security strategy for urban and rural households. In addition, future cassava consumption studies should address the industrial demand to establish whether there are differences in the factors that affect cassava consumption pattern between households and industrial demand.

REFERENCES

Adkins, R. (1976). Engel's curve of four major consumption items from the 1969 Tanzanian household budget survey. University of Dar-es-Salaam.

Alderman, H. (1990). Nutritional status in Ghana and its determinants. Social Dimensions of Adjustment in Sub-Saharan Africa, World Bank, Washington, D.C.

Al-Habashneh, F. and Al-Majali, K. (2014). Estimating the Engel curves for household expenditures in Jordan from 2010 to 2011, *European Scientific Journal*, pp 267-282

Alston, J.M. and Chalfant, J.A. (1993). The Silence of the Lambdas: A test of the Almost Ideal and Rotterdam models. *American Journal of Agricultural Economics* 75:304–313.

Bailey, D.K. (1998). Methods of Social Research. The Press Collier, Macmillan Publisher, London

Banks, J., Richard, B. and Lewbel, A. (1997). Quadratic Engel curves and consumer demand, *The Review of Economics and Statistics* 79(4):527-539.

Barten, A. P. (1969). Maximum Likelihood estimation of a Complete System of Demand Equations. *European Economic Review* 1:7-73.

Behrman, J. R. and Wolfe, B. (1984). More evidence on nutrition demand: Incomes seems over-rated and Women's Schooling under-emphasized. *Journal of* Development Economics 14(1):105-128.

Blisard, N. (2001). Income and food expenditures decomposed by cohort, age, and time effect: Electronic report from the Economic Research Service,

United States Department of Agriculture (USDA), Technical Bullctin No. 1896

Boateng, O., Ewusi, K., Kanbur, R. and Mckay, A. (1992). A poverty profile for Ghana 1987-1988. *Journal of African Economies,* pp. 25-58.

Bobby, B. (2004). Household education level's relationship to intra-household consumption: A study of South Africa using the Saldru 1993 data set, Working paper, December, 2004.

Brown, A. and Deaton, A. (1972). Survey of applied economics: Models of consumer behavior. *Economic Journal* 82:1145–1236.

Burger, R., Servaas, V. B, and Sihaam, N. (2004). Consumption patterns of South Africa's rising black middle-class: Correcting for measurement errors, Center for the Study of African Economies on Poverty Reduction, Growth and Human Development in Africa, Oxford, Working paper, March 2004

Buse, A. (1994). Evaluating the linearized almost ideal demand system. *American Journal of Agricultural Economics* 74:781-793.

Cage, R. (1989). Spending differences across occupational fields. *Monthly Labor Review* 112 (12): 33-43.

Chern, S.W., Ishibashi, K., Taniguchi, K. and Tokoyama, Y. (2002). Analysis of the food consumption of Japanese households [http://www.fao.org/docrep/007/ae025e/ae025e00.htm] site visited on 9/12/2015.

Chern, W. S., Ishibashi, K., Taniguchi, K., and Tokoyma, Y. (2003). Analysis of the food consumption of Japanese households, FAO Economic and Social Development Paper, No. 152, FAO, Rome.

Chern, W.S., Huang, K.S, Lee, H.J and Tweeten, L. (1993). Food demand models for forecasting. In: *Japanese and American Agriculture*: Tradition and Progress. (Edited by Tweeten, L., Dishon, C.L., Chern, W.S., N. Imamura, N. and Morishima, M.) San Francisco, CA: Westview Press. pp. 249-279.

Chongela, J., Vasudev, N. and Korabandi, S. (2014). Consumer demand system of agri-food in Tanzania. *Journal of Development and Agricultural Economics* 6(1):42-48.

Christensen, L.R, Jorgenson, D.W, and Lau, L. J. (1975). Transcendental logarithmic utility functions. *American Economic Review* 65: 367–383.

Cochrane, N. and D'Souza, A. (2015). Measuring access to food in Tanzania: A food basket approach, United States Department of Agriculture, Economic Information Bulletin Number 135.

Cock, J.H. (1985). Cassava: New potential for a neglected crop, West view Press, Inc United States of America.

Cox, T.L and Wohlgenant, M.K. (1986). Prices and quality effects in cross-sectional demand analysis. *American Journal of Agricultural Economics* 68(4):908–919.

Cranfield, J., Preckel, P., Eales, J., Hertel, T. (2003). Estimating consumer demands across the development spectrum: Maximum Likelihood estimates of an Implicit Direct Additivity Model. *Empirical Economics* 68:289-307

Dai, S.H., and Wang, M.O. (1992). Reliability analysis in engineering applications. Van Nostrand Reinhold, New York.

Deaton, A. and Muellbauer, J. (1980). An almost ideal demand system. *American Economic Review* 70(3):312-326.

Deaton A., Ruiz J.C, Thomas, D. (1989). The Influence of household composition on household expenditure patterns: Theory and Spanish Evidence. *Journal of Political Economy* 97:179-120

Ekelund, R. B. and Richard, A. (1995). Intermediate Microeconomics; Price theory and Applications, Health and Company Washington D.C.

Ezemenari, K., Nweke, F. and Strauss, J. (1998). Consumption patterns and expenditure elasticity of demand for food staples in rural Africa: Focus on cassava growing area. Draft COSCA Working Paper, Collaborative Study of Cassava in Africa. IITA, Ibadan.

Fagiolo, G. (2001). Engel curves specification in an artificial model of consumption dynamics with socially evolving preferences, LEM Working Papers [http://www.lem.sssup.it] site visited on 20/3/2016

Food and Agriculture Organization (1990). Patterns of urban food consumption in developing countries. Food and Nutrition Division, FAO, Rome, Italy.

FAO and IFAD (2005). A review of cassava in Africa: Proceedings of the validation forum on the global cassava development strategy, FAO, Rome, Italy.

FAOSTAT (2008). Production database, FAO, Rome, Italy [http://faostat.fao.org] site visited on 3/3/2016

FAOSTAT (2016). Agricultural data, FAO, Rome, Italy. [http://faostat3.fao.org/download/Q/QC/E] site visited on 21/04/2016

Ferris, J. N. (1998). Agricultural prices and commodity market analysis, McGraw-Hill Publishers, New York.

Frost and Sullivan (2004). Food group consumption patterns from childhood to young adulthood, Nutrition Research Newsletter [http://www.frost.com] site visited on 27/03/2016

Gale, F., Tang, P., Xianhong, B and Huijun, Xu. (2005). Commercialization of food consumption in rural China, Economic Research Report No. 8, USDA, Washington, DC.

Gale, F. and Huang, K. (2007). Demand for food quantity and quality in China: Economic Research Report No. 32, USDA, Washington, DC.

Gary, A. and Kotler, P. (2000). Marketing: An introduction, 5th edition, Prentice Hall publishers.

George, P.S., and King, G.A. (1971). Consumer demand for food commodities in the United States with Projections for 1980 [http://s.giannini.ucop.edu/uploads/giannini_public/02/b4/02b43388-3356-4ddd-93fa-b668e7b48c54/26_george_king.pdf] site visited on 3/2/2016

Greene, W.H. (2012). Econometric analysis, 7th edition, Harlow- Pearson Education, New York.

Gujarati, D.N. (2003). Basic Econometrics, 4th Edition, McGraw-Hill, New York.

Gustavsen, G.W. (2004). Essays on food demand analysis [orgprints.org/6192/1/Doktoravhandling-Gustavsen.pdf] site visited on 3/4/2016

Hair, J. *et al.* (1995). Multivariate Data Analysis with Readings, Prentice-Hall, Englewood Cliffs, New Jersey

Handa, S. and Mlay, G. (2006). Food consumption patterns, seasonality and market access in Mozambique. *Development Southern Africa* 23 (4): 541-560

Hassan, Z.A. and Johnson, S.R. (1977). Urban food consumption patterns in Canada: An empirical analysis [http://ageconsearch.umn.edu/handle/149019] site visited on 3/5/2016

Hoddinott, J. and Haddad, L. (1995). Does female income share influence household expenditures? Evidence from Cote d'Ivoire. *Oxford Bulletin of Economics and Statistics* 57 (1):77-96

Hoddinott, J. and Yohannes, Y. (2002). Dietary diversity as a food security indicator, Food and Nutrition Technical Assistance, Academy for Educational Development, Washington, D.C.

Honfoga, B.G. and Boom, J.M. (2003). Food consumption patterns in Central West Africa and challenges to combating malnutrition. *Food and Nutrition Bulletin* 24(2):167-176

Hopkins, J., Levin, C. and Haddad, L. (1994). Women's income and household expenditure patterns: Gender or flow? Evidence from Niger. *American Journal of Agricultural Economics* 76 (5):1220 -1225

Houthakker, H.S. (1957). An international comparison of household expenditure patterns, commemorating the centenary of Engel's Law. *Econometrica* 25(4):532-551.

International Institute of Tropical Agriculture (2016). Cassava Consumption [http://www.iita.org/cassava] site visited on 22/04/2016

International Institute of Tropical Agriculture (2016). Cassava production [http://www.iita.org/cassava] site visited on 22/04/2016

Jerome, M. E and Perreault, D. W. (1991). Essentials of Marketing, 5th Edition; IRWIN publishers, New York.

John Y.T., Shamsudin, M.N., Mohamed, Z., and Abdullah, A.M. (2009). Evidence of Engel curves in food away from home: A Study of Malaysia, MPRA Paper No. 14833.

Kalwij, A., Alessie, R and Fontein, P. (1998). Household commodity demand and demographics in the Netherlands: A microeconometric analysis. *Journal of Population Economics* 11(1):551-577.

Kapunda, S.M. (1983). Engel's law and its application to Tanzania. Economic Research Bureau, seminar paper No. 77/7, University of Dar es Salaam.

Kapunda, S.M. (1988). Consumption patterns and Tanzania's economic development. Ph.D. thesis, University of Dar es Salaam.

Kennedy, P. (1992). A Guide to Econometrics. Oxford: Blackwell, Oxford.

Kormawa, P and Akoroda, M.O (2003). Cassava Supply Chain Arrangement for Industrial Utilization in Nigeria, IITA. Ibadan, Nigeria

Lanjouw, P. and Ravallion. M, (1995). Poverty and household size. *Economic Journal* 105:1415-1434.

Leser, C. (1963). Forms for Engel curves. *Econometrica* 31:694-703.

Lipsey, R. G and Chrystal, K. A. (1999). Principles of Economics, 9th edition, Oxford University Press, Oxford.

Loudon, D. L. and Bitta, A. J. (1993). Consumer Behaviour; Concepts and Applications, 4th edition, McGraw-Hill, Inc., New York

Mhlongo, V. and Daniels, R:C. (2013). Food expenditure patterns in South Africa: Evidence from the National Income Dynamics Study (NIDS) [http://www.opensaldru.uct.ac.za] site visited on 22/9/2015

Mkamilo G.S and Jeremiah S.C. (2005). Current status of cassava improvement programme in Tanzania. *African Crop Science Society* 7:1311-1314

National Bureau of Statistics (2009). Household Budget Survey of 2007, National Bureau of Statistics, Dar es Salaam

National Bureau of Statistics (2012). National Sample Census of Agriculture: Smallholder Agriculture, Volume II: Crop Sector, National Bureau of Statistics, Dar es Salaam.

National Bureau of Statistics (2013). Population and Housing Census, Population Distribution by Administrative Areas, National Bureau of Statistics, Dar es Salaam.

National Bureau of Statistics (2013). Population and Housing Census, Population Distribution by Administrative Areas, National Bureau of Statistics, Dar es Salaam.

National Bureau of Statistics (2014). Household Budget Survey of 2011/12, National Bureau of Statistics, Dar es Salaam.

Ndanshau, M.O.A. (2001). An econometric analysis of Engel's Curve: The case of peasant households in Northern Tanzania. *Utafiti* 4:57-70

Neter, J. (1970). Measurement errors in reports of consumer expenditures. *Journal of Marketing Research* 8(1):11-25.

Nicholson, W. (1992). Microeconomic Theory: Basic Principles and Extensions, 5th Edition. The Dryden Press, Fort Worth, Texas.

Nweke, F. *et al.* (2002). Cassava Transformation: Africa's best kept secret. East Lansing, MI: Michigan State University Press, Washington, D.C.

Nweke, F. (2004). New challenges in cassava transformation in Nigeria and Ghana, Environment and production technology division, International Food Policy Research Institute Washington, D.C.

Organisation for Economic Co-operation and Development (1982). List of Social Indicators, OECD Publishing, Paris.

Organisation for Economic Co-operation and Development (2008). Growing Unequal? Income distribution and poverty in OECD Countries, OECD Publishing, Paris.

Organisation for Economic Co-operation and Development (2011). Divided We Stand – Why Inequality Keeps Rising, OECD Publishing, Paris.

Onyemauwa, C.S. (2010). Analysis of Household Consumption of Cassava Products in Ohaozara, Ebonyi State, Southeast Nigeria, Federal University of Technology, Owerri, Nigeria.

Ostby, I. (1968). An econometric study of demand patterns in Dar es Salaam: preliminary review. Economic Research Bureau, seminar paper No. 68/5

Pan, Y, and Jackson, R. T. (2008). Ethnic difference in the relationship between acute inflammation and serum ferritin in US adult males. *Epidemiology and Infection* 136:421-431.

Perthel, D. (1975). Engel's Law Revisited. *International Statistical Review* 43(2):211-218.

Prais, S., and Houthakker, H. (1971). The analysis of family budgets, Cambridge University Press, Cambridge.

Rogerson, P. A. (2001). Statistical methods for geography, Sage, London.

Sadoulet, E. and de Janvry, A. (1995). Quantitative Development Policy Analysis, Johns Hopkins University Press, London.

Scott, G.J., Rosegrant M. and Ringler C. (2000), Roots and tubers for the 21st century: Trends, projections and policy options. Food, Agriculture and the Environment Discussion Paper No. 31. International Food Policy Research Institute, Washington, D.C.

Sdrali, D. (2006). Effects of socio-demographic and economic factors on food expenditure in a prefecture of Greece, PhD Dissertation, Department of Home Economics and Ecology, Harokopio University of Athens, Greece

Sewando, P.T., and. Mdoe N. Y. S, and Mutabazi, K. D. S. (2011). Farmers' preferential choice decisions to alternative cassava value chain strands in Morogoro rural district, Tanzania, MPRA Paper No. 29797

Stanlake, G.F (1989). Macroeconomics: An Introduction, 4th edition, Longman Group, United Kingdom.

Stone, R. (1954). Linear expenditure systems and demand analysis: An Application to the pattern of British demand. *Economic Journal*, pp 511-527.

Taljaard, P. (2004). The demand for meat in South Africa: An almost ideal estimation. *Agrekon* 43(4):430- 443

Theil, H. (1965). The information approach to demand analysis. *Econometrica* 33: 67-87

Tsegai, D. and Kormawa, P. (2002). Determinants of urban households' demand for cassava and cassava products in Kaduna, northern Nigeria: The

application of AIDS model. Conference on International Agricultural Research for Development, Deutscher Tropentag – Witzenhausen.

United Republic of Tanzania (2014). Dar es salaam region socio-economic profile, Prime minister's office, Regional Administration and Local government, National Bureau of Statistics and Regional Commissioner's Office Dar es Salaam, Tanzania.

United Republic of Tanzania (2015). Coast Region investment profile, Prime Minister's Office, Regional Administration and Local Government, Regional Commissioner's, Coast Region.

Wan, G.H. (1996). Income elasticities of household demand in rural China: Estimates from cross-sectional survey data. *Journal of Economic Studies* 23:18-33.

White, H. (1980). A heteroskedasticity-consistent covariance matrix and a direct test for heteroskedasticity. *Econometrica* 48:817-838.

Widowati, S. and Hartojo, K. (2000). Production and use of cassava flour: A new product of future potential in Indonesia. Proceedings of the 6th Regional cassava Workshop, Vietnam.

Woolard, I. and Leibbrandt, M. (1999). Measuring Poverty in South Africa, DPRU Working Paper No 99/33.

Working, H. (1943). Statistical laws and family expenditure. *Journal of the American Statistical Association* 38:43-56.

Yamane, T. (1967). Statistics: An Introductory Analysis, second edition, Harper and Row, New York.

Yengar, N.S. and Raghuprasad, S. (1988). Estimation of additive Engel curves in the presence of heteroscedasticity. *Journal of Quantitative Economics* 4(2):279-291.

Yu, W., Hertel, T., Preckel, P., and Eales, J. (2004). Projecting World food demand using alternative demand systems. *World Bank Economic Review* 18(2):205-236.

APPENDICES

Appendix 1: Forms of cassava utilization

Plate 1: Smoked cassava

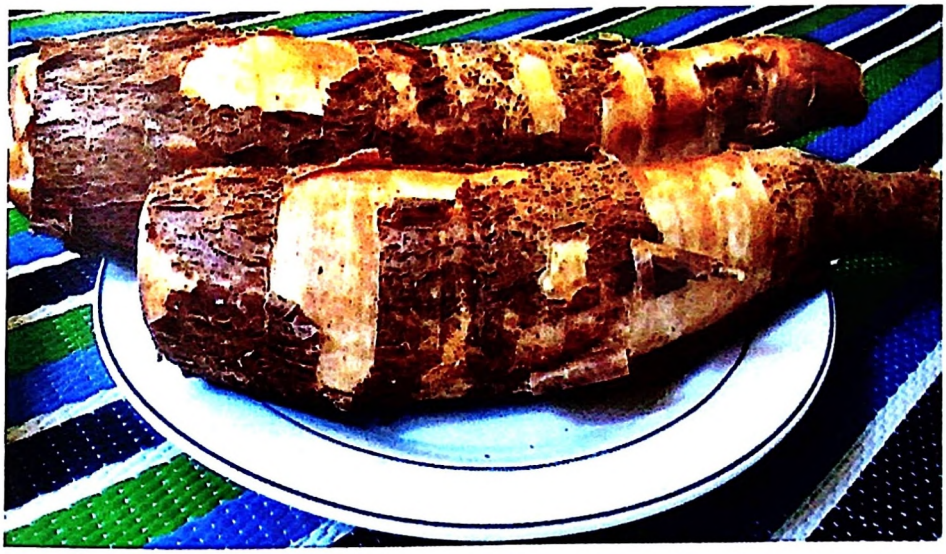

Plate 2: Fresh raw cassava

Plate 3: Peeled raw cassava

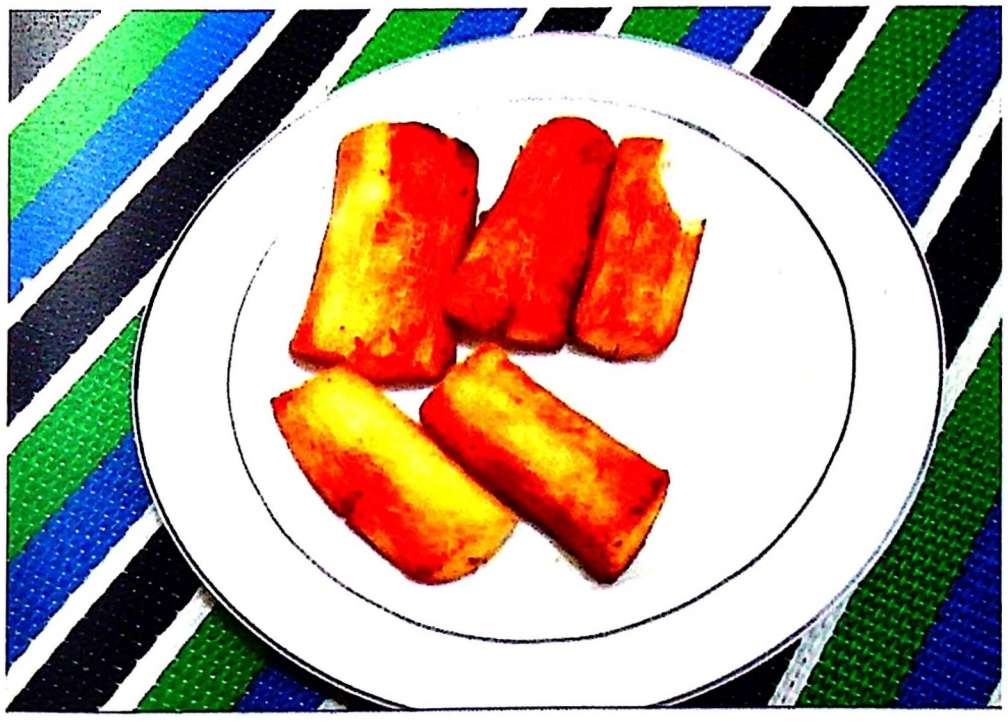

Plate 4: Fried cassava

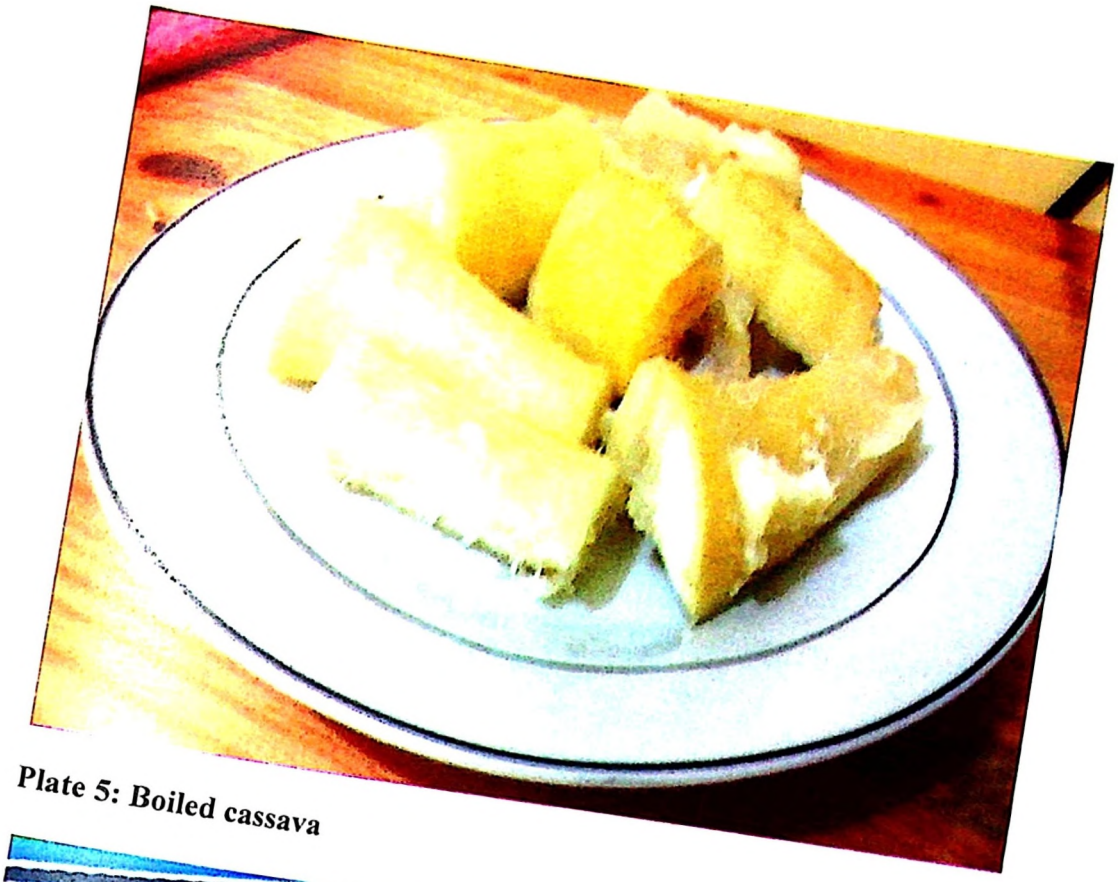

Plate 5: Boiled cassava

Plate 6: Stiff Porridge (Ugali)

Appendix 2: Average monthly per capita consumption expenditure by income groups and location (TZS)

Income groups	Rural	Urban
Low income	49,000	98,000
Middle income	76,000	119,000
High income	121,000	167,000
Pooled sample mean	**78,000**	**118,000**

Classification is based on 2011/12 HBS (NBS, 2014)

Appendix 3: Average monthly cassava per capita consumption expenditure share by income groups and location

Income groups	Rural		Urban	
	Log of per capita expenditure share	Per capita cassava share	Log of per capita expenditure share	Per capita cassava share
Low income	-0.0099	0.0225	-0.0151	0.03421
Middle income	-0.0110	0.0250	-0.0169	0.03813
High income	-0.0138	0.0313	-0.0179	0.04027

Appendix 4: Heteroskedasticity diagnostics

A: Diagnostics test based on regression model estimates for rural areas (Coast Region)

White's test for Ho: homoskedasticity
against Ha: unrestricted heteroskedasticity

chi2(19) = 0.5628364
Prob > chi2 = 0.6751

Cameron & Trivedi's decomposition of IM-test

Source	chi2	df	p
Heteroskedasticity	0.56284	19	0.6951
Skewness	2.98	5	0.1022
Kurtosis	0.29	1	0.1226
Total	**3.83284**	**25**	**0.8999**

B: Diagnostics test based on regression model estimates for urban areas (DSM)

White's test for Ho: homoskedasticity
against Ha: unrestricted heteroskedasticity

chi2(19) = 0.4281
Prob > chi2 = 0.1201

Cameron & Trivedi's decomposition of IM-test

Source	chi2	df	p
Heteroskedasticity	0.4281	19	0.1201
Skewness	2.79	5	0.3012
Kurtosis	0.42	1	0.3116
Total	**3.6381**	**25**	**0.7329**

Appendix 5: T-Test for difference in mean households' expenditure and cassava budget share between urban and rural households in the selected study areas

A: T-Test for difference in mean household expenditure between Dar es Salaam (urban) and Coast Region (rural) households

```
Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
urban_~x |     100    563952.4    37289.33    372893.3    489962.3    637942.5
rural_~x |     100    282596.8    24588.17    245881.7    233808.5    331385.1
---------+--------------------------------------------------------------------
combined |     200    423274.6    24407.17    345169.6    375144.7    471404.5
---------+--------------------------------------------------------------------
    diff |            281355.6    44666.23                193273    369438.2
------------------------------------------------------------------------------
    diff = mean(urban_tex) - mean(rural_tex)                      t =   6.2991
Ho: diff = 0                                     degrees of freedom =      198

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
```

B: T-Test for difference in mean cassava expenditure share between Dar es Salaam (urban) and Coast Region (rural) households

```
Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
 urban_w |      83    14635.05    1551.009    14130.36     11549.6     17720.5
 rural_w |      78    10643.59    808.9711    7144.639    9032.723    12254.46
---------+--------------------------------------------------------------------
combined |     161     12701.3    901.6866    11441.12    10920.56    14482.04
---------+--------------------------------------------------------------------
    diff |            3991.458    1782.012                471.9907    7510.926
------------------------------------------------------------------------------
  diff = mean(urban_w) - mean(rural_w)                            t =   2.2399
Ho: diff = 0                                     degrees of freedom =      159

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9868         Pr(|T| > |t|) = 0.0265          Pr(T > t) = 0.0132
```

Appendix 6: Consumer survey questionnaire

Section 1: Introduction

My name is Basil Msuha; a student at Sokoine University of Agriculture undertaking MSc. Agricultural Economics. I am conducting a research on **"Rural and Urban Household Demand Analysis for Cassava in Dare es Salaam and Coast Region".** The findings of this research will help in the design of intervention strategies for vibrant cassava subsector in our country. I will not cite an individual's opinions, but your views will be included in the report. If you have any question I will be ready to clarify, otherwise we would like to start the interview. Thank you.

Section 2: Personal and Household Characteristics: Location.....

2.1 Sex: Male □ Female □

2.2 Age .....(years)

2.3 Educational level of respondent (years spent in education):-

i. No formal education (o years) □
ii. Primary education (7 years) □
iii. Secondary education (11-13 years) □
iv. Tertiary (>13 years) □
v. Others (specify)..... □

2.4 How many members do you have in your household with the following age groups

Age Groups	Sex	
	Male	Female
0-2		
3-4		
5-6		
7-8		
9-10		
11-12		
13-14		
15-18		
19-59		
60+		
Total		

Section 3: Preference and expenditure on Cassava and Cassava Products

3.1 Have you consumed cassava for the past month? Yes □ No □

3.2 How many times did you consume cassava for the last month? (Number)....

3.3 If yes (in 3.1 above) which form of cassava do you prefer?

i. Raw cassava □

ii. Boiled cassava □

iii. Futali/Mseto □

iv. Stiff porridge (ugali) □

v. Fried/Chips □

vi. Other Forms □; Specify...

3.4 In order to prepare the preferred form mentioned (in 3.2 above); which form of cassava do you purchase in the market?

i. Raw cassava □

ii. High quality cassava flour (HQCF) □

iii. Flour from traditionally dried cassava roots □

iv. Other Forms □; Specify...

3.5 How much did you spent on cassava (in 3.1 or 3.3 or 3.4 above) for last month? (TZS).....

3.6 What are the most important characteristics do you consider when purchasing and consuming raw cassava (Rank by numbers):-

i. Colour □

ii. Time of cooking □

iii. Taste □

iv. Texture (level of hardness in chewing the cassava) □

v. Fiber □

vi. Easy of peeling □

vii. Size (thickness) of the root □

3.7 How much did you spent on cassava (in 3.4 above) for last month? (TZS).....

3.8 List other food types consumed in your household for the last month

(i)..... (ii)..... (iii)..... (iv)..... (v).....(vi).....(vii).....

3.8 How much did you spend on other food types mentioned on 3.7 above? (TZS)....

3.9 How much did you spend on the following items in the last month (TAS)

ITEM	TZS	ITEM	TZS
Food		Rent	
Education		Gifts	
Medical care		Donation	
Utilities		Transportation	
Alcoholic beverage		Lottery	
Non alcoholic beverage		Communication	
Cigarette		Others	

3.10 What is your total expenditure per month (TAS)? .....

Section 4: Occupation and income

	Occupation	Income per month (TAS)
Major		
Minor (if any)		
Total income per month (TAS)		