AN ANALYSIS OF YAM CONSUMPTION PATTERNS IN GHANAIAN URBAN COMMUNITIES

BY:
ROBERT AIDOO
(MSc. Agricultural Economics, BSc. Agriculture)

A DISSERTATION
SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES, KWAME NKRUMAH UNIVERSITY OF SCIENCE & TECHNOLOGY, KUMASI, GHANA IN FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

DEPARTMENT OF AGRICULTURAL ECONOMICS, AGRIBUSINESS & EXTENSION, FACULTY OF AGRICULTURE, KNUST, KUMASI

MARCH 2009

DISSERTATION COMMITTEE/SUPERVISORS

1. Dr. Kwasi Ohene-Yankyera; Department of Agricultural Economics, Agribusiness & Extension, Kwame Nkrumah University of Science & Technology, Kumasi, Ghana.

2. Dr. Kofi Marfo; Crops Research Institute (CRI)-Kumasi, Council for Scientific and Industrial Research (CSIR), Ghana.

3. Dr. Simon C. Fialor; Department of Agricultural Economics, Agribusiness & Extension, Kwame Nkrumah University of Science & Technology, Kumasi, Ghana.

4. Dr. Blaise Nkamleu Guy; Formerly of International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria and now with the African Development Bank, Tunis, Tunisia.

ABSTRACT

This study examined the major factors that drive changes in yam consumption patterns across income groups, seasons and urban centers in Ghana to inform food policy formulation. The study, among other things, sought to provide evidence on whether or not yam had become a luxury food commodity in Ghanaian urban communities. Special attention was also given to the question of whether household income allocation between males and females had any significant effect on yam consumption. Quarterly household panel data collected from four urban centers were used to conduct a complete demand system analysis by employing the Almost Ideal Demand system (AIDS) and Quadratic Almost Ideal Demand System (QUAIDS) models through the use of the Ordinary Least Squares (OLS) method. The study estimated yam expenditure elasticities for the pooled/aggregate data and the four different urban centers across different income groups to test Engel's law. Results of the study showed that majority (>80%) of yam consumers in Ghanaian urban communities preferred white yam to yellow and water yams, and the most important reason for their preference was taste. Boiled yam (*ampesi*) was the most preferred yam product in Ghanaian urban centers followed by pounded yam (*fufu*). Rice was identified as the most important substitute for yam in urban communities. In a typical Ghanaian urban center, household food budget formed about 51% of the total household budget. Yam constituted about 12% of household at-home food budget and 13% of its away-from-home food budget. The shares of food budget that households allocated to yam generally increased during the peak harvest season and dropped during lean season across all urban centers in Ghana. Yam expenditure elasticity for the pooled sample was found to be inelastic (0.76), suggesting that yam is a basic food commodity in a typical Ghanaian urban center. Yam expenditure elasticity was lowest for Tamale (0.64), a less urbanized center, and highest for Accra (1.01), a more urbanized center. Generally, across urban centers, the study supported Bennett's law which posits that households switch from less to more expensive calorie consumption as their incomes increase. However, in each particular urban center, Engel's law was affirmed; yam expenditure elasticity was higher for low-income households and lower for high-income households. Yam expenditure elasticity was found to vary across seasons; yam was expenditure elastic during the lean season and expenditure inelastic during the harvest season. Women's share of household income was found to be positively related to household yam budget share. Evidence from this study did not support the hypothesis of economies of household size with respect to household yam budget share when the pooled data was used for analysis. However, the hypothesis of economies of household size was supported in the seasonal consumption analysis where households were found to enjoy economies of size during the relatively yam abundant period of August to December and diseconomies of size during the lean season. The study showed that yam budget share was own-price elastic but expenditure inelastic. Urban households were more responsive to changes in yam prices than changes in household income, implying that the substitution effect is stronger than the income effect. The high price elasticity for yam budget share stresses the importance of food price changes for households, and it is important that households' reactions are taken into account in the development of comprehensive agricultural and food policies in Ghana. Based on the findings of the study, recommendations have been made to help improve the Ghanaian yam sector and household food security in urban centers.

DEDICATION

This dissertation is dedicated to my family generally and specifically to my wife, Abena, and the little Kwabena for their patience, encouragement and support.

The dissertation is also dedicated to all needy and underprivileged students in Ghana, especially those from Sefwiland.

ROBERT AIDOO
MARCH 2009

ACKNOWLEDGEMENT

I thank God for the protection, guidance, inner strength and perseverance throughout this programme of higher learning. Lord Almighty, all the good in my life is your gift; I am but a shadow.

I owe a debt of gratitude to my main supervisor, Dr. Kwasi Ohene-Yankyera for his professional advice, excellent guidance and continuous encouragement, which contributed to the success of this work. I wish to express my profound gratitude to Dr. Kofi Marfo (CRI), Dr. S.C Fialor (KNUST) and Dr. Blaise Nkamleu Guy (formerly of IITA) for their valuable contributions and advise in their capacities as co-supervisors. I am grateful to all the Lecturers in the Department of Agricultural Economics, Agribusiness and Extension, Faculty of Agriculture, KNUST for their support and encouragement throughout my work. I thank all students and workers at the Department of Agricultural Economics, Agribusiness and Extension for their support during my stay at the department. I am particularly grateful to Mr. D.C. Asante-Kwatia for his fatherly advice throughout my stay at the Department.

I am grateful to all the Field/Research Assistants who helped me during the field survey. The efforts of staff of the Ministry of Food and Agriculture (MoFA) in Techiman and Kumasi; Abdul-Rauf and students of University for Development Studies (UDS) in Tamale; and Mr. Tabi and Prince from the University of Ghana in Accra during the data collection are greatly appreciated. God bless you for your untiring effort. I say a big thank you to Nicholas Nyamekeh Dadzie and Bright Asante for their vigilance during data entry.

Special thanks go to all my family and church members whose guidance, love and prayers have become a priceless asset in my life. I thank you for the patience and understanding throughout this long period of studies.

This research was made possible through financial support from International Fund for Agricultural Development (IFAD) and the International Institute of Tropical Agriculture (IITA). IFAD provided funds under the TAG project through IITA for the field survey and also granted studentship to the author for this Ph.D work. The Scholarship provided by the Kwame Nkrumah University of Science and Technology under the Vice Chancellor's Initiative to produce lecturers for the University is also acknowledged.

Finally, I thank all my friends especially Vincent Abankwah, A.G. Kassim, Francis Apori-Buabeng, Della Ahiale, Abdul-Rhaman Yussif, and all the Ph.D students under the VC's initiative for their support and continuous query on my work, which spurred me on to work harder. May God bless you all!

ROBERT AIDOO
MARCH 2009

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List of Abbreviations/Acronyms

AIC	Akaike Information Criterion
AIDS	Almost Ideal Demand System AIM
	Asymptotically Ideal Model AMA
	Accra Metropolitan Area ANOVA
	Analysis of Variance
AUES	Allen Uzawz Elasticity of Substitution
Df	Degrees of Freedom
FAO	Food and Agricultural Organization of the United Nations
FES	Family Expenditure System
FFF	Fourier Flexible Functional Form
GDP	Gross Domestic Product
GEF	Generalized Exponential Function
GF	Generalized Leontief
GHC	Ghana Cedis
GLSS	Ghana Living Standards Survey
GSS	Ghana Statistical Service
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
ISSER	Institute of Statistical, Social and Economic Research
LA/AIDS	Linearized Approximate Almost Ideal Demand System
LES	Linear Expenditure System

MoFA Ministry of Food and Agriculture OLS
Ordinary Least Squares
OPCS Office of Population, Censuses and Surveys
PIGLOG Price Independent Generalized Logarithmic
QUAIDS Quadratic Almost Ideal Demand System
RAIDS Rational Rank Four Almost Ideal Demand System SIC
Bayesian-Schwartz Information Criterion
SNP Semi Non-Parametric
Translog Transcendental Logarithmic

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Food and nutrition security are Africa's most fundamental challenges. The number of Africans who are undernourished has been on the rise and now stands at about 200 million people (Honfoga and Boom, 2003). Since the 1960s, technological advances in agriculture have substantially contributed to growth in crop production in the third world, particularly Asia. Despite this, food demand has continued to outpace supply, and trade has grown as imports rise to meet domestic food demand. Leonardo (1986) examines the trends in trade, production, and consumption of the basic food staples (cereals, roots and tubers, pulses, groundnuts, and bananas and plantains) in 105 developing countries. Using these trends, he discusses the size, geographical composition, and dynamics of the third world's food problems. A trend scenario of the food situation in 2000 (based on data from 1961-1980 for production; and 1966 – 1980 for consumption) projects a third world production shortfall in basic food staples of about 70 million tonnes. North Africa and the Middle East were projected to have the largest net food deficit (60 million tonnes) followed by sub-Saharan Africa with a gap of 50 million tonnes.

It is implied from the foregoing that the potential demand for basic food staples, including root and tuber products, on both domestic and international markets will continue to rise. According to Scott, Rosegrant and Ringler (2000), agricultural potential is greatest for root and tuber crops like yam and cassava due to their adaptability to marginal environments, their contribution to household food security, and their flexibility in mixed cropping systems. The end uses of roots and tubers make them an important component of a targeted strategy for improving the welfare of the poor and linking smallholder farmers to markets (ibid). Root and tuber crops can help the poor in developing countries. The increased use of major roots and tubers (cassava, potato, sweet potato, and yam) for food and livestock feed in developing countries will have wide-ranging effects on global public- and private-

sector policies and investments (IFPRI, 2000). Roots and tubers will continue to play a significant role in developing country food systems because they:

- contribute to the energy and nutrition requirements of more than 2 billion people,
- are produced and consumed by many of the world's poorest households,
- are an important source of employment and income in rural, and often marginal areas, especially for women, and
- adapt to a wide range of uses, from food-security crops to cash crops, raw material for industrial uses, and from fresh to high-end processed products.

The total use of roots and tubers in developing countries is projected to increase by 232 million tonnes to 635 million tonnes between 1993 and 2020, a 58 percent increase (Scott *et al*, 2000). Cassava's share of the increase will be 44 percent, potato's 29 percent, and yam and sweet potato's share will be 27 percent. In the final analysis, Scott *et al* (2000) stress two primary "underground solutions" for promoting roots and tubers in the marketplace: removing policy distortions that bias market signals in favor of other agricultural commodities and lifting trade restrictions on exports from developing countries.

Roots and tubers belong to the class of foods that basically provide energy in the human diet in the form of carbohydrates. The terms refer to any growing plant that stores edible material in subterranean root, corm or tuber. Historically, policy makers and researchers have paid very little attention to root crops, as most of their efforts have been concentrated on cash crops or the more familiar grains. Root crops were regarded as food mainly for the poor, and have played a very minor role in international trade. This misconception has lingered for so long because of the lack of appreciation of the number of people who depend on these root crops, and the number of lives that have been saved during famine or disasters by root crops. Root crops are consumed as a basic source of calories or as a supplement to cereals. The cost of calories from cassava is low as compared to calories from root crops such as yam, which is considerably expensive.

The tendency to treat roots and tubers as undifferentiated commodities has obscured their varying uses and performances. It has also hindered the analysis of their roles in the global food system, clouded understanding of their future prospects, and handicapped formulation of appropriate policies to exploit

their unrealized potentials. Therefore, it is imperative to isolate the various roots and tubers as individual food crops for critical analysis.

This study focuses on yam, one of the most important staples in Ghana. Lately, yam has become an important export crop in Ghana. Yam ranked second after pineapple in terms of volume and value of non-traditional export crops in Ghana (Asuming-Brempong, 1994). Because of its importance on the international market as an export crop, yam has increasingly become expensive on the domestic market. Low income households therefore find it relatively unaffordable compared to other roots and tubers like cassava, cocoyam, and taro. The research will enhance understanding of the important factors affecting Ghanaian yam consumption patterns. The econometric results from this study should be useful for assessing the future trend of yam consumption pattern in Ghana and other subSaharan African countries. This study will represent a milestone in analyzing yam demand structure and consumption patterns in Ghana. Hopefully, the study would motivate researchers and generate more interest in the analyses of food consumption behaviour in Ghana and perhaps, more debate on the key demand elasticities for yam and other related food commodities.

The pattern of food consumption in Ghana and the world over has been undergoing dramatic changes over the last 30 years. Some economists have attributed these changes to such factors as higher household income, an ageing population and a more westernized lifestyle (Chern *et al*, 2003). Many factors have influenced the Ghanaian food consumption pattern, and an understanding of these factors is very important for the assessment of the agricultural products market in Ghana. Whereas there is relatively satisfactory research information on yam consumption in Nigeria (e.g. Tsegai and Kormawa, 1985; Dorosh, 1988; and Nweke *et al*, 1989), information on yam demand and consumption patterns is limited in Ghana. The few studies on yam consumption in Ghana were carried out in the 1960s and 1970s (e.g. Ord, 1965; Kaneda and Johnson, 1961; and Haessel, 1976). As the second largest yam producing country and the leading yam exporting country in the world, changes in Ghana's yam consumption pattern will directly affect sub-regional and world yam trade.

The study will provide timely and useful information for assessing the future of yam as a food commodity in Ghana. There are several unique features of this study. First, the study uses household survey data, which have been rarely used in the study of food demand and consumption patterns in many countries. The use of household data allows for the modeling of yam consumption with demographic variables. The estimates of income/expenditure elasticity obtained from cross-sectional

household data are more credible than those obtained from time-series data (Ruel *et al*, 2005). Second, the study estimates different models for the individual urban centers considered in the study. An aggregate model was built by pooling the data from all the urban centers. The estimated demand elasticities would be useful for those who work on various forecasting models as well as for agricultural policymakers.

The next subsections focus on yam as a root and tuber crop, its production and consumption. The various varieties of yam produced in Ghana and yam production levels for the major producing countries have been highlighted with emphasis on how important yam is to households in Ghana in particular and the West African sub-region as a whole.

1.2 Yam

Yams (*Dioscorea spp*.) are annual or perennial climbing plants with edible underground tubers. Yam (also called Ñamé -Spanish and Igname - French) belongs to the genus *Dioscorea* (family *Dioscoreaceae*). Of the estimated 300-600 species available, there are just over half-dozen principal species that are grown for consumption, while others are grown for medicinal purposes. Yams originated in the Far East and spread westwards. They have since evolved independently in the Eastern and Western Hemispheres, and today yams are grown widely throughout the tropics. In the West African yam zone, which is the principal producer on a global basis, white yam (*D. rotundata), water yam (D. alata*), and yellow yam (*D. cayenensis)* are the most common species.

White yam (*D. rotundata*) originated in Africa and is the most widely grown and preferred yam species. The tuber is roughly cylindrical in shape, the skin is smooth and brown and the flesh usually white and firm. A large number of white yam cultivars exist with differences in their production and post harvest characteristics. Yellow yam (*D. cayenensis*) derives its common name from its yellow flesh, which is caused by the presence of carotenoids. It is also native to West Africa and very similar to the white yam in appearance. Apart from some morphological differences (the tuber skin is firm and less extensively grooved), the yellow yam has a longer period of vegetation and a shorter dormancy than white yam. Water yam (*D. alata*) originated from South East Asia. It is the species most widely spread throughout the world and in Africa it is second to white yam in popularity. The

tuber shape is generally cylindrical, but can be extremely variable. The tuber flesh is white and "watery" in texture.

Yams have both economic and social value in many growing areas. They are extremely important for at least 60 million people comprising rural producers, processors and consumers in West Africa (Babaleye, 2005). Yam provides multiple opportunities for poverty reduction and nourishment of poor people in the sub-region. Yams are second to cassava as the most important tropical root crop. Yam is a staple crop in many parts of Africa and Southeast Asia. In the South Pacific, yam is a significant food crop, accounting for over 20%, 8.1%, and 4.6% of the total dietary calorie intake in the Kingdom of Tonga, Solomon Islands, and Papua New Guinea, respectively. Yams store relatively longer in comparison with other tropical fresh produce, and therefore stored yam represents stored wealth, which can be sold all-year-round by the farmer or marketer. Besides their economic importance, yams also play a significant role in the socio-cultural lives of some producing regions like the celebrated New Yam Festival in West Africa, a practice that has also extended to overseas where there is a significant population of the tribes that observe it. In some parts of Southeastern Nigeria, the meals offered to gods and ancestors consist principally of mashed yam. In parts of *Igboland* in Southeastern Nigeria, it is customary for the parents of a bride to offer her yams for planting as a resource to assist them in raising a family. According to Diop (1998), the ritual, ceremony and superstition often surrounding yam cultivation and utilization in West Africa is a strong indication of the antiquity of use of this crop. In Nigeria, yam is considered to be a "man's property" and the traditional ceremonies that still accompany yam production indicate the high status given to the plant.

1.3 Yam production

Developing country's root and tuber supply increased to 449 million tonnes in 1996, an increase of 30% over the 1983 production level. In sub-Saharan Africa, yam output slightly exceeded the global average and cassava output grew at twice the global rate. According to Scott *et al* (2000), more than half of the output growth for yam and cassava in the region came from area expansion rather than from productivity growth. More than 95% of the world's yams are currently grown in sub-Saharan Africa, with the remainder grown in the West Indies and parts of Asia and South and Central America. There are over 600 yam species grown throughout the world. Among the three main species in West Africa, *D. rotundata* (white yam) is the most important variety and *D. cayenesis* (yellow yam) is the least important (IITA, 2001).

According to FAO Statistics Division (2005), 38 million tonnes of yam were produced worldwide in 2000, 96% of this in Africa. Table 1.1 provides yam production volumes for major yam producing countries in West Africa. From the Table, the leading producer was Nigeria with average of over 26 million tonnes from 2000 to 2004, followed by Ghana with over 3.3 million tonnes, and Côte d'Ivoire with over 2.9 million tonnes. During that period nearly 4 million hectares of land was planted with yam throughout the world. More than 69% of this total area was located in Nigeria. The average yield was nearly 10 tonnes per hectare. World annual production of yam was estimated at 17.4 million tonnes in 1970 and 21.1 million tonnes in 1990. Total world production increased from 38 million tonnes in 2000 to 40 million tonnes in 2004.

Table 1.1: Yam production figures for selected countries 1961 - 2004 ('000 Mt)

Year	Nigeria	Ghana	Ivory Coast	Benin	Togo	World
1961	3,500	1,100.0	1,150.0	614.2	300.0	8,324.4
1970	12,033	909.0	1,551.0	515.8	290.0	17,428.4
1980	5,248	650.0	2,040.0	694.4	483.9	11,638.5
1989	9,609	1,258.0	2,474.0	1,009.9	405.1	17,304.6
1990	13,624	877.0	2,528.0	1,046.1	391.9	21,114.2
1991	16,956	2,631.9	2,890.0	1,177.5	376.5	26,835.7
1992	19,781	2,331.4	2,758.0	1,124.9	368.0	29,278.1
1993	21,632	2,720.3	2,771.0	1,185.1	530.4	31,647.7
1994	23,153	1,700.1	2,823.7	1,250.5	484.0	32,471.4
1995	22,818	2,125.7	2,869.0	1,285.9	530.5	32,559.2
1996	23,201	2,274.8	2,924.0	1,346.1	604.7	33,385.6
1997	23,972	2,407.9	2,987.0	1,407.7	683.0	34,428.8
1998	24,768	2,702.9	2,921.0	1,583.7	696.1	35,802.6
1999	25,873	3,249.0	2,944.0	1,647.0	665.6	37,618.9
2000	26,201	3,362.9	2,950.0	1,742.0	563.3	38,131.3
2001	26,232	3,546.7	2,938.0	1,701.0	549.1	38,379.4
2002	26,258	3,900.0	2,966.1	1,875.0	574.9	38,894.2
2003	26,324	3,812.8	3,048.3	2,408.6	568.9	39,579.9
2004	26,587	3,892.3	3,050.0	2,500.0	570.0	40,048.1

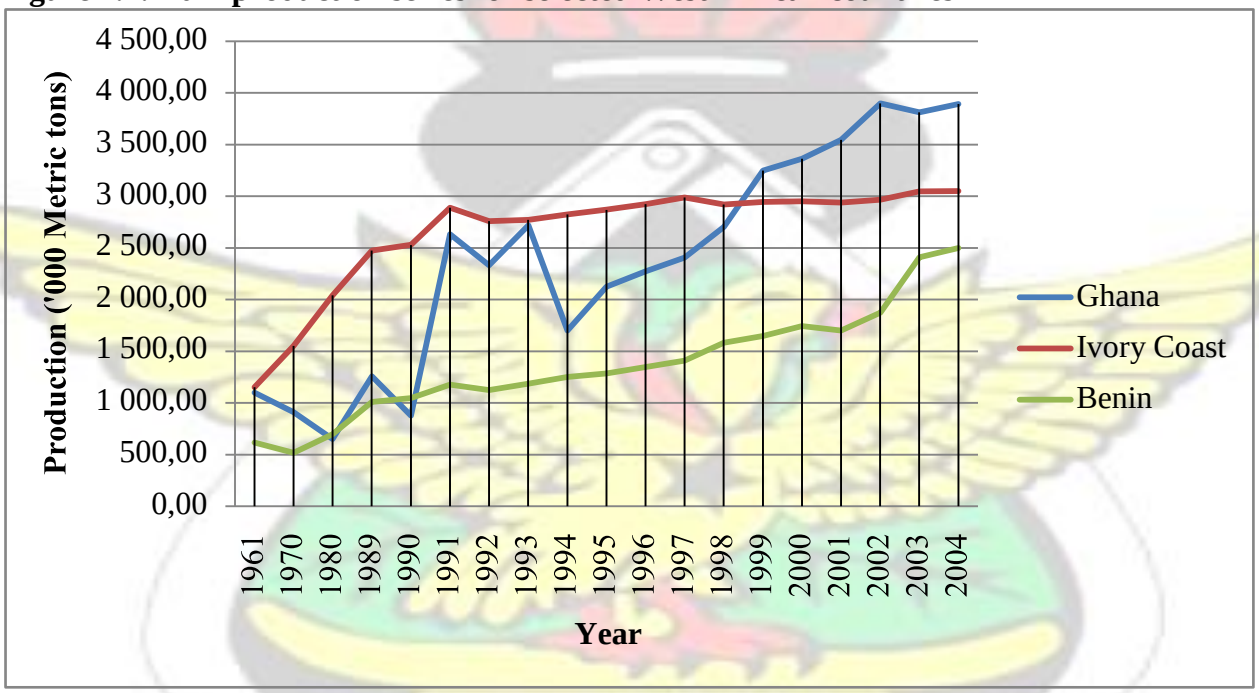
Source: FAOSTAT (2005).

From Table 1.1, it is evident that yam production in Ghana increased from 2.1 million tonnes in 1995 to 3.9 million tonnes in 2002. In 2003, however, yam production in Ghana decreased to 3.8 million tonnes. A similar decline is observed between 1993 and 1994 where yam output reduced from 2.7

million tonnes to 1.7 million tonnes (Tetteh and Saakwa, 1994). During the period 1975-90, total yam cultivated area increased by about 38.8% globally, while the total production increased by 45.8%.

Fig. 1.1 shows the yam production series for selected yam producing countries in West Africa from 1961 to 2004. It may be evident from the figure that Ghana has consistently been producing more yams than Benin. However, Ghana's yam production lagged behind that of Ivory Coast until the year 1999 when Ghana became the world's second highest producer of yam after Nigeria. It may be observed from the production trends that Ghana's yam production tended to fluctuate more than the other counties in 1990-1994 probably due to price fluctuations (Cobweb theorem).

Figure 1.1: Yam production series for selected West African countries



Source: Underlying data from FAO Stats (2005).

The importance of yam in the economy of the main producing areas appears to be declining due partly to competition from other crops like cassava in Nigeria, and taro in the South Pacific (Opara, 1999). However, in the case of Ghana the contribution of yam to the economy by way of meeting household food needs and foreign exchange earnings through exports has been growing.

1.4 Yam consumption

The selection of foodstuffs by consumers depends on many factors including familiarity, income, price, religion and availability as well as availability of substitutes and complements. The results of a study on food preferences in Nigeria indicated that about 70% of roots and tuber consumers ranked white yam as their first choice, while about 18% ranked cassava first. The least preferred tubers were yellow yam, white cocoyam, red cocoyam and water yam. It was noted that these results notwithstanding, water yam, yellow yam and red cocoyam have greater nutritive content than white yam (Ojofeitimi and Olufokunbi, 2003). This means that consumers may often not bother so much about the nutritive value of what they consume.

Between 1983 and 1996, developing country consumption of roots and tubers as food increased by 45 million metric tonnes (or 22%) to reach 253 million metric tonnes. Yam accounted for 16 million tonnes of this increase. Cassava, at 93 million tonnes, accounted for the largest share of root and tubers consumed as food in 1996, followed by sweet potato (69 million tonnes), and potato (65 million tonnes). Although yam consumption increased most rapidly, it was from low levels (Scott *et al*, 2000). They further indicated that sub-Saharan Africa achieved both the highest level and sharpest absolute rise in per capita food consumption of roots and tubers between 1983 and 1996.

Root and tuber crops are second in importance to cereals as a global source of carbohydrates. They also provide some minerals and essential vitamins, although a proportion may be lost during processing (Diop, 1998). Table 1.2 below shows the per capita daily consumption of selected food commodities in Africa as a percentage of total consumption. In Africa root crops constitute between 18.6% of per capita daily calorie consumption in East Africa to a high of 41.4% in Equatorial Africa. Root crops are the highest supplier of calories in Equatorial Africa and second highest in all other parts of Africa after cereals (Table 1.2). This underscores the importance of root crops as staple foods in Africa.

Table 1.2: Per capita daily consumption of food commodities as percent of total consumption (1983 – 1996)

Food Commodity	Equatorial Africa	Humid West Africa	Semi-arid West Africa	East Africa
Root Crops	41.4	29.6	19.1	18.6
Cereals	26.7	38.9	49.0	48.5
Pulses	4.9	1.5	3.5	3.8
Fruits & Vegetables	6.2	7.7	2.0	4.4
Oil Crops	10.4	12.7	13.3	9.1
Livestock products	3.2	3.7	4.5	6.4
Other products	7.2	5.9	7.7	9.6
Total	**100.0**	**100.0**	**100.0**	**100.0**

Source: Diop (1998).

Table 1.3 shows that tropical root crops may supply from as much as 56% of the total daily calorie (energy) intake in DR Congo to as little as 7% of the total daily calorie intake in Jamaica. In Ghana, roots and tubers constitute 43% of total calorie intake per day as compared to 19% in Nigeria. Yam contributes more than 200 dietary calories per capita daily for more than 150 million people in West Africa (See ANB-BIA Supplement, 2003).

Table 1.3: Share (%) of dietary components of total energy consumption for selected countries (2001-2003)

COUNTRY	Cereals (excl. beer)	Vegetable oils	Sugar & Sweeteners	Meat & Offals	Roots and Tubers	Milk, Eggs & Fish	Fruits & Vegetable	Animal fats	Pulses	Others
Ghana	29.2	5.2	2.6	1.4	42.7	2.9	10.4	0.2	0.2	5.3
Nigeria	45.4	12.3	4.1	1.6	19.3	1.4	4.8	0.3	3.3	7.6
DR Congo	19.8	8.2	1.8	1.2	56.3	0.8	3.8	0.1	2.1	5.9
Côte d'Ivoire	40.8	12.4	4.1	2.1	24.1	1.8	7.8	0.1	0.2	6.4
Togo	49.5	9.5	2.3	1.7	26.9	1.4	1.3	0.2	3.0	4.4
Jamaica	33.7	10.8	19.4	8.8	6.7	4.1	7.9	2.0	1.0	5.6
Cameroon	40.2	8.0	4.4	3.2	18.0	2.5	9.1	0.3	5.9	8.5

Source: FAO Statistics Division, 2009 (www.faostats.com; accessed in January, 2009).

According to Scott *et al* (2000), the total use of roots and tubers in developing countries is projected to increase by 58 percent (by 232 million tonnes to 635 million tonnes) between 1993 and 2020. Cassava's share of the increase will be 44 percent, potato's 29 percent, and the remaining 27% will be the share of yam and sweet potato.

Table 1.4 shows the different levels of staple food consumption in sub-Saharan Africa. Root crops contributed about 78% of the total calorie intake in the Group I region of sub-Saharan Africa, which is mainly in the tropical rain forest belt; and about 43% of the total calorie intake in Group II area. However, in the more arid zone in Group III cereals were more prominent. The FAO country classification lists Group I members as Central African Republic, Congo and Mozambique. In these countries, both production and consumption patterns were dominated by root crops (mainly cassava), which accounted for over 50% of staple food consumption. Group II members include Angola, Benin, Burundi, Cameroon, Comoros, Equatorial Guinea, Gabon, Ghana, Cote d'Ivoire, Nigeria, Rwanda, Tanzania, Togo, and Uganda. A far more divergent consumption pattern is prevalent in this group. While roots and plantains are the main staple foods, cassava consumption is much less important here than in Group I. Included in Group II are countries typical of the West African yamproducing belt. Per capita yam consumption in this group is thus far higher (72.4Kg/annum) than Group I members (6.6Kg/annum) and Group III members (3.5Kg/annum). In Group III, where cereals play far greater role in consumption, the countries include Botswana, Burkina Faso, Cape Verde, Chad, Ethiopia, Gambia, Guinea, Guinea Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Namibia, the Niger, Reunion, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, Sudan, Swaziland, Zambia, and Zimbabwe.

Table 1.4: Levels of consumption of staple foods in sub-Saharan Africa, 1981 - 1983

Food Staple	Kg per caput/Annum				Percentage (in Calorie Equivalent)			
	Group I	Group II	Group III	Total	Group I	Group II	Group III	Total
Starchy staples	453.4	274.0	45.1	205.1	78	49	9	39
Cassava	407.4	123.0	21.3	117.8	70	22	4	24
Yams	6.6	72.4	3.5	36.8	1	14	1	7
Sweet potatoes	6.6	20.3	5.0	12.5	2	3	1	2
Plantains	26.2	39.1	2.0	22.7	4	6	-	4
Others	6.6	19.2	13.3	15.3	1	4	3	2
Cereals	39.7	83.8	134.1	98.3	22	51	91	61

Source: FAO, 1987.

In 1981, per capita consumption of yam in Colombia was found to be higher in the rural areas (5.9 kg/year) than the urban areas (2.8kg/year) when quantity eaten from own production were valued (See Sanint *et al*, 1985). According to Gebremeskel and Oyewole (1987), yam accounted for 55.3% of total root and tuber consumption in West Africa and 4.1% in Central Africa during 1975 – 1984.

They further showed that average per capita consumption of yam was 99.4Kg/yr in W/Africa and 10.5kg/yr in C/Africa. Nweke *et al.* (1989) noted that in southeast Nigeria, people in major food producing rural areas consume 757 calories per capita per day from yam, compared to 345 calories from cassava, 298 calories from rice, 185 calories from wheat, and 149 calories from grain legumes, with lower but comparable figures in urban areas.

There are two broad groups of consumers of roots and tubers; these are rural and urban consumers. For rural consumers, who cultivate staple crops in a subsistence-oriented traditional production system and are largely self-sufficient, the choice of food is often determined by the opportunities for diversification of agricultural production in their areas. Urban consumers, over time, have developed a preference for more convenient foods due to the availability and convenience of low-cost imports of rice and wheat, limited time for food preparation as a result of pressure from work and the high opportunity cost of time in urban areas, as well as increased cash income and purchasing power. The essential difference between these two groups is that in rural areas farmers produce for their own consumption, and exchange any surplus with their neighbours or sell in their local market for extra income. The urban consumer, however, buys most of his requirements and often considers roots and tubers difficult to store, sometimes wasteful because of spoilage and inconvenient to prepare and use when compared with the availability of cheaper food imports and the increasing prevalence of convenience foods (Diop, 1998).

Table 1.5 shows that Ghanaians consume more yam than Nigerians on per capita basis; whereas the average Ghanaian consumes a little more than 110kg of yam per annum, the average Nigerian consumes less than 80kg of yam per annum.

Table 1.5: Yam consumption in Ghana and Nigeria (kg/caput/year)

Country	2000	2001	2002	2003
Ghana	114.00	119.00	116.00	114.00
Nigeria	79.00	77.00	76.00	74.00

Source: FAO Statistics Division, 2009 (www.faostats.org; accessed in January, 2009).

In Nigeria, although cassava as dry gari is consumed more in the urban areas than in rural areas the reverse is true with yam, probably because of the high expense of transporting fresh yams and the ease of preparing meals using dried gari, which is of great convenience to urban workers (Oke, 1990). Per

capita consumption of yam is high in rural Nigeria than urban centers. In Ghana, however, yam consumption level in urban areas is higher than that in rural areas. Per caput yam consumption per day in urban communities in Ghana was found to be more than double the consumption level in rural areas (Oke, 1990). The level of consumption is dependent on the locality of the study. In the forest belt for instance, communities will depend more on roots and tubers like cassava and cocoyam; however, in the savanna and transitional belt, communities will depend more on cereals and yam. Since many households in these areas produce their own food, what they eat will hinge critically on the production possibilities in the locality.

The demand for food in large urban areas has increased and is continuing to increase due to the large population migration from the rural areas, which has continued for three decades and shows no signs of abating (FAO, 1987). The migrating rural population takes with it its traditional eating habits, particularly until it becomes urbanized. High transportation cost due to bad road network linking producing and consuming centers and the bulky nature of yam leads to high marketing costs and high consumer prices. As a consequence, in urban communities the consumption of root crops tends to be replaced by imported cereals like rice and wheat flour (Ibid).

Table 1.6 shows the average per capita food expenditures and food budget shares for households in rural and urban Ghana.

Table 1.6: Average per capita food consumption and food budget shares by locality in Ghana

Food Group	Cash Expenditure (GH¢)[1]	Value of home produced food (GHC¢)	Total (GHC¢)	Food budget share (%)
Urban Centers				
Food and beverages	*67.57*	*2.92*	*70.51*	*97.2*
-Cereals and cereal products	10.34	0.312	10.65	14.7
- Roots and tubers	9.69	1.92	11.61	16.0
- Other food and Beverages	47.56	0.69	48.25	66.6
Total Food Consumption	**69.47**	**2.96**	**72.42**	**100.0**
Rural Areas				
Food and beverages	*30.91*	*17.21*	*48.13*	*96.4*
-Cereals and cereal products	4.79	1.97	6.76	13.5
- Roots and tubers	4.00	11.85	15.85	31.7
- Other food and beverages	22.13	3.39	25.52	51.0
Total Food Consumption	**32.76**	**17.26**	**50.02**	**100.0**

[1] *Ghana Cedis (GH¢) is name of the Ghanaian Currency (exchange rate: US$1.00 = GH¢ 1.20).*

Source: Ghana Statistical Service, 2000.

Per capita cash expenditure on roots and tubers in Ghana in the year 2000 was estimated at GH¢9.69 in urban centers and GH¢4.00 in rural areas. However, the value of home produced roots and tubers was far higher in rural areas (GH¢ 11.85) than in urban areas (GH¢ 1.92). When own production and purchased foods were put together, rural households in Ghana consumed more roots and tubers by value (GH¢ 15.85) on per capita basis in the year 2000 than urban households which consumed GH¢ 11.61 worth of root and tubers. On the average, urban consumption levels of staple foods are lower than in or sub-urban areas and non-staples tend to dominate urban diets.

1.5 Organization of the dissertation

This dissertation is organized into six chapters. The first chapter provides the background to the study. In this chapter information on yam as a staple crop, its production and consumption are discussed under separate sub-headings.

An extensive review of the theoretical and empirical framework of the study is provided in Chapter Two. This chapter gives the existing body of knowledge regarding the economic theories underpinning the relationship between personal, household and socio-cultural factors on one hand, and household food consumption on the other hand. The chapter also discusses empirical results from some household food demand studies in the light of the theoretical literature provided. The general research issues, which center on the research problem conceptualisation, research questions, objectives of the study and the hypotheses tested as well as the justification for the study, are provided in the last section of Chapter Two.

Chapter Three deals with the study area and the research methodology for the study. All the data issues relating to types, sources, sampling technique, and data collection methods are discussed in this chapter. An extensive review of literature on the various econometric models used for consumer behaviour analysis is found in Chapter Three. The strengths and weaknesses of the various nonflexible and flexible functional forms of applied econometric models have been provided to form the basis for the choice of model in this study. Chapter Four deals with the description of the characteristics of respondent households. Also, a descriptive analysis of household food consumption expenditures with special emphasis on yam budget share is provided.

The empirical results from the econometric analysis are presented and discussed in Chapter Five. Results for the aggregate model are discussed before the estimates for the specific urban centers and seasonal models are examined. Chapter Six concludes the study with the summary of findings and recommendations.

1.6 Chapter Summary

Chapter One has given an introduction to the study by providing the background to the study and an overview of yam as a major staple crop in Ghana, its production, and importance in the food economies of producing countries. This has set the stage for the review of the theoretical and empirical framework for the study which is the subject matter of the next chapter. After the review of the theoretical and empirical framework, the research issues (i.e. problem statement, research questions, study objectives, hypotheses and justification) are addressed in Chapter Two.

CHAPTER TWO

2.0 THEORETICAL, EMPIRICAL AND CONCEPTUAL FRAMEWORK OF THE STUDY

2.1 Broad framework

The analysis in this study was approached from the point of view of a cooperative bargaining household model. There are two general classes of household models, namely: income pooling and bargaining models. The income pooling models assume that household demand (or expenditure share) is not affected by the identity of the individual that earns the income. The effective constraint on the household welfare function is the quantum of pooled household income. On the other hand, the bargaining model throws away the income pooling assumption and allows for the explicit effect of distributional factors on demand or expenditure share (See Adebayo, 2004).

Income pooling models are of two types – unitary/common preference models and collective/individual preference models of the household. The unitary model (which is a restricted form of income pooling models) assumes that the preferences of household members are uniform or that the preference of just one household member (the household head or dictator) is imposed on all other members. The unitary household thus maximizes a welfare function whose only component is the utility function of the dictator or household head. On the other hand, the collective model allows for a more general formulation of the household welfare function while still accommodating income as the pooling restriction. Unlike the unitary model, the collective model allows for differences in preferences between actors within the household (Adebayo, 2004).

In the set of collective preference models, household welfare function is defined as:

$$U^h = \sum_{i=1}^{I} \varphi_i U_i \qquad (2.1)$$

where:

$i = 1 \ldots\ldots I$, and $\varphi_i = K$;

where: U^h is the household welfare function, U_i is individual *i*'s utility function in a household with *I* individuals. φ_i is the welfare or Pareto weight attached to the utility function of each individual *i*, and *K* is a vector of constants with *I* elements whose values range between 0 and 1.

By characterization of this model, φ_i is fixed and does not vary with changes in factors that affect resource control power (also called distributional factors) within the household such as individual income, assets, and schooling. Adebayo (2004) noted that changes in distributional factors do not affect the relative expenditure share on goods in a collective model. It is assumed that φ_i is set from marriage and does not change throughout the lifetime of the household. So the collective model results in a demand system derived from a Pareto optimal allocation with a fixed φ_i vector. There is no movement along the utility possibility frontier of the household, since only one point on the contract curve (the contract curve is a locus of Pareto optimal allocations for the household) is relevant. The prediction of the collective model is that income changes only affect household demand directly through the Slutsky income effect and not through the power sharing factor in the household welfare function. The unitary model is a special case of the collective model where $\varphi_i = [1, 0]$, given that i = 2 (ibid).

The second broad class of household models is the non-income pooling or bargaining model. This is the model that is assumed for the analysis carried out in this study. The bargaining model throws away the income pooling assumption of the collective model and allows for the explicit effect of distributional factors on household demand or expenditure levels. The model specifically assumes that $\varphi_i \neq [1, 0]$ and that $\varphi_i \neq K$. Thus, the whole range of utility possibility frontier is the set of feasible Pareto optimal allocations for the decision-making environment characterized by bargaining. In this model, changes in power sharing or distributional factors are expected to lead to changes in φ_i and the changes in φ_i are in turn expected to result in changing demand pattern or expenditure shares. Thus, the bargaining model predicts that income changes affect demand both directly (through the Slutsky income effect) and indirectly (through the power sharing factor, φ_i).

Assume that a household is made up of a man (m), a woman (f), and other members who are nonincome earners (c); individuals in the household have differentiated preferences; and household income is not pooled. Suppose that each individual in the household derives utility from two composite goods: calorie/energy producing good, C, and non-calorie producing good, Q. Calorie itself cannot be purchased but its intake depends on the amount of food item X_j consumed. The amount of food item, X_j, consumed in turn depends on its price, P_j, and a number of tastes factors such as characteristics of the individual (γ^i) and household level characteristics (γ^h). It is assumed that the Pareto/welfare weights of the man, φ^m, and the woman, φ^f, sum to unity, implying that other members of the household, (c), who have no bargaining power have Pareto weights $\varphi^c = 0$. Also the household income, Y^h, is the sum of the individual incomes of the man, Y^m, and the woman, Y^f. Given a particular level of household income, higher levels of Y^f would imply higher bargaining power for the woman or higher φ^f. Thus φ^f is a function of the distributional/power-sharing factor Y^f/Y^h.

The household solves the maximization problem stated in expressions 2.2 to 2.7:

Maximize $U^h = \varphi^m U^m(C, Q) + \varphi^f U^f(C, Q)$ (2.2)

Subject to:

$Y^h = p_j X_j + Q$ (2.3)

$Y^h = Y^m + Y^f$

(2.4) $C = C(X_j, \gamma^i, \gamma^h)$

(2.5) $\varphi^i \neq K$; where K is a constant and i = (m, f)

(2.6) $\varphi^f = \varphi^f(Y^f/Y^h)$, and $\varphi^m = (1 - \varphi^f)$

(2.7)

From this constrained maximization problem, Adebayo (2004) derived an optimal demand function for food consumption/calorie intake as a function of prices, household income, a power sharing or distributional factor, individual factors and household level characteristics. The implicit household consumption model is therefore specified as:

$$C = C\,[(X_j(p),\ Y^h,\ \varphi^f(Y^f/Y^h),\ \gamma^i,\ \gamma^h)] \qquad (2.8)$$

2.2 The theory of consumer behaviour

Loudon and Bitta (1993) define consumer behaviour as the decision process and physical activity individuals engage in when evaluating, acquiring, using, or disposing of goods and services. Consumer purchase decisions appear to be based on a combination of economic and sociological factors and they could therefore be better understood if the concepts of the two disciplines are combined for the purposes of analysis. Consumers around the world vary tremendously in age, income, educational level and taste, among other factors and therefore buy an incredible variety of goods and services to satisfy their needs (see Gary and Kotler, 2000).

According to Kinsey (1988), because majority of people in developing countries have low disposable incomes and because conditions of supply and demand are very different, it is assumed that physiological needs (e.g. food and water) are predominant in developing countries. She however pointed out that this may not always be the case because of people's self-concept and the cultural values and beliefs individuals subscribe to. Walter (1974) asserted that the poorer the economic outlook, the more important the small luxury of a flavoured soft drink or perfumed soap. He emphasized that to the dismay of the would-be benefactor, the poorer the malnourished are, the more likely they are to spend a disproportionate amount of whatever they have on some luxury rather than on what they so desperately need (i.e. physiological needs). The implication is that even though poorer people are supposed to spend more money on their physiological needs, certain cultural and economic factors can compel them to purchase some luxuries they may not desperately need. Thus, consumer behaviour can sometimes be too complex to be predicted.

The household's consumption function gives the maximum amount of commodities consumed as a function of product price, income and some qualitative socio-cultural factors (Varian, 1990). Actual consumer behaviour is multidimensional and very complex. When a consumer goes shopping, his concern is not limited to how much of one good to buy; rather he must decide which of many available goods to buy at their respective prices. Thus, the presence of different yam products on the market and

the differences in preferences among household members complicates yam consumption decisions of the household. In all cases, the consumer wants to get maximum satisfaction from his available income. According to Schiller (1997), the economic explanation for consumer choice builds on the theory of marginal utility and the law of demand.

Another postulate of consumer-choice theory takes into account the market prices of goods that are desired by consumers. Thus, rational behaviour requires one to compare the anticipated utility of each expenditure with cost and to choose those products that promise to provide the most pleasure for the amount of income available. Varian (1990) argues that the key to utility maximization is not simply buying what one likes best; instead, one must compare goods on the basis of their marginal utility and price. To maximize utility, the consumer should choose that good which delivers the most marginal utility per cedi. Optimal consumption refers to the mix of products that maximizes total utility for the limited amount of income one has to spend. The basic approach to utility maximization is to purchase the next yam product that delivers the most marginal utility per cedi. Varian (1990) concludes that all goods included in the optimal consumption mix yield the same marginal utility per cedi. From the first order condition for utility maximization, the utility-maximizing rule is to satisfy the condition where the marginal utility per cedi derived from one yam product is the same as that derived from consuming another yam product in the consumption basket of the consumer. In other words, a cedi spent on one yam product must yield the same marginal utility as that obtained when a cedi is spent on another yam product. This condition gives the greatest satisfaction from the limited income of the consumer.

2.3 The theory of consumer demand

A 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 Ault, 1995). Given any available set of bundles of products, the consumer chooses that bundle which maximizes his utility or satisfaction. Thus, consumer's demand for a good is the quantity chosen as a result of this utility maximization, which is also dependent on precisely what sets of bundles of goods are available. According to Henderson and Quandt (1986), commodity prices and consumer income are the main determinants of the demand level for a commodity. McKenna and Rees (1992) also noted that prices, consumer income and preferences (i.e. tastes, habits, desires and drives) interact to determine the individual demand function. According to them, the 'law' of demand is a fundamental economic principle, which indicates that a decrease in the price of a commodity results in an increase in the

quantity of the commodity that buyers are willing and able to purchase in a given period of time, if other factors are held constant. Tambi (1995), in static and dynamic demand analysis, also found that income, own-price, prices of substitutes, and previous consumption are the important determinants of household beef consumption patterns in Cameroon.

Apart from product price, prices of substitutes and income, certain household and socio-cultural factors play very significant roles in shaping household consumption patterns. Household factors such as household size/number of dependants, age, gender and socio-cultural factors such as religion, tribal/ethnic affiliation, educational background, and occupation, among others, affect consumption pattern (Lipsey and Crystal, 1999). According to Gao and Spreen (1992), socioeconomic variables also have significant impacts on consumer demand for commodities. In their analysis of consumer demand for meat products, it was shown that the most significant household characteristic variables include region of residence, ethnic background, household size, female household head employment status and away-from-home food consumption.

Demand is defined as the quantities of goods and services people are willing and able to buy at alternative prices in a given time period (see Marshall, 1920; Schiller, 1997). For the ultimate buyer of food, demand could relate retail prices to amounts that will actually be consumed within a given time frame. Purchases essentially reflect the demand for immediate consumption and the inclination of consumers to restock their shelves or freezers when prices are particularly attractive or reduce inventories when prices are high. On the other hand, ***consumption*** is defined as the quantity of a particular commodity consumed or amount spent on the commodity by the household in a specified period. Often, consumption of food items is expressed in terms of three different measures: weight of food items consumed, expenditure on different food items, and nutritive value of food items expressed in terms of calories, proteins, fats, and other vitamins and minerals (George and King, 1971). When we are interested in the demand for an individual commodity, the most appropriate measure of consumption would be the quantity of the commodity being used. However, when aggregates of individual commodities are being dealt with, it will be difficult to aggregate different commodities if they are expressed in physical units. In such a case, we have to convert the quantities to comparable units. In this situation, it becomes convenient to measure demand in terms of expenditure or nutritive values. In this study, yam consumption refers to the amount spent on yam products by the household

in a given period, say a week or month. Measurement of yam consumption in nutritive value terms is beyond the scope of this study as that might require some chemical analysis.

2.3.1 Income

It is important to note that desire is only the first step in the consumption process. To acquire the product one must be willing and able to pay for one's wants. Producers will not give you their yam products just because you want to satisfy your household food needs. Producers want money in exchange for their products. Income is therefore as relevant to consumption decisions as are basic desires and preferences. Hence, in explaining consumer behaviour, economists focus on the demand for products and services, which entails both the willingness and ability to pay for them.

National income statistics suggest that there is a close relationship between consumption expenditure and the level of disposable income (Dernburg and McDougall, 1972). According to Keynesian economics, the level of disposable income principally determines aggregate consumption expenditure. According to Baker (1981), having income or purchasing power implies having a choice not only between products but also between different versions/brands/varieties of the same product. As income rises, the proportion spent on basic necessities like food products tends to fall whereas the proportion of consumers' expenditure devoted to services and durable goods tends to rise (see Stanlake, 1989). He observed that the most obvious limitation on consumption is the level of income, stressing that in the long run, most people cannot consume more than their real income. In the short run, however, there is the possibility of supplementing one's income by borrowing; but such debts have to be repaid so that a borrower, in the future, must spend less while the debt is repaid. Therefore, in the long run income provides the upper limit in the ability to consume.

Markets are made up of people with money to spend and thus consumer spending patterns are related to income (Jerome and Perreault, 1991). They indicated that consumer budget studies show that most consumers spend their incomes as part of family or household income. It is worthy of mention that a family's purchase of luxuries comes from discretionary income (income after paying taxes and paying for basic necessities). In view of this discretionary income, which varies from family to family and over time, is an elusive concept particularly in the determination of expenditure on necessities, such as yam products.

It is normal for a person to wish to eat until his appetite is completely satisfied. If his income is so low that he cannot afford his desired level of food consumption, any increase in income is likely to be spent mainly on food. On the other hand, at high income levels, food consumption becomes a less important factor in the individual's budget and any increase in income will not lead to an increase in the quantity of food consumed although it might result in extra expenditure through the purchase of better quality food (Baker, 1981). That is to emphasize that when incomes rise consumers could afford to switch to more expensive and superior substitutes.

Consumer income has a significant effect on the quantity of goods demanded and consumption pattern, for that matter. A rise in consumer income shifts the demand curve for "normal" products to the right; indicating that more will be demanded of that product at each possible price. However, for "inferior" goods, a rise in consumer income leads to a reduction in their purchases (i.e. the demand curve will shift to the left). Thus, the income elasticity of demand for normal goods is positive whereas that for inferior goods is negative (see Lancaster, 1971; Mansfield, 1989; and Walton and Wykoff, 1998). Henderson and Quandt (1986) however noted that the income elasticity of demand for a commodity is likely to vary with the level of income under consideration. For example, if only families at the lowest income levels are considered, the income elasticity of demand for even well known inferior goods can be positive. It must be emphasized that the economic terms of "normal" and "inferior" imply no 'value judgment' on the items they categorize. In other words, the nutritional value or content is not considered in classifying food commodities into inferior, normal or luxury goods; rather, the response of consumers to the demand for these commodities when their income increases is considered.

A wide range of empirical literature has provided evidence that the level of per capita calorie intake has a strong positive but non-linear relationship with household income, after controlling for household and demographic variables (for example, Bouis and Haddad, 1992; Subramanian and Deaton, 1996; and Grimard, 1996). The work by Bouis and Haddad (1992) presented results of 30 investigations into calorie-income elasticity between 1979 and 1991. The range of calorie-income elasticity estimates for those who used calories from food expenditures was 0.22 – 1.18, while estimates from studies that used calories from 24 hour recall of quantity intake range between 0.01 and 0.37. Subramanian and Deaton (1996) estimated calorie-total expenditure elasticity of between 0.3 and 0.5 for households in rural Maharashtra in India. Grimard (1996) reported the

calorieexpenditure elasticity for urban Pakistan to range between 0.51 and 0.25 for low to high-income households respectively and 0.62 to 0.35 for the rural sector. Prior to 1987, calorie-income elasticity for low-income populations throughout the developing world was estimated to be between 0.4 and 0.8 (Boius *et al*, 1992; and Boius, 1994). Thus, income increases for the poor as a food policy strategy has received strong justification in that it is expected to reduce malnutrition (Alderman, 1986). However, Behrman and Deolalikar (1987, 1990) analyzed data for India, and found calorieincome elasticity estimates that were not significantly different from zero. They concluded that the linkage between income and nutrient consumption is weak and that nutrient improvements should not be expected with income gains in low income communities. This was a follow-up on Wolfe and Behrman (1983) who found calorie income elasticity in the neighborhood of 0.01 for household sample collected from Nicaragua. The weak relationship between calorie intake and income is supported by the findings of Bouis and Haddad (1992) who estimated calorie intake-total expenditure elasticity ranging between 0.08 and 0.14 with four different estimation techniques using a sample of Philippine farm households. Bouis *et al* (1992) argue that several studies after Behrman and Deolalikar (1987) reported calorie-income elasticity estimates which are in most cases, lower than 0.2 (also see Behrman and Deolalikar, 1990; and Adebayo, 2004).

The conventional school of thought which supports the traditional view that calorie-income elasticities are sizeable at least among low income households argue that recent low estimates of calorie-income elasticity in households could arise from two sources. First is the frequent use of *current income* as a measure of wealth rather than *permanent income* (Behrman and Deolalikar, 1990), while the second is measurement error in income and expenditure. Current income is a very 'noisy' (i.e. it may overstate or understate the real wealth or income level) measure of the wealth flow into a household and this enlarges/diminishes the value in the denominator of the regression coefficient estimator. The permanent income hypothesis posits that individuals or households base their consumption decisions on their permanent income *(constant stream of income over a relatively longer time period)* and thus, consumption does not increase with a transitory increase in current income. The covariance between current income and food consumption is believed to be lower than that between permanent income and food consumption (Behrman and Deolalikar, 1990). A major problem associated with data collected in developing countries is the difficulty in obtaining accurate data on income and expenditure. The major reasons for this are: the disproportionately large informal sector with little or no formal income and expenditure records, and the general view that detailed information on personal

income is private and that this privacy should be protected from second parties including members of the same household (Adebayo, 2004). To reduce biases in estimation, per-capita expenditure is used in place of current income since it is a better proxy for permanent income (Adebayo (2004). Furthermore, the use of per capita expenditure as proxy for income reduces measurement error in income since it is easier to get information on expenditures than on income in developing countries due to the sensitive nature of the latter. To further reduce the magnitude of error in his study, Adebayo (2004) used income, expenditure and quantity/calorie intake values, which are averages over 12 fortnightly visits to each sample household. In the light of the foregoing, per capita household expenditure was used as the proxy for household income in this study and the data used for analysis were averages over four quarters of a complete year cycle.

A socio economic survey conducted in Indonesia in 1980 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 (Cock, 1985). A similar result has been observed in Brazil where the elasticity of demand for cassava is positive at low income levels and decreases at higher income levels, and in Ghana where there is no further tendency for the consumption to increase as per caput income increases to levels well above subsistence (FAO, 1990). With some root crops, especially yams, the study found that consumption tends to increase with rising income, as yams are relatively expensive. Tsegai and Komawa (2002) also found yam to be a luxury commodity with expenditure elasticity of 1.30 for all households (low and high income groups combined), 1.21 for low income earners and 1.56 for high income earners.

In view of the difficulty in obtaining accurate information on incomes especially in developing countries, per capita household expenditure was used as a surrogate for household income. To obtain the per capita household expenditure, total household expenditure per month was divided by household size.

2.3.2 Commodity prices

Product characteristics such as own price and price of substitutes have effects on yam consumption patterns. The quantity demanded of some commodities is fairly sensitive to changes in the commodity's price. That is, changes in own price results in significant changes in quantity demanded

(see Mansfield, 1989). Price elasticity of demand is expressed in terms of relative (i.e. proportional or percentage) changes in price and quantity demanded. Even though it is generally assumed that demand curves are negatively sloped, there are exceptional cases in which the relationship between demand and commodity price may be positive. In the case of ostentatious consumption the demand function may have a positive slope if the consumer derives utility from a high price.

When price is raised or lowered, the effect may be either an increase or a decrease in the amount spent on a commodity depending on the price elasticity of demand for the commodity in question. If the demand for a commodity is price elastic, the total amount spent on it will increase when the price is reduced and vice versa. However, in a case where the demand for a commodity is unitary elastic, a price increase or decrease results in no difference in the total amount spent on the commodity. This is so because a price decrease (increase) of a certain percentage always results in a quantity increase (decrease) of the same percentage so that the product (multiplication) of the price and quantity is unaffected. A numerically large value for elasticity implies that quantity demanded is proportionately very responsive to price changes (see Ekelund and Ault, 1995, and Henderson and Quandt, 1986). Baumol (1965) noted that if a demand curve has elasticity less than unity (i.e. inelastic), a rise in price will increase consumer expenditure, and if the curve has elasticity greater than unity (i.e. elastic), a fall in price will increase consumer expenditure on the commodity in question.

The prices of substitute products also affect the demand for a particular commodity. Two commodities are substitutes if both can satisfy the same need of the consumer. A rise in the price of a substitute increases the demand for the competing product while a decrease in the price of the substitute causes a reduction in the demand for the competing product (Theil, 1975). Prager (1993) also noted that the price of a substitute product is directly (positively) related to the quantity demanded of a product and if a commodity has many close substitutes, its demand is likely to be highly elastic. This is because if the price of a product increases, a large proportion of its buyers would turn to the close substitutes that are available. On the other hand, if its price decreases a great number of buyers of substitutes will switch to this product thereby increasing the demand for the product. The decision to buy less of one good depends in part on the availability of other products, which serve as substitutes (Schiller, 1997). Consumers have different tastes and preferences for the various varieties of yam and the other root crops. Consumers who purchase and consume expensive yam varieties or root crops are likely to spend more than those who consume relatively cheaper products, given that quantities consumed remain

unchanged, implying higher elasticities for the former group than the latter group. Since availability of close substitutes for yam varies across the season, it may imply that elasticity will also vary across the season.

Even though economists maintain that when a product becomes cheaper a greater quantity is demanded, Evans (1992) contended that whilst this generalization has a lot of truth in it, there are some exceptions. He noted that some individual customers and consumers often regard price as a mark of quality and in some situations more is purchased at higher prices. He stated further that in some situations, when delivery or immediate possession is an urgent requirement or where a particular price level is perceived to be the 'going rate,' price becomes relatively unimportant in the buying and consumption process. In the specific case of yam, the commodity may be urgently required towards the end of the 'hunger' season (i.e. commencement of the harvest season) and thus price may be relatively unimportant and hence price elasticity may be low.

Tsegai and Kormawa (2002) found yam, cassava tuber and gari to be strong substitutes in Nigeria in their study to examine the determinants of urban household demand for cassava and cassava products. The cross price elasticity between cassava and yam was found to be 1.024 and that between yam and gari was estimated at 0.835. Potato and cocoyam were found to be weak substitutes for yam with cross price elasticities of 0.107 and 0.451 respectively. The study found an inverse inelastic relationship between own price of yam and yam consumption (own price elasticity of yam was 0.21 for low income earners, 0.78 for high income earners, and 0.72 for all households). With the exception of yam, low-income households seem to be highly responsive to changes in prices of root crops than high-income households. In the case of cassava tuber, its demand by the rich is less sensitive to its market price, probably because the share of cassava to total food expenditure is lower and therefore it is not as important to the rich as it is to the poor. In the case of yam, the study showed that price responsiveness is higher for richer households reflecting its importance for the rich. This implies that high income earners are more likely to benefit from lower yam prices through increased production/supply. However, since prices will come down, low income households would also benefit a great deal as yam will become affordable.

2.3.3 Personal and household characteristics

Buyers' decisions are influenced by personal characteristics such as age, gender, and educational level (Gary and Kotler, 2000). Household factors like household size, number of dependants (<15 and >60 year olds) in household, number of household members in full time employment, number of women in household and their employment status also influence household consumption patterns.

2.3.3.1 Age

Consumption decisions are shaped by the age of the consumer. Gary and Kotler (2000) asserted that marketers often define their target markets in terms of lifecycle stage and develop appropriate products and marketing plans for each age group. Jerome and Perreault (1991) also noted that young people spend more on basic necessities than the aged who spend a lot more on durable consumer goods. Empirical work shows that age influences consumption demand in a nonlinear fashion (e.g. Blisard *et al*, 2003). According to these authors, the inclusion of the age variable in household consumption models could be justified on the grounds that it may capture changes in purchase behaviour due to the changes in the consumer's biogenic and psychogenic needs over the life cycle.

Blisard (2001) expanded aggregate lifecycle expenditure analysis by separating generational or cohort effects from aging effects. This is important since different generations or age groups may exhibit expenditure patterns that are the result of higher incomes and/or different tastes and preferences. Ignoring these generational effects produces income and consumption age profiles that can be misleading. With accurate consumption and age profiles, policymakers can gain a better idea of food intake patterns by cohort, and thereby identify groups that may need additional diet and health information. Using survey data to follow eight cohort groups from 1982 through 1995, Blisard (2001) found that all food categories (except for vegetables and sugar & sweets) have statistically significant cohort effects; younger cohorts spend less than older cohorts on food at home, meat, poultry, fish, eggs, and dairy products, but more on cereal and bakery goods because of higher energy demand resulting from higher level of activity. A recent study set out to determine the extent to which food consumption patterns in childhood changed in young adulthood showed that at age 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. There was higher percentage of young adults consuming cheese, more sweetened beverages and seafood than they did in childhood (Frost and Sullivan, 2004). These empirical findings notwithstanding, for yam products one does not expect a total shift to or from the commodity with increasing age since it is a major staple food commodity in Ghana. However, in this study an attempt was made to disaggregate the data according to age profile to examine how age differences influence yam consumption patterns in urban communities.

2.3.3.2 Gender

Gender of the consumer influences his purchasing decisions and hence consumption expenditure on goods and services. Evans (1998) noted that males and females have different purchasing and spending patterns due to differences in their needs and wants. It was noted that whereas males are normally concerned about capital expenditures as well as away-from-home food expenditures, females are mostly interested in the purchase of clothing, cosmetics, and most importantly food for the home, among other things.

Adebayo (2004) noted that studies that investigate the effect of variation in household resource control pattern on household consumption patterns in developing countries are not common, due to lack of gender disaggregated household level information on income, expenditure and consumption. Hopkins *et al* (1994) found that in Niger changes in female annual income, while controlling for male income, impacted positively (though marginal) on household food expenditures. These results, they noted, hold for both earned and unearned income (e.g. remittances and gifts). Hoddinott and Haddad (1995), using data from Ivory Coast, found a positive but small marginal effect of women's income share on household food budget share. They noted that a doubling of the proportion of household cash income received by wives would lead to a 1.9 % rise in budget share of food eaten within the household. Thomas (1997) on the other hand found in his analysis of Brazilian data that, the marginal effect of increasing women's income on food expenditure share was negative. He, however, found that household food calorie and protein intake respond more positively to increases in women's income than to increases in husband's income. This apparent paradox could suggest that males in Brazil spend more on other food commodities like fruits, vegetables, and food-away-fromhome whereas females spend more on carbohydrate and protein sources. The study concluded that the identity of the household member controlling income affects calorie and protein intake and hence height-for-age and

weight-for height of children. On the whole, the observed impact of women's income share on household consumption patterns is thought to be a reflection of genderdifferentiated preferences. The analysis in this study was therefore based on household consumption and expenditure data disaggregated by gender.

Since yam meal preparation can be time consuming (especially, *fufu*, fried and roasted yam), households with female heads who are not into full time employment may consume more yam. Male-headed households with mature females who are non-workers or part-time workers are also expected to have high expenditure on at-home yam consumption. Accordingly, this study incorporated number of females in household and females in full-time employment in the regression analysis to examine their respective effects on household yam expenditure.

In this study the proportion of household income controlled by women/females was estimated and related to household yam budget share. To obtain this variable, the sum of the monthly incomes of all female household members was found and divided by the total household income from all household members.

2.3.3.3 Education

The effects of education are widely researched in many advanced societies. However, classical works of the effects of education have tended to focus on the analysis of the financial returns to education. The measurements of increased wage compensation and increased total income are often strikingly conclusive (Bobby, 2004). The level of education is likely to affect the consumption patterns of households. The level of formal education is likely to be highly influential in either promoting traditional attitudes or introducing new attitudes towards product needs and wants (Jerome and Perreault, 1991). The higher the level of formal education and the more widely available it is, the more it will be an agent of change in the definition of wants and needs. As people become more conscious that a better standard of living is possible, new needs develop as old ones become satisfied (see Kinsey, 1988).

In a study to examine the effect of educational level on consumption in South Africa by Bobby (2004), the results of the regression analysis consistently revealed that an increase in educational level yielded

an increase in percent per capita expenditure for all expenditure categories investigated. The largest percentage increase was related to risk aversion expenditure (e.g. savings and insurance expenditures), while per capita food expenditure experienced the smallest magnitude effect. The regression analysis, while controlling for race, residence location, and per capita income, indicated a 1.7% increase in per capita expenditure for an increase in the educational level of a household. It was noted that these results might be a function of the nature of the goods being investigated. Savings and insurance expenditures usually involve discretionary spending, while food expenditure is essential to every household. Therefore, these results may suggest that increased education has more of an effect on non-essential goods expenditure in households than it has on essential goods. Since yam is an essential good, the educational level of household members is not expected to have much influence on household yam consumption.

2.3.3.4 Household size

Household can be defined as a group of people (or a social unit) who live together and eat from the same pot. The worldwide web defines a household to include all the persons who occupy a housing unit together with common housekeeping, sharing at least one meal a day, and occupying a common living or sitting room (*www.eia.doe.gov/nei/datadefinition/*; Accessed in May, 2008). Household size has relevant implications for household purchasing and spending behaviour (Jerome and Perreault, 1991). Households with large family sizes spend more on consumer goods than households with small family sizes, *ceteris paribus*. Evans (1992) emphasized that an understanding of household dynamics is important in consumer marketing as the household is the basic unit of consumption.

Even though the study by Gale *et al* (2005) found food to be the largest single expenditure item for rural Chinese people, larger households were found to spend more on non-food items. The presence of school-age children was associated with larger cash expenditures on education and less on food. Larger family size was therefore found to be associated with greater budget shares devoted to housing and education and less devoted to at-home food and other non-food expenditures. Sdrali (2006) noted that household size was a significant and positive factor in food expenditure, consistent with the results of Cage (1989) and Kalwij *et al.* (1998). These studies found food expenditure to be positively related to increases in the number of household members. The change in food expenditure increases at a decreasing rate as household size increases and becomes negative when household size becomes large.

Lazear and Michael (1980) estimate that the expenditures of two adults living together are 31-35% lower than a single-adult household using the U.S. Consumer Expenditure Survey (CES), with the largest savings on food and shelter expenditure and smaller savings on personal care. Deaton and Paxson (1998) present evidence of economies of scale in food consumption from a number of developed and developing countries. The observed economies of scale in food expenditures are particularly interesting and somewhat puzzling. Food itself is a private good which cannot be shared, but there is likely to be a substantial public component in preparing meals. Vernon (2004) noted that models that do not include time costs predict that at a constant per capita expenditure larger households save on public goods like housing and increase per-person expenditures on private goods like food. She, however, notes again that empirical evidence shows the opposite for both modern households and those observed a century ago by Engel (that per capita food expenditures fall as households grow). This seeming paradox was introduced by Deaton and Muellbauer (1980a) and extended by Deaton and Paxson (1998). Several subsequent studies have attempted to resolve it in a variety of ways. Gibson (2002) suggests that large estimates of economies in size may be due to a measurement error in recall expenditure data. Gan and Vernon (2003) show that food expenditures increase relative to another more sharable good and decrease relatively to a less sharable good, and therefore, the paradox disappears when subsets of expenditures are examined. Using household expenditure survey data from Russia, Vernon (2004) estimated the effect of changing household size on food expenditures and found out that doubling the size of a household causes the household to reduce per capita food expenditure by over 30%.

Although recent studies shed new light on the nature of household economies, the puzzle remains unresolved. Different studies have had mixed results and this study attempts to estimate household food budget share elasticity with respect to household size in the Ghanaian context with an important staple food (i.e. yam).

In this study household members are considered to be people who have continuously resided together and shared resources for at least a quarter of a year (i.e. three months continuous stay). It does not include members who only sleep but do not eat from the household. Members considered were those who ordinarily ate at least once a day or seven times a week from the household. However, members

who ate from the household (and were considered when food purchases were being made) but did not sleep in the house regularly were considered as household members in this study.

2.3.3.5 Occupation and away-from-home food consumption

Consumer's occupation affects the products he buys and consumes. Seyoum (1988) reports that results from consumer surveys in 1979 and 1981/82 in Cote d'Ivoire and Nigeria respectively indicated that clerks and wage earners are major consumers of milk products. Gary and Kotler (2000), in recognition of the effect of occupation on consumption, suggested that marketers should try to identify the occupational groups that have an above-average interest in their products and target them as separate market niches.

Collaborative survey work by IFPRI and the University of Ouagadougou revealed that urban rice consumption is especially sensitive to work patterns in the urban household. As women enter the work force, and men work away from home, there is strong demand for staples that can be prepared quickly at low cost and that are available in roadside restaurants. Since rice meets both needs, urbanization appears to dominate price factors in explaining the shift toward rice (Delgado and Reardon, 2000). As household members eat away from home, the total at-home food consumption will decrease. Yam is bulky and meals that can be prepared from yam can be relatively time consuming. As a result, members of the working class who are bent on eating yam would prefer to take already prepared yam product away from home due to limited time at home. Therefore, a negative relationship between away-from-home food consumption and household expenditure on yam is envisaged. Also, household expenditure on yam is expected to be low for households with many full time employees. In Nigeria, although cassava as dry gari is consumed more in the urban areas than in the rural areas, the reverse is true with yam. This is probably because of the high expense of transporting fresh yams and the ease of preparing meals using gari, which is of great convenience to urban workers (Collis *et al*, 1962; and McFie, 1967). Also, longer shelf life of gari and the fact that it can easily be packaged and stored in the corner of a room, unlike yam, makes it a convenient commodity for the urban household.

Food consumed away-from-home is one of the fastest growing categories of rural household expenditures in China, doubling in budget share from 1995 to 2001 (Gale *et al*, 2005). It was noted in their study that food away-from home stands out as the one food expenditure item that is taking a larger share of household budgets as expenditure rises. In 1995, just 3.2% of rural food spending was

on food-away-from-home, but this share more than tripled to 11.2% in 2003. This study attempted to estimate household expenditure on yam away from home and how it influences at-home yam consumption patterns.

2.3.4 Cultural factors (ethnic and religious affiliation)

Culture refers to the values, ideas, attitudes and symbols that people adopt to communicate, interpret, and interact as members of a society. Kinsey (1988) described culture as one of the most significant factors that may be used to explain differences in consumer behaviour. She stressed that whilst basic needs are the same the world over, the drives to satisfy them are affected by the compulsion, checks and guidance systems, which originate from culture. Thus cultural overlay forms the foundation for all motivational differences between consumer groups. Gary and Kotler (2000) also stated that cultural factors exert the broadest and deepest influence on consumer behaviour. From the viewpoint of Bearden *et al* (1995), the concept of culture has two primary implications for marketing; it determines the most basic values that influence consumer behaviour patterns, and it can be used to distinguish subcultures that represent substantial market segments and opportunities. The ways in which culture directly affects needs and wants may be understood with reference to the major aspects of culture: ethnic and religious affiliations.

Ethnic groups may be formed around national, racial or geographical factors. Members of an ethnic group or tribe share similar values and patterns of behaviour, which make them attractive market targets for specific products or brands. Particular tribes may have certain beliefs about specific food products and this influences their decision to consume such foods or otherwise.

Food is an important part of religious observance and spiritual ritual for many different faiths, including Christianity, Judaism, Islam, Hinduism and Buddhism. The role of food in cultural practices and religious beliefs is complex and varies among individuals and communities. Religion, being the mainspring of culture, affects the type of products consumed by a certain group of people based on their belief and value systems. Because some products have traditional importance in many countries, religion might affect the consumption pattern of such products if taken to its logical conclusion. However, Kinsey (1988) contended that in reality, rarely are religious ideals taken to their ultimate conclusions. Also, there has been much watering down of traditional and religious beliefs through the

introduction of new values and products from other cultures. Nevertheless, Kinsey (1988) maintained that tribal and religious affiliations still affect tradition, superstition, taboos and perceptions and may help explain otherwise inexplicable consumer attitudes which determine how needs are fulfilled.

Heiman *et al* (2004) used data from Israel to analyze food consumption and showed that beliefs, lifestyle and ability to cook affect food consumption patterns. The intensity of belief was especially important and more devout followers of certain religions were seen to present unique market opportunities. They asserted that food purchases are largely affected by religious lifestyle and cultural factors, in addition to prices and income. This is because patterns of behavior vary among followers of different religions, resulting from different norms. Religious intensity affects attitudes towards food modifications. The intensity of religious beliefs was the most dominant explanatory variable when consumers were presented with the hypothetical choices between chicken fortified with hormones versus the same fortification through genetic modification, and between beef coloured through chemical dye versus genetic modification. While overall, 70 percent of the population preferred the genetic modification; the largest opposition came from the orthodox religious groups, from which 40 percent preferred the chemical treatment. Among the conservatives, 20 percent preferred the chemical treatment, while among the secular, only 10 percent preferred the chemical treatment (Heiman *et al*, 2004).

Yam is associated with a lot of traditional practices and ceremonies in most yam growing countries. It is therefore expected that tribal and religious affiliations of consumers will affect household yam consumption patterns.

The preceding subsections have provided the theoretical and empirical framework for the study and have set the stage for the conceptualisation of the research problem, objectives and hypotheses as well as the justification for the study, which form the subject matter of the next subsections.

2.4 RESEARCH ISSUES

2.4.1 The problem

Urbanisation is the phenomenon of increasing concentration of the population in urban settings (FAO, 1990). Urbanisation usually involves varying degrees of modernisation and westernisation which all impact on dietary habits. In certain instances, urbanisation also involves some acculturation or the adoption of values and behaviours by indigenous populations when they urbanise. Globally, virtually all population growth between 2000 and 2030 will be urban; in subSaharan Africa and Asia, urban populations will be growing at an astounding rate of nearly 5% per year (Smil, 2000). Rapid urbanisation has affected and will continue to affect consumption patterns. Urbanisation also means higher female participation in the work force and with that a shift away from traditional time-intensive food preparations towards pre-cooked, convenience food at home or fast food and snacks for outside meals. Particularly for the urban poor, the shift towards fast and convenience foods may also imply a shift away from fresh fruits and vegetables, pulses, potatoes and other roots and tubers towards a much more sugary, salty, and fatty diet. It is also often a shift from a diet rich in fibre, minerals and vitamins towards one rich in energy, saturated fats and cholesterol (Smil, 2000).

The urban environment entails important changes in lifestyles, economic activities, exposure to marketing and reference group influences. All these impinge on traditional diets and lead to shifts in food consumption patterns. Unless local food production and distribution systems are able to cope with and adapt to this growing and changing food demand, market tensions will grow or a country's reliance on imported foods will increase, with possible deleterious economic consequences and a growing dependency on the world market. The tendency for certain urban consumers to move away from local food has a potentially adverse effect on rural food production (FAO, 1990). Thus, urban consumption patterns deserve particular attention, since urban food demand provides opportunities for domestic production, and therefore greater integration and links between rural and urban development.

Due to their bulky nature, the supply of roots and tubers in urban centers is associated with high marketing costs and high consumer prices. As a consequence, in urban communities the consumption of root crops tends to be replaced by imported cereals like rice and wheat flour (FAO, 1987). Most of these imported food commodities are in a more convenient form and their preparation is less time intensive. In some cases, the substitution can be on a large scale and involve levels of cereal imports that cause grave concern. For example, in Central African urban centers (Douala in Cameroon, Brazzaville in the Congo and Libreville in Gabon) the consumption of bread has reached 80kg per

capita per annum. If nothing is done to slow down or reverse the rate of substitution the increasing dependency on imported food products will lead to an increasing shift away from traditional foods. In South America and the Caribbean, the overall per capita consumption of roots and tubers has declined on average by 2.5% per annum since 1970 while in the same period the consumption of cereals (imported wheat and rice) has risen by about 1% per year (ibid). This reflects the rapid rate of urbanization (at the beginning of the 1960s 30% of the population lived in towns, and by the mid 1980s 70% of the population became urban) and the relatively low level of consumption of roots and tubers in the towns where they are rarely seen as staples. The increasing dependence in developing countries on imported cereals appears to be unsustainable and the trend should be reversed by stimulating reliance on indigenous crops, in particular roots and tubers. The importance of roots and tubers as a global source of carbohydrates is well established. Regrettably, however, research and development on roots and tubers are limited and tend to be focused on pre-harvest production only, especially genetic improvement and agronomic practices. For instance, in spite of the tremendous importance of yams in the West African sub-region, the crop has generally been neglected in policy-decisions related to research on marketing; demand and consumption (ANB-BIA Supplement, 2003). IITA has been working on providing a more constant flow of yam planting materials. Breeding of yams for ecological adaptation and resistance is an ongoing activity at IITA, and researchers have also been working to get a better understanding of the physiology of yam (IITA, 2001). Research work on yam demand and consumption, and indeed many root crops has not engaged the attention of researchers to the same degree as its agronomy and genetics.

It is generally hypothesized that price, income, household characteristics and socio-cultural factors influence food consumption patterns in Ghanaian urban communities. However, this hypothesis has not been tested and corroborated from micro data. This study, therefore, addressed the following central research question: *how and to what extent does household yam consumption vary across different groups of consumers located in different urban settings in Ghana and across yam seasons?*

The following specific research questions were addressed in the study:

- What are the factors that drive changes in household yam consumption in Ghanaian urban communities and to what extent are these factors important in different urban settings in the country?

- Do yam demand elasticities vary across income groups in Ghanaian urban centers?

- Do yam expenditure elasticities vary across seasons in Ghana?

- Are urban households more responsive to price changes than income changes as far as their yam budget shares are concerned?

- Does women's share of household income significantly influence yam consumption patterns in urban areas?

- Do urban households enjoy economies of size with respect to yam consumption?

- Is there any significant difference between younger and older age cohorts in respect of household food budget allocated to yam?

The purpose of this study was to advance current understanding of food consumption patterns in Ghanaian urban communities by analyzing yam demand elasticities and the extent to which household and socio-cultural factors affect yam consumption patterns. The questions above were answered by providing empirical econometric evidence.

2.4.2 Research objectives

The broad objective of the study was to examine household yam consumption patterns in Ghanaian urban communities. Specifically, the study addressed the following objectives:

- To identify the most preferred yam variety, yam product and yam substitute among Ghanaian urban households,

- To determine how yam expenditure patterns differ across income groups in selected urban centers in Ghana,

- To estimate household yam expenditure models for selected Ghanaian urban communities. The models account for the effects of household characteristics and socio-cultural factors on yam consumption patterns,

- To estimate yam expenditure and price elasticities using the estimated models and evaluate how these elasticities differ across regional/consumer locations, income groups, and across seasons; and

- To examine the effects of women's share of household income and household size on household yam budget share.

2.4.3 Hypotheses

The major hypotheses tested in this study included:

- Household yam budget share differs across different income groups. Due to its high price relative to other roots and tubers, yam constitutes a greater share of the food budgets of lowincome households compared to their high-income counterparts;

- Yam is a luxury food commodity for low income households in Ghanaian urban centers; low income households are therefore expected to be more responsive to changes in household income level in respect of food budget share allocated to yam;

- The demand for yam will be more price elastic in more urbanized communities due to the availability of many substitutes in these communities;

- Since availability of yam, its prices and close substitutes vary across yam seasons, yam expenditure elasticity is also likely to vary across seasons. Yam is expected to be more expenditure-elastic during the lean season and less elastic during the harvest season when yam is relatively abundant and quite cheap.

- Increases in women's income as a proportion of total household income would increase household yam budget share in urban communities;

- Households enjoy economies of size in respect of food consumption expenditure. Larger households will therefore allocate a relatively smaller proportion of their food budget to yam as compared to smaller households;

2.4.4 Justification

Roots and tubers (yam, cassava, potato, and sweet potato) play a significant role in the global food system. They contribute to the energy and nutrition requirements of more than 2 billion people in developing countries especially in West Africa, the major yam producing zone in the world. In Ghana, yam is not only an important staple crop domestically but its export earnings contribute significantly towards the country's socio-economic development. Yam is produced and consumed by many of the country's poorest and most food-insecure households. The commodity also constitutes an important source of employment and income in both rural and urban areas, and for women who mainly trade in the crop. Because yam has the potential to provide multiple opportunities for poverty reduction and nourishment for poor people in West Africa, the International Fund for Agricultural Development (IFAD), International Institute of Tropical Agriculture (IITA), National Agricultural Research institutes, and selected Universities are working together to examine and subsequently tap the full potential of yam to enhance the livelihoods of producers, processors, traders, and consumers in the sub-region by addressing yam productivity and demand for yam products. This study looked at the post-production segment (demand side) of the yam sector by evaluating the major factors that drive changes in yam consumption patterns across seasons, income groups and urban centers in Ghana. This is expected to inform future policy direction in the Ghanaian food sector by opening up yam consumption to a broader consumer base and to enhance a more effective participation of producers, processors, traders, and other entrepreneurs in the yam sub-sector.

Majority of consumption studies in the food sector the world over have tended to focus on animal products and beverages (e.g. Duffy, 1983; McGuinness, 1980; McGuinness, 1983; Gao and Spreen, 1992; Tambi, 1995; Balcombe and Davids, 1996). However, roots and tubers have become the subject of increasing attention in recent years. The tendency has been to treat roots and tubers as undifferentiated commodities and this has often obscured and hindered the analysis of their individual roles in the global food system. Research on individual roots and tubers have concentrated on genetic improvements and agronomic practices to the neglect of postharvest activities especially consumption. This study addresses this gap by examining household consumption of yam in urban Ghana with special emphasis on the factors that drive changes in household food budget share allocated to yam.

The few reported studies on yam consumption carried out in Nigeria, the world's major producer of yam include the studies by Tsegai and Kormawa (1985), Dorosh (1988), and Nweke *et al* (1989). In Tsegai and Kormawa's study, the focus was on demand for cassava and cassava products and yam was included only as a substitute product. In the case of Ghana, works by Kaneda and Johnson (1961), Ord (1965) and Haessel (1976), though old, are the available empirical studies on yam demand. These studies used aggregated composite commodity definition for yam and typically ignored any effect of demographic factors on food demand. They defined yam as total roots and tubers (yam, cocoyam and cassava) and thus the expenditure elasticities were not calculated for yam as a separate food commodity. The present study fills this identified gap in previous studies.

Again, because of income disparities among households in different urban settings in Ghana, pooling data across all households obscures important information on variability in consumer behaviour across households in different socio-economic groups. To determine the effect of this household heterogeneity on consumption, this study analyses household yam consumption patterns for different income groups in different urban settings in Ghana. Elasticities were estimated for different urban areas to examine the differences in behaviours of households in different agro-ecological zones in Ghana. Furthermore, previous studies did not disaggregate yam consumption across seasons. Elasticities were estimated with one set of data as though they remain the same across the lean and harvest seasons. This study estimated expenditure elasticities across different periods (yam seasons) in one complete year cycle to examine how households behave during 'yam-scarce' and 'yamabundant' periods in the year.

There are other interesting dimensions to the study. For instance, the inclusion of household demographic characteristics to explain changes in household yam consumption patterns is an added contribution of this study to the body of knowledge in food demand patterns in the developing world. Special attention was also focused on the effects of household size and women's share of household income on yam consumption behaviour. Also, instead of employing only linear, semi-log and double logarithmic functional forms of the regression model, which have many shortcomings and yet have characterized previous applied food consumption studies, this study used complete demand system models (AIDS and QUAIDs) to estimate yam expenditure parameters.

This study provides important information to help guide future policy initiatives to promote and facilitate greater consumption of yam and yam products in Ghana. Information on how changes in

price, income, socio-cultural, and household variables impact yam consumption is an important issue for research because yam is an important staple in the Ghanaian consumer food basket. Policy makers have clear interest in the behaviour of households and in the behavioural response of households to policy instruments. The research output will be important to industry participants (producers, traders, exporters, consumers) and government for commercial and public policies. Consumption parameters are needed at the macro level to link aggregate food consumption to production levels as well as food imports and exports. At the micro level, consumption parameters are used to determine the implications of price and income changes on nutritional status of households, especially among the poor. Balcombe and Davids (1996) noted that demand elasticity estimates may prove useful to decision makers in considering the implications of policy regimes which may affect the relative prices of food items and the incomes of consumers. The inclusion of household factors in consumption studies can provide insights into how shifts in the composition of the population can affect consumer demand for food.

Information generated through this study will contribute to the debate on how to improve the performance of the yam sector, based on which appropriate strategies and policies would be formulated to ensure that the full potential of yam as a staple crop is realized for the benefit of the entire country.

2.5 Chapter summary

The chapter provided the theoretical and empirical framework for the study. The research problem, study objectives and the justification for the study are also contained in this chapter. Household food consumption is affected by several factors including household/demographic, socio-cultural and economic factors. Chapter Three follows with a description of the study area and the methodology adopted for the study. A review of the econometric models used in applied demand and consumption studies has also been provided in the following chapter.

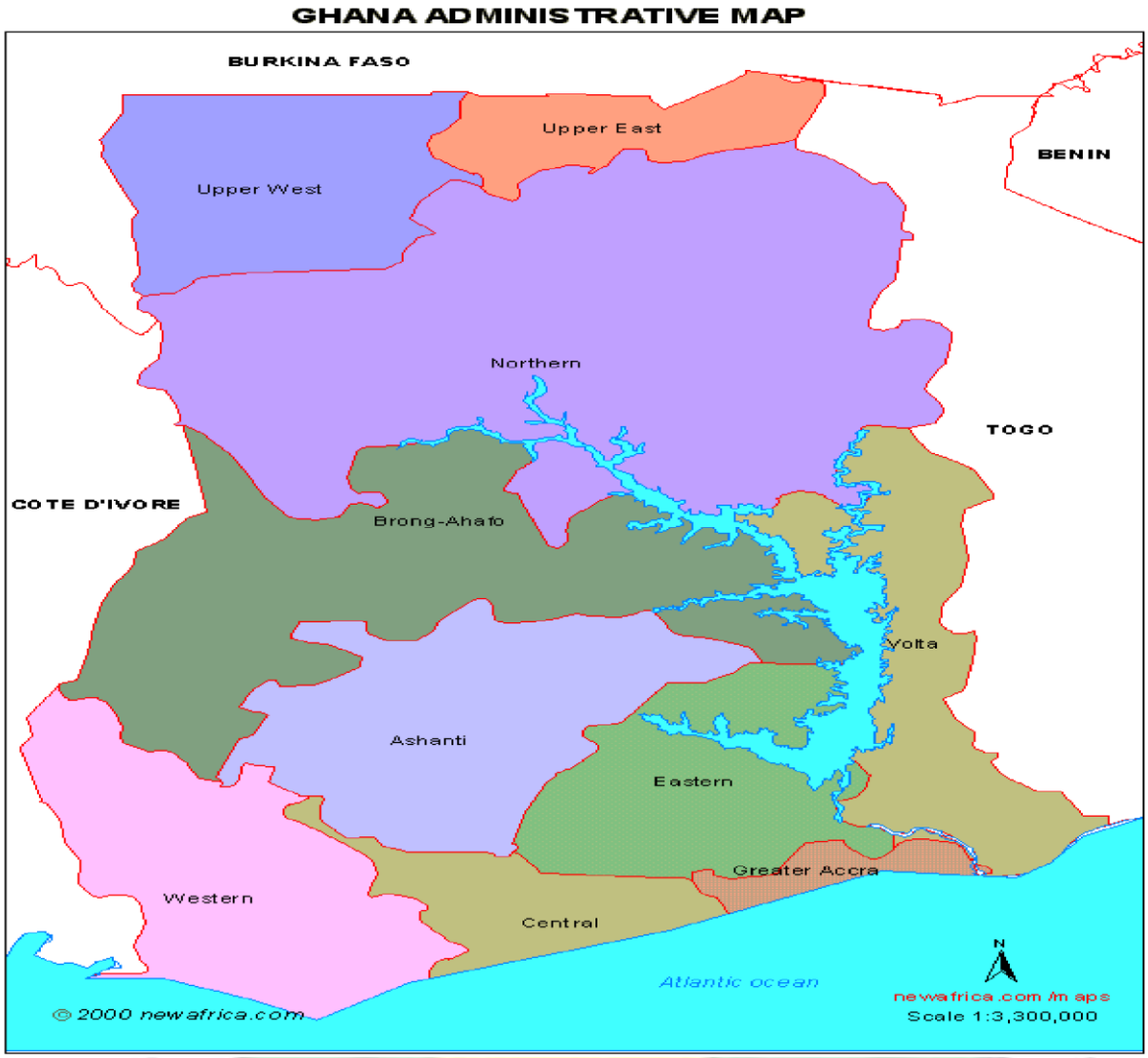
CHAPTER THREE

3.0 STUDY AREA AND RESEARCH METHODOLOGY

3.1 Study area

The study was conducted in four urban communities in Ghana. Two communities, Accra and Kumasi, are purely consuming urban centers whereas the remaining two, Techiman and Tamale, serve as both producing and consuming urban centers for yam.

Figure 3.1 Map of Ghana showing study Areas in their respective Regions



Source: newfrica.com (2000)-www.newafrica.com/maps (Accessed in September, 2010).

3.1.1 Accra

The Accra Metropolitan Area (AMA) is Ghana's biggest, most diverse and most cosmopolitan city. Apart from being the country's biggest city, it is also the second largest industrial center in Ghana. The size of the city relative to others is matched by its comparative affluence. About half of all the motor vehicles in Ghana are located in the city. With a population of about 1,695,136 people (2000 National Population Census), Accra is today one of the most populated and fast growing metropolis of Africa with an annual growth rate of 3.36%. The decline in agriculture in rural communities in Ghana and industrialisation in urban regions, as well as the relative boom in the service sector has propelled immigration to Accra. The census population figures do not show the daily influx of people into Accra. It is estimated that the city accommodates between 2.5 million to 3 million people in terms of socio-economic activities aside the residential dimension captured by the 2000 National Population

Census. Migration contributes to over 35% of the population increase in AMA. Accra's population, like that of other urban centers, is a very youthful one with 56% of the population under the age of 24years. About 51% of the population is females and the remaining 49% males, which gives a sex ratio of 1:1.04 males to females. The dominance of females over males is a reflection of the nationwide trend where the estimated ratio is 1:1.03(www.ghanadistricts.com; accessed in January, 2009).

The AMA's economy consists of the primary sector (farming, fishing, mining and quarrying), secondary sector (manufacturing, electricity, gas, water, construction) and tertiary sector (wholesale trade, retail trade, hotel, restaurant, transportation, storage, communication, financial intermediation, real estate service, public administration, education, health and other social services). As an urban economy the service sector is the largest, employing about 531,670 people (64.6% of the population). Accra has 114,198 of its labour force unemployed, giving an unemployment rate of 12.2%. Farming in Accra is a typical urban farming system characterized by the cultivation of vegetables (e.g. okra, garden eggs, tomatoes, carrots, cucumber, cabbage, cauliflower, and lettuce). According to Table 3.1, the whole Greater Accra Region does not produce yam; yam is only sold and consumed in Accra.

Table 3.1: Production of major crops by Regions in Ghana – 2004 (figures in metric tonnes)*

Region	Yam	Cassava	Cocoyam	Plantain	Maize	Rice
Western	94,291	827,439	246,751	521,182	85,480	24,204
Central	24,748	1,549,226	-	-	159,622	3,898
Eastern	622,555	2,058,413	438,104	757,482	241,621	25,420
Gt. Accra	-	56,498	-	-	2,714	3,621
Volta	212,600	1,085,950	31,300	43,500	53,868	42,243
Ashanti	230,367	1,226,931	638,942	600,595	183,032	9,926
Brong Ahafo	1,848,323	2,463,455	360,768	458,098	281,267	3,407
Northern	568,275	470,900	-	-	74,566	92,650
Upper West	291,099	-	-	-	60,801	5,748
Upper East	-	-	-	-	14,650	30,691
Total	**3,892,259**	**9,738,812**	**1,715,864**	**2,380,858**	**1,157,621**	**241,807**

dash (-) means no production (these food commodities were not produced in the affected regions during the period).

Source: Ministry of Food and Agriculture, 2005.

3.1.2 Kumasi

The Kumasi metropolis is centrally located in the Ashanti Region of Ghana. The Kumasi metropolis has a population of 1,170,270 and accounts for nearly one-third of the Ashanti region's population of 3,612,950 (GSS, 2000). The services sector is the largest and most important sector in the metropolis, contributing about 60% of its GDP. The unique location of the city as a traversing point from all parts of the country makes it an ideal place for the development of commercial activity. It is, therefore, not surprising that Kumasi's central market is the largest single market in Ghana. The metropolis has additional 20 markets within which yam and other food commodities are sold. The industrial sector accounts for about 30% of the metropolis' GDP. The medium and large scale industrial activities include pharmaceuticals and medical accessories, mechanical and electrical engineering works, logging and saw milling, alcoholic beverages and textiles. The small-scale industrial activities include footwear, cosmetics, soap making, carpentry and joinery, foam and plastic, printing and stationery and metal works. About 50% of the labour force in the industrial sector is employed in the wood and wood-related industries. Like any other urban economy, the agricultural sector is very small, accounting for just about 10% of its Gross Domestic Product. Agriculture is mostly practiced in the peripheral areas. Crops grown in the metropolis are mostly staple crops for subsistence; few cash crops are also cultivated for industrial processing and little for export. One important agricultural activity in the metropolis is the cultivation of exotic vegetables like cabbage, lettuce and carrots. The Ashanti Region produced 230,367 Metric tonnes of yam in 2004 (Table 3.1). However, the Kumasi metropolis is purely a yam consuming but not a producing center (www.ghanadistricts.com).

3.1.3 Techiman

The Techiman municipality is strategically situated with very good roads linking it to most of Ghana's major commercial centers and also to the republics of Togo, Burkina Faso and Cote d'Ivoire. According to the 2000 Population and Housing Census, the population of the Municipality stood at 174,600, with an average growth rate of 3.0% per annum (GSS, 2000). The population density was over 260 persons/Km^2; far higher than the regional figure of 45.9 and national figure of 79.3. Females dominate the population of the municipality; the sex ratio (male to females) is 99.9 in contrast to the regional ratio of 100.8. From the 2000 census the population dependency ratio of 81.3 is below the

regional average of 90.5. The composition and structure of the households reflects the social structure of the society. The average household size is 5.1 as compared to the regional average of 5.3. About 34.2% of the households in the municipality are female headed. The municipality is the second most urbanized (55.7% urban) in the Brong Ahafo region. There is considerable movement of people into and out of the municipality. This significant migrant population is attributable to the advantageous location of the municipality and the bustling food crop market and commercial center of Techiman. The famous Techiman market attracts a floating population of over three thousand for three days every week, into the municipality. The immigrant proportion of labour force is also quite high, about 20%. This makes labour cost cheaper and promotes economic activities, especially farming (www.ghanadistricts.com). According to the 2000 census, agriculture (and related activities) is the major occupation in the municipality accounting for about 57% of the labour force. About 13.7% of the economically active population is engaged as sales workers; production, transport operators and labourers constitute 12.4% of the population. The Techiman Municipality is generally regarded as an Agricultural production corridor. This is largely attributed to the vast fertile lands, especially in the southern part of the Municipality which has attracted migrant farmers from the northern regions of Ghana. There are more males engaged in agriculture than females whereas females outnumber males in service and sales work. The major crops grown are food crops such as yam, maize, cassava, cocoyam, plantain and vegetables like tomatoes, garden eggs, onions and okra as well as cash crops like cocoa, cashew and mango. Techiman is a major producing and trading center for yam in Ghana. Table 3.1 shows that Brong Ahafo Region is the major yam producing region in Ghana. The Region produced about 48% (1,848,323 tonnes) of the total yam production in Ghana which stood at 3,892,259 metric tonnes in
2004(www.ghanadistricts.com, accessed in January, 2009).

3.1.4 Tamale

The Tamale metropolis is one of the 18 districts in the Northern Region. Tamale, the regional and metropolitan capital, is centrally located in the region and hence serves as a hub for all administrative and commercial activities in the region. The 2000 population census puts the population of the Tamale metropolis at 293,881; made up of 146,979 males and 146,902 females. With an urban population of 67.1%, the metropolis is the only district in the region which is predominantly urban. The population density of 318.6 persons per square kilometers for the metropolis is about 12 times higher than the

regional average of 25.9 persons per square kilometers. Islam is the predominant religion in the metropolis with 84% of the population affiliated to it. The economy of the metropolis until the 1980s was basically agricultural. During this period over 70% of all indigenous people in the metropolis were farmers. Currently it is estimated that 60% of the population are engaged in agriculture. Tamale, and indeed the northern region, has a comparative advantage in the production of cereals, cotton, legumes, yam, and livestock. There are large arable farmlands, relatively uniform in vegetation cover. The generally flat land with undulating relief is suitable for both hand and mechanical cultivation. Farmers in the metropolis and rural Tamale in particular are small scale holder subsistence food producers with low incomes. The metropolis experiences one rainy season starting from April/May to September/October with a peak season in July/August. The metropolis experiences a mean annual rainfall of 1100mm within 95 days of intense rainfall. Staple crop farming is highly restricted by the short rainfall duration. The dry season is usually from November to March (www.ghanadistricts.com). From Table 3.1, the Northern Region produces about 15% of the total yam production in Ghana. Tamale serves as both yam producing and marketing center (www.ghanadistricts.com; accessed in January, 2009).

3.1.5 Prices of yam and other root & tuber crops in Ghana

Table 3.2 shows the wholesale and retail prices of the main roots and tubers in Ghana. Yam appears to be more expensive than the other root and tuber crops on per unit basis.

Table 3.2: Wholesale and retail prices of selected roots and tubers (GH¢/kg)

Year	Yam		Cassava		Cocoyam		Plantain	
	Wholesale	*Retail*	*Wholesale*	*Retail*	*Wholesale*	*Retail*	*Wholesale*	*Retail*
2000	0.09	0.16	0.02	0.06	0.08	0.13	0.09	0.14
2001	0.14	0.27	0.09	0.14	0.11	0.21	0.14	0.22
2002	0.17	0.24	0.07	0.13	0.14	0.22	0.11	0.25
2003	0.19	0.27	0.06	0.26	0.14	0.24	0.12	0.27
2004	0.22	0.29	0.08	0.14	0.19	0.27	0.15	0.31
2005	0.27	0.40	0.12	0.21	0.23	0.34	0.16	0.37
2006	0.28	0.38	0.12	0.21	0.26	0.37	0.18	0.40

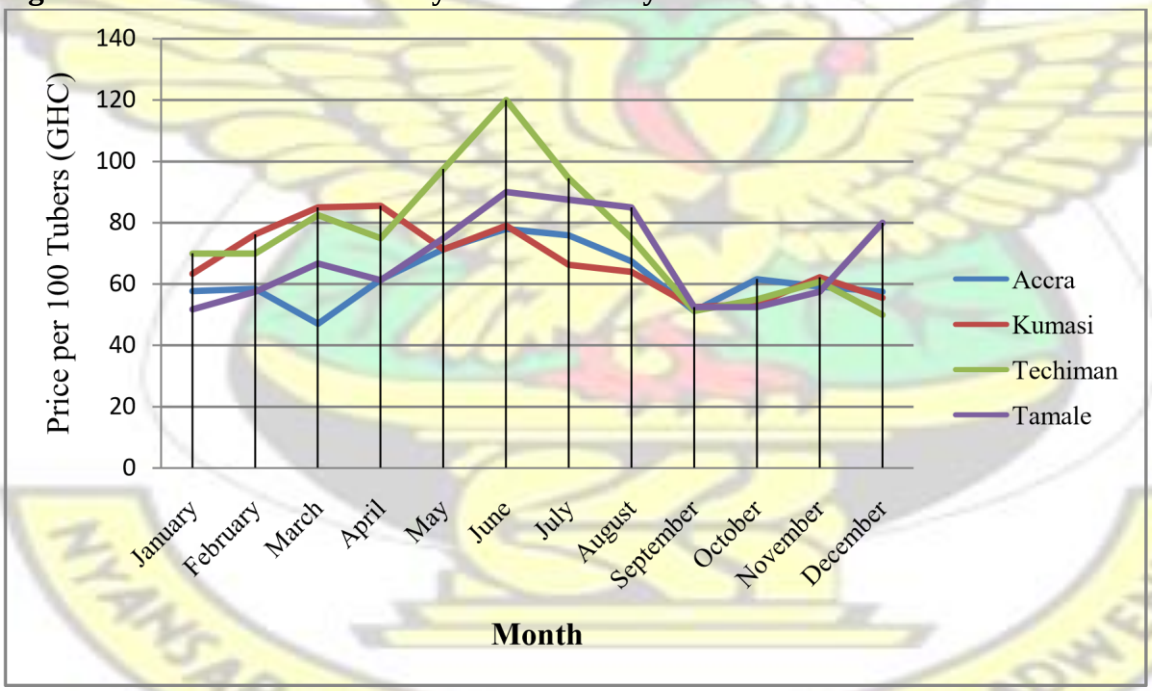
Source: ISSER, 2007.

Figure 3.2 provides the monthly market price series for yam in the four urban centers under study. It could be inferred from the Figure that yam prices are generally high during the pre-harvest (lean)

season which spans from May through July. Prices are at their lowest levels during the peak harvest (main) season ranging between August and October. From November to January, yam prices pick up due to the Christmas and New Year festivities. Prices increase further during the planting season (February to April).

From Figure 3.2 yam price was higher in the main producing urban centers (Techiman and Tamale) compared to the consuming urban centers (Accra and Kumasi) during the lean season. The possible reason could be the high market demand in Techiman and Tamale to feed destination markets in neighbouring Burkina Faso and Togo. In the *State of the Ghanaian Economy* for 2006 (ISSER, 2007), yam price was quoted at between GH¢ 0.25 and GH¢ 0.31 per kg at the wholesale level, with Tamale recording the lowest price and Techiman recording the highest price.

Figure 3.2: Wholesale Prices of yam in the study areas in 2006



Source: Generated from Ministry of Food and Agriculture Data, 2007.

3.2 RESEARCH METHODOLOGY

3.2.1 Data issues

3.2.1.1 Types and sources of data

Primary data was used for the household yam consumption analysis. A quarterly panel data collected from August 2006 through July 2007 was used for the study. This was cross-sectional micro data collected from the same households for four quarters in one complete year cycle. The first set of data focused on household characteristics, personal characteristics of the household head and the sociocultural factors in addition to household food consumption information. The subsequent quarterly data was only on household expenditures. This information was obtained from household heads and/or the household member in charge of food purchases, especially wives.

According to Gao and Spreen (1992), analysis of micro or household level data can provide valuable insights in understanding household consumption behaviour by estimating relatively long-run relationship in comparison with macro data. Another advantage of micro-data analysis is that it can provide accurate estimation of consumer demand. Unlike time-series data, microdata gives the quantities and expenditures on goods purchased directly by consumers for home consumption. Microdata can render valuable information on consumer demand at the retail level. Microdata analysis

may also yield substantially greater precision in the estimation of the parameters than estimates based on aggregate data. This is because, importantly, some of the relevant explanatory variables at the micro level may exist in a form that cannot readily be aggregated. According to Lau (1982), microdata are also more informative about demand relationships than macrodata when individual demand functions are nonlinear. This justifies why the study uses primary data at the micro level for yam consumption analysis.

Data on amounts spent on various yam products and substitute products (e.g. cassava, gari, cocoyam, plantain, rice, and maize, among others) consumed by households for a period of one week and one month were gathered. Prices of these products as well as the income of the household members were also obtained. The socio-cultural factors of interest in the study were educational background, age, gender, religious and ethnic affiliation of the household head. Information on household characteristics such as household size, number of wage earners in the household, proportion of household income controlled by women, and region of household location, among others, were elicited. Another important variable in consumption pattern analysis is the percentage of away-fromhome food expenditure; the study collected data on amounts spent on yam and other foods consumed away from home.

The focus of the study was on the three main yam varieties produced and consumed in West Africa and for that matter, Ghana; namely yellow yam, white yam and water yam. With regards to the various forms in which yam is purchased and consumed, yam products have been classified into boiled/cooked yam (*ampesi*), pounded yam (*fufu*), roasted yam, fried yam/yam chips and yam floor. Apart from these yam products and their substitutes, an attempt was made to gather information on all household expenditure items including other food products and non-food products/services like education, healthcare, funerals, travels, and clothing, among others, to help in the budget share analysis and in the computation of per capita expenditure.

3.2.1.2 Sampling technique

A multi-stage sampling method was adopted for the study. Four urban centers in which the study was conducted were purposively selected to reflect not only yam production and distribution patterns in the country but the agro-ecological zones as well. The four (4) urban centers include: Tamale in the

Northern Region (Guinea Savannah zone), Techiman in the Brong Ahafo Region (Transitional zone), Kumasi in the Ashanti Region (Forest zone), and Accra in the Greater Accra Region (Coastal Savanna zone).

A combination of stratified, systematic and simple random sampling techniques was used to select respondent households. The selected urban centers were stratified into low, medium, and highincome areas with the help of the local government authorities (i.e. the Municipal and Metropolitan Assemblies) in the respective study communities. Within each income stratum, a systematic random sampling technique was employed to select respondent houses. Where there were streets, every third street in the area was selected and along each street, every fifth house was selected until the number required for that stratum was obtained. In areas where there were no clear cut streets, each area was imaginary divided into four parts - north, south, east and west and for each part or quadrant, field enumerators moved from one end to the other and selected every fifth house. The houses selected through the systematic procedure were visited and one household was chosen by a simple random sampling procedure if more than one household were found to dwell there. This was based on the general assumption that households living in the same house are likely to have similar living standards. The suburbs selected for enumeration in the four urban centers are provided in Table 3.3 according to income group. A total of five hundred and ten respondent households were sampled for the study.

Table 3.3: Selected communities for the study by income group

Location	Low income areas	Middle income areas	High income areas	Sample Size
Accra	Nima James Town Bukom	Kaneshie Labadi/Labone Ashongman	East Legon Ring Way Airport Resid. Area	150
Kumasi	Moshi Zongo Aboabo	Tafo/Pankrono Kwadaso/Abuakwa Atonsu	Bomso/KNUST Nhyiaeso	120
Techiman	Tonnsuoase	Abanmu	Ahenfie	120
Tamale	Chogu Sabongida Moshi Zongo	Sakasaka Gumani Kukuo	Vitim Estate Kapohini Estate VRA	120
Total	**170**	**170**	**170**	**510**

3.2.1.3 Methods of data collection

The methodology of conducting household expenditure surveys has been discussed extensively in the literature (See Neter and Waksberg, 1965; Pearl, 1968; Neter, 1970; among others). The two major methods in use are the personal interview, whereby an enumerator asks one or more household members to recall expenditures made during a given reference period, and the diary method, where the respondent is asked to record, usually daily, expenditures in an account book (Grootaert, 1986). 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, resulting in a long and demanding interview for respondents.

Changes in data collection methodology were considered because response burden and response errors due to the difficulty in recalling detailed expenditures have become major issues of concern. Measurement error is a ubiquitous feature of micro data. Two alternative approaches have been proposed to reduce measurement error (Tremblay and Hale, 1999). They involve a mixed collection method where frequent expenditures are obtained from a diary and less frequent expenditures from an interview. The first approach is a modified version of the collection methodology used in most European countries where a separate contact is made for the retrospective interview. The second is a panel approach similar to the collection methodology of the Consumer Expenditure Survey conducted by the U.S. Bureau of Labor Statistics where expenditures collected in the panel interviews are restricted to less frequent purchases to reduce response burden.

The Canadian approach, which is also used in countries with smaller economies, uses both a diary and retrospective interview for the collection of expenditure data. The European approach primarily used in Europe and Australia is certainly the most common approach. The survey period (generally one year) is subdivided into a number of time periods of equal length and a different sub sample of households is observed for each single period. Each selected household enters all its expenditures daily in a diary for a short period of time (generally two weeks). At the beginning or the end of the diary period, they complete a retrospective interview covering the less frequent purchases. Depending on the type of expenditure, the reference period for the interview varies from as long as one year for very infrequent purchases such as cars and household appliances to shorter timeframes for other expenditures such as health services and recreation expenditures. There is no control for telescoping with this collection methodology, as the beginning of the reference period is not bounded.

Another collection method is the panel approach where the same households are contacted many times during a certain period and asked to report all expenditures they have made since the previous contact. The panel approach allows for a better control on the telescoping error since the preceding interview serves as a bounding for the next. In conducting its Consumer Expenditure Survey (CES), the U.S. Bureau of Labor Statistics uses a panel approach in which respondents are visited on a quarterly basis for a total of five interviews (Pearl and Levine, 1971). The first interview is used essentially as a bounding interview. Its main purpose is to inventory the household's durable goods and to record expenditures for a certain period so that telescoping can be avoided in the next interview. The panel approach can combine the use of diary and interviews, as is the case for some countries in the Eastern Europe. In the US, a separate sample of households is used for the diary because the response burden would be too high with the five interviews of the panel. For the same reason, it is felt that if a panel approach would be implemented in Canada, the diary would also have to be completed by a different sample of households.

One of the biggest advantages to the European approach of keeping the diary and the interview on the same sample is that for a fixed collection budget the sample size will be much larger. However, the importance of having some way of minimizing the telescoping error has led to the consideration of a hybrid option. Each household would be asked to provide expenditures through the use of a diary and an interview, with an additional contact done three months after the end of the diary period for the retrospective interview. The end of the diary period would provide the respondent with a point of reference for the beginning of the recall period. The information on the diary could also be used to verify that an expenditure reported in the interview has not already been reported during the diary period (all expenditures are generally reported in the diary in order to avoid complexity and errors due to classification). This proposed hybrid methodology, which will be referred to as the Modified European approach, as well as the Panel approach have been identified as interesting alternatives to the current Canadian methodology. Both meet many of the objectives of the desired new collection methodology in terms of data quality improvement: the use of a more appropriate collection mode for frequently purchased products, a shorter reference period (three months) for the retrospective interview, and the possibility of implementing some controls to minimize telescoping. With a first bounding interview, such as in the CES, and repeated contacts, the panel approach has a better mechanism for controlling telescoping but the Modified European approach would allow some control

during the diary period of 14 days. The two proposed approaches would produce an increase in the sampling error for aggregate estimates of less frequent purchases, compared to the current methodology because of the reduction of the length of the reference period. Although the sampling error is not the only factor in the choice of a new collection methodology for the survey, it is an important issue for the major users of aggregate data.

A mixed approach, which combines both retrospective interview and diary surveys, was used to gather primary data for this study. Respondent characteristics, household characteristics, and other demographic variables were collected through recall interview. Also weekly and monthly expenses on food and non-food items were captured under the recall interview approach. Detailed household expenditure data on all food commodities and other expenditure items were collected through diary survey.

Diary survey – a review

Diaries are used as research instruments to collect detailed information about behaviour, events and other aspects of individuals' daily lives. Diaries have been used extensively to collect data in fields as diverse as transportation and health (Roghmann and Haggerty, 1972; Thompson, 1977; Harkins, 1979; Verbrugge, 1980). Diaries also have been an important source of information on consumer spending for some time (Pearl and Levine, 1971; Fluek et al, 1971) because they are particularly good instruments for collecting small, inexpensive items. Dairies were first used in the 'time-budget' schedule, which involved respondents keeping a detailed log of how they allocated their time during the day. More qualitative studies have since used a "standard day" diary, which focuses on a typical day in the life of an individual from a particular group or community.

Two major areas where diaries are often used are consumer expenditure and transport planning research. For example, the U.K. Family Expenditure Survey uses diaries to collect data for the National Accounts and to provide weights for the Retail Price Index. In the National Travel Survey, respondents record information about all journeys made over a specified time period in a diary (Also see Redpath, 1991 and Silberstein & Scott, 1991 for more on the use of diaries in household and consumer expenditure surveys). Other topics covered using diary methods are social networks, health, illness and associated behaviour, diet and nutrition, social work and other areas of social policy, clinical psychology and family therapy, crime behaviour, alcohol consumption and drug usage, and sexual behaviour (see Douglas *et al*, 1968; Verbrugge, 1980; Hilton, 1989; Butcher & Eldridge, 1990;

Gregory, 1990; Coxon *et al*, 1990; etc.). Diaries are also increasingly being used in market research (see Cortis, 1993).

In expenditure surveys, the primary objective of the diary survey is to obtain detailed expenditure data on small, frequently purchased items, because such data are normally difficult to recall. Some of these items include food and beverages, at-home and in eating-places away from home; housekeeping supplies and services; non-prescription drugs; and personal care products and services. Diary survey is not limited to these expenditure items, but it includes all expenses incurred by the consumer unit during the survey period.

Self-completion diaries have a number of advantages over other data collections methods. First, diaries can provide a reliable alternative to the traditional recall interview method for events that are difficult to recall accurately or that are easily forgotten. Second, like other self-completion methods, diaries can help to overcome the problems associated with collecting sensitive information by personal interview. Finally, they can be used to supplement recall interview data to provide a rich source of information on respondents' behaviour and experiences on a daily basis. Diary surveys often use personal interview to collect additional background information about the household and sometimes about behaviour or events of interest that the diary will not capture (such as large items of expenditure for consumer expenditure surveys). According to Cortis (1993), a placing interview is important for explaining the diary keeping procedures to the respondent and a concluding interview may be used to check on the completeness of the recorded entries. Often retrospective estimates of the behaviour occurring over the diary period are collected at the final interview. The diary interview method where the diary-keeping period is followed by an interview asking detailed questions about the diary entries is considered to be one of the most reliable methods of obtaining information.

Much research has been devoted to the topic of consumer expenditure diary methodology. Several studies have compared the differences in the estimates from personal interviews involving recall and those from diaries (See Neter and Waksberg, 1965; Stanton and Tucci, 1982; Silberstein and Scott, 1992). As Grootaert (1986) has pointed out, the results from the studies are inconclusive. One method may be superior over the other for some expenditure, but the reverse seems to be the case for other expenditures. Some studies (e.g. Silberstein and Scott, 1991; Silberstein, 1991; Tucker, 1992) have looked at various measures of error in the U.S. Consumer Expenditure Diary Survey (CE Diary). Variations in diary procedures also have been examined. One group of studies has dealt with the effects

of placing multiple diaries in a household as opposed to only one diary. Generally speaking, providing a diary to every family member over a certain age produces better reporting than having one member keep a diary for the entire family (Kemsley and Nicholson, 1960; Sudman and Ferber, 1971). On the other hand, in addition to the difficulty in obtaining cooperation from all participating family members in the multiple-diary situation, Grootaert (1986) found that proxy reporting was better where elderly respondents were concerned. The other aspects of diary methodology which have been investigated include length of the reporting period, the format of the diary itself, and the impact of incentives (Turner, 1961; Sudman and Ferber, 1971; Walsh, 1977; Nasholm *et al*, 1989). Respondents typically report more items at the beginning of the reporting period than at the end. This probably reflects a loss of interest in keeping the diary due to the tediousness of the task. There is evidence that diaries organized according to commodity categories produce the best results and that incentives can increase response rates.

In a study to analyse response performance in consumer expenditure diary survey, Silberstein (1991) found that young and single respondents in diary survey are more likely to compile diaries of lower quality than other respondents. Lyberg (1991) also notes that one-person households have greater nonresponse in Sweden, and better cooperation to expenditure surveys is gained from families with children. Harrison (1991) cites higher nonresponse for households with fewer members in the Australian Household Expenditure Survey. A multivariate study of non-respondents to the U.K. Family Expenditure Survey shows that response tends to increase for households with children, and is lowest for households with more than one adult and no children (see Elliot, 1991).

There is a strong association of homeowners and respondents in higher income brackets with norecall diaries (Silberstein, 1991). The study also found out that the use of total recall in diary surveys is more pronounced when older people are living alone. Single person households and less educated respondents show a greater propensity to use total recall in diary survey was also affirmed by Silberstein's study in 1991 by using US household data.

i) Weaknesses in the use of diaries - data quality and response rate

Disappointing as it might seem, respondents do not normally carry their diaries around with them. Such respondents tend to apply the recall method later in completing the diaries. In addition to the

types of errors encountered in all survey methods, diaries are especially prone to errors arising from respondent conditioning, incomplete recording of information and under-reporting, inadequate recall, insufficient cooperation and sample selection bias.

Diary keeping period: The period over which a diary is to be kept needs to be long enough to capture the behaviour or events of interest without jeopardizing successful completion by imposing an overly burdensome task. The Office of Population, Censuses and Surveys (OPCS) National Travel Survey and the Adult Dietary Survey use seven day diaries, while the UK Family Expenditure Survey uses a fourteen day recording period. For collecting time-use data, anything from one to three day diaries may be used. Household expenditure surveys usually place diaries on specific days to ensure an even coverage across the week and distribute their fieldwork over the year to ensure seasonal variation in earnings and spending is captured.

Reporting errors: In household expenditure surveys it is routinely found that the first day and first week of diary keeping shows higher reporting of expenditure than the following days. This is also observed for other types of behaviour and the effects are generally termed "first day effects". They may be due to respondents changing their behaviour as a result of keeping the diary (conditioning), or becoming less conscientious than when they started the diary. Recall errors may also extend to 'tomorrow' diaries. Respondents often write down their entries at the end of a day and only a small minority are diligent (and perhaps obsessive!) diary keepers who carry their diary with them at all times. Expenditure surveys find that an intermediate visit from an interviewer during the diary keeping period helps preserve 'good' diary keeping to the end of the period.

Literacy: Keeping a diary demands considerable ability and motivation by respondents, often encompassing retrieval of information from other individuals in the household. All methods that involve self-completion of information demand that the respondent has a reasonable standard of literacy. Thus the diary sample and the data may be biased towards the population of competent diary keepers.

Participation: The best response rates for diary surveys are achieved when diary keepers are recruited on a face-to-face basis, rather than by post. Personal collection of diaries also allows any problems in the completed diary to be sorted out on the spot. Success may also depend on the quality of interviewing staff who should be highly motivated, competent and well-briefed.

Appealing to respondent's altruistic nature, reassuring them of confidentiality and offering incentives are thought to influence co-operation in diary surveys. The Family Expenditure Survey (FES) gives a 10-pound postal order for completion of their fourteen-day diary and other surveys offer lottery tickets or small promotional items.

Data processing: Data processing from diaries can be very demanding in terms of amount of time and work. This however depends largely on how structured the diary is. For many largescale diary surveys, part of the editing and coding process is done by the interviewer while still on the field. Following this is an intensive editing procedure, which includes checking entries against information collected in the personal interview. For unstructured diaries, involving coding of verbatim entries, the processing can be very labour intensive; in much the same way as it is for processing qualitative interview transcripts. Using highly trained coders and a rigorous unambiguous coding scheme is very important particularly where there is no clear demarcation of events or behaviour in the diary entries. Clearly, a well-designed diary with a coherent pre-coding system should cut down on the degree of editing and coding.

Cost of survey: The diary method is generally more expensive than the personal interview, and personal placement and pick-up visits are more costly than postal administration. For the majority of OPCS diary surveys, interviewers usually make at least two visits and are often expected to spend time checking the diary with the respondent. If the diary is unstructured, intensive editing and coding will push up the costs. However, these costs must be balanced against the superiority of the diary method in obtaining more accurate data, particularly where the recall method gives poor results. The ratio of costs for diaries compared with recall time budgets are of the order of three or four to one (Juster & Stafford, 1985).

ii) Advantages of diary survey over recall interview

The tendency to forget earlier transactions - what Deaton (1997) describes as ‘progressive amnesia’ - is very common in recall surveys. Scott and Amenuvegbe (1991) found that average daily expenditures reported by respondents fall by almost three percent for every day added to the recall period, with the greatest decline for the more frequently purchased items. In their recall survey, the expenditures on most frequently purchased foods were lowest as compared to the figures obtained through the diary

survey. The correlation between recall error and the length of recall period was found to be statistically significant at the 1% level. An alternative hypothesis that recall errors reflect respondent fatigue was not supported by the data. Diary recorders usually make written reports on the day expenditure occurs, which should minimize recall error, while respondents in an interview are asked to recall expenditures that may have been made many days earlier. Scott and Amenuvegbe (1991) also suggest that after a threshold number of purchases during the recall period, respondents switch from reporting their actual expenditures to what they think are their usual expenditures. This change in reporting style means that exceptionally high expenditures tend to be overlooked, and this leads to underestimation. Because larger households generate more transactions per time period, they are more likely to reach this threshold where respondents switch away from reporting actual expenditures. Moreover, a large household may have a high proportion of people who are nonnuclear family members and who make purchases that the respondent does not know about. The most plausible interpretation of the foregoing is that food expenditure data collected with the recall method have measurement errors that are correlated with household size. As household size increases, it becomes increasingly harder for a survey respondent to accurately recall expenditures on food because of the rise in the number of transactions. By using household data from Papua New Guinea, Gibson (2002) found out that households with two people make an average of 50 food and 25 non-food purchases per fortnight, while households with 10 people make 140 food and 50 nonfood purchases per fortnight. Thus, the respondent from the large household is the one most likely to forget food purchases when giving verbal report on expenditures in the previous fortnight. But whether a household has 2 or 10 people, it needs only one gas stove, so the reporting task for nonfoods is easier and less proportional to household size. It is easier to recall expenditures on non-food items because these may be purchased only sporadically (Gibson, 2002). He further noted that measurement errors in expenditure data cause a negative bias in the coefficient of household size in food Engel curves.

iii) Field survey - the Canadian example

The 1996 Canadian Food Expenditure Survey is a large, nationally representative survey of Canadian households. Respondents were asked basic demographic questions and recall food expenditure questions. In the recall interview, respondents were asked to estimate the household's food expenditure over the past four weeks. In addition, they were asked to record every food purchase in a diary, for two contiguous weeks. Conducting the survey involved three visits to each household. At the initial

visit, demographic and recall food expenditure questions were asked. In addition, respondents were instructed on the proper technique for filling out the food expenditure diaries. After a week the first diary was collected and the household received another second blank diary in which to record purchases made in the following week. This second diary was collected during the third visit. During the second and third visits the interviewers double-checked the diaries and verified the exactness and fullness of the responses. The survey was run continuously throughout the year so that the seasonality of purchases was not an issue (Battistin, 2004; and Ahmed *et al*, 2005).

In summary, there were three distinct survey data items that capture the distribution of food expenditures in Canada in 1996. These included:

i. The recall food expenditure measure

ii. Food expenditures recorded in the first week diaries iii. Food expenditures recorded in the second week diaries

The first expenditure data set was multiplied by 12; and the second and third data sets were each multiplied by 52 to get the annual measures.

Several features are notable. First, the diary records were considerably lower than the recall responses of the same individuals or a second sample drawn from the same population. Second, diary records were considerably more variable. Third, there was a notable drop off (average of 10 percent) between the first and second week of the diary. The drop off between the first and second week of the diary seems to be evidence of "diary fatigue" or "diary exhaustion". The Canadian Statistical Bureau concluded that diary exhaustion was a significant factor affecting accuracy of the responses. They report that, in addition to the between week differences, within week responses tended to be significantly larger for the earlier days of either week. Such exhaustion effects in expenditure diaries have been known for a long time (e.g. McWhinney and Champion, 1974.). Recently, Stephens (2003) reported similar phenomena in the diary sample of the U.S. Consumer Expenditure Survey (also a two-week back-to-back panel).

From the forgoing, it can be concluded that even though diary survey is superior over recall interview, respondent fatigue and non-cooperation, if not checked, could reduce an expensive diary survey to an ordinary recall survey.

In this study, therefore, both personal recall interviews and diary survey were used. Respondents were asked firstly to recall food and non-food expenditures for the past one-week and one month. The diary was placed in the household for two continuous weeks and each household was visited at least three times during the survey period to ensure that daily expenditures were correctly recorded in the diaries. The household head was made to fill the diary if literate. If the household head could not complete the diary, any household member above 15 years who could write was asked to complete the diary for the family with support from those in charge of household purchases.

Due to resource constraints, and also to reduce measurement error to the barest minimum, panel data was collected quarterly through the use of diary survey method throughout one calendar year (August 2006 to July 2007). The first and second week expenditure figures were averaged out to get household expenditure for a typical week and multiplying the figure by 4, the monthly household expenditure figures were obtained.

The difference between the Canadian survey and the current study is that in the former, replacement sampling was done. In the current study, however, the same households were covered throughout the year to collect the panel data for analysis. Continuous data collection on the same sample on weekly, fortnightly, or monthly basis throughout the year raises data quality issues due to respondent fatigue. Time and cost implications could also be enormous. In view of this consideration, diary survey was conducted for two continuous weeks in each of the four quarters in the specified survey period.

3.2.2 Econometric models for consumer behaviour analysis

3.2.2.1 Introduction

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, 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 (1980a). 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 modeling of the representative consumer using time-series data.

Economic theory has generated a large number of consumer demand systems over the past decades, all of which continue to coexist and to be used in applied work. From a theoretical point of view, much attention has been paid to the local and global properties of alternative models. Beyond that, there seems to be little further role for economic theory in discriminating between alternative functional form specifications. Besides estimation, the empirical work on demand systems has been largely confined to testing the integrability conditions and other restrictions within a given system of demand equations. As a result, the test outcomes -usually rejections of the propositions of demand theory - are conditional upon the maintained model being correctly specified.

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 (Ferris, 1998). The estimation of demand or expenditure models involves the application of econometric and mathematical tools for estimating single equations and by systems of equations. Even though it is admitted that some "trial and error" efforts are inevitable, Ferris (1998) contends that strong logic is paramount in approaching demand and consumption measurements.

According to Ferris (1998), the consumption demand for a commodity is a function of many factors too numerous to measure independently by the Ordinary Least Square (OLS) approach. The task of the econometrician is thus to introduce conditions that will conserve on degrees of freedom, reduce multicolinearity and still meet certain *a priori* beliefs about demand.

In the theory of econometrics, there are a number of mathematical forms that a demand or consumption function can take. Apart from the simple linear specification of a regression model, a function could also be specified in the quadratic form, power form (e.g. Cob Douglas function), and logarithmic form or in the exponential form. Linear specification of economic relationship is too simplistic a way of describing rather complex real life economic phenomena (Henderson and Quandt, 1986). Consequently, most empirical studies on consumption demand have tended to focus on the nonlinear specification. According to Adesini (1978), economic theory provides little guide concerning the

mathematical form of the regression model that suite a particular study. He revealed that in practice researchers tend to follow either of two approaches. First, a strong assumption may be made concerning the particular mathematical form that would best characterize the problem being investigated. Second, if the researcher is unable to make such an assumption, *ex-post* criteria may be relied upon by fitting different mathematical functions to the data and selecting the best on the basis of R^2, t-values, and the "reasonableness" of the estimated parameters.

Asenso-Okyere *et al* (1997) used the double logarithmic function to find the determinants of household nutritional intake in Ghana with satisfactory results. Adesini (1978) also used double logarithmic regression function in his study to examine the structural relationships underlying household food expenditures in Ile Ife, Nigeria. He used the double logarithmic function as a logarithmic transformation of a Cobb-Douglas type of production function.

In a study to examine the determinants of urban household demand for cassava products in Nigeria, Tsegai and Kormawa (1985) used the Almost Ideal Demand System. In the study, income, price and household characteristics were used as the explanatory variables in the model. According to Tambi (1995), the more theoretically appealing static model of the double-log form is normally used in empirical work using cross-sectional consumption data. He used the double-log functional form in his analysis of the consumption of meat in Cameroon. Peel (1975) also used the double logarithmic regression model to estimate the Keynesian and permanent income consumption functions for the United Kingdom from 1956 to 1966. In a study on consumption expenditure on alcoholic beverages, Duffy (1982 and 1983) estimated demand equations in the log-linear form where he expressed the consumption of each alcoholic beverage as a function of real income, own price and advertising for the alcoholic beverages. In another study, however, McGuinness (1980) used data from 1956-75 to estimate a simple linear demand equation with total alcohol consumption as the dependent variable. The real price of alcohol, real income, real cost of advertising of beer, wine and spirits (individually) and the number of licensed premises were the explanatory variables. In a subsequent study, McGuinness (1983) estimated separate linear demand equations for beer, wine and spirits with the volume of consumption of each beverage as the dependent variable. He however acknowledged that the simple linear regression model is a rather simplistic way of specifying a demand function, which has income as one of the regressors.

Deaton and Muellbauer (1980b) revealed that the double log functional form is the most common specification for consumption expenditure studies. The advantage with this specification is that the estimated parameters can be interpreted as elasticities or propensities. Deaton and Muellbauer (1980b) also pointed out that there are several weaknesses in the linear expenditure system that makes it unattractive in applied work. As the name indicates, the demand functions are linear in expenditure and accordingly, Engel's law cannot hold. Moreover, it is not possible to test restrictions implied by consumer theory, such as the hypotheses of symmetry and homogeneity. It was further explained that its functional form is restrictive in that only substitutes and normal goods are allowed if the system is to be theoretically consistent.

A non-linear specification of per capita expenditure is generally accepted in both theoretical and empirical literature on income elasticity estimation. Since a log-linear specification of per capita expenditure would restrict the elasticity coefficient to be constant across income levels and theory suggests that this elasticity is likely to decline as income level increases (i.e. that income/expenditure elasticity is an inverse function of income level), an alternative specification for which per capita expenditure is specified as a quadratic function could be considered. Nutrition studies that use loglinear relationships assume constant elasticity. Many studies have, however, used forms that permit variable elasticities (e.g. Pitt, 1983; Strauss 1984; Strauss and Thomas, 1990; Behrman and Wolfe, 1984; Timmer and Alderman, 1979). Timmer and Alderman (1979) particularly found quadratic specification to have the best fit out of all the different forms of Engel specifications that were tried. Engel specification implies that income elasticity or expenditure elasticity declines with income level (also see Adebayo, 2004).

Empirical comparisons between models have been rare, and most of them lack a full-fledged formal testing framework. The earliest example is perhaps Theil (1965), who used the average information inaccuracy to judge the different systems. The coexistence of a large and growing number of demand systems, however, raises the problem of choosing between them in applied work, which relies upon some sort of knowledge of consumer behaviour, such as price elasticities. The general finding that elasticities are sensitive to the underlying specification, and often also the results based upon these elasticities, renders acute the problem of formally discriminating between competing demand systems. Although the selection of the most appropriate model is, formally speaking, a contextdependent

decision-theoretic problem, final decisions are likely to be governed by outcomes of formal statistical tests.

Estimation of demand functions consistent with economic theory has been one highly published area in the last forty years. Majority of the papers follow the adoption of flexible functional forms and relies heavily on duality theory. The Generalized Leontief (Diewert, 1971), the translog (Christensen et al., 1975), the Rotterdam (Theil, 1965, 1975) and the Almost Ideal Demand System or AIDS (Deaton and Muellbauer, 1980a) are examples of popular demand models. Their functional forms are locally flexible, that is, they do not put *a priori* restrictions on the possible elasticities. Instead, they possess enough parameters to approximate any elasticity at a given point. These locally flexible functional forms often exhibit small regular regions. Thus, a number of alternative flexible functional forms with larger regular regions have been developed. Examples include the Quadratic AIDS model (QUAIDS) (Banks et al., 1997), the Laurent model (Barnett, 1983, 1985, Barnett and
Lee 1985, and Barnett et al. 1985, 1987) and the Generalized Exponential Form (G.E.F) (Cooper and McLaren, 1996). Besides the locally flexible functional forms, a semi-nonparametric approach was used to specify globally flexible functional forms with enough parameters to approach any elasticity at any point. Gallant (1981) put forward the Fourier model using the sin/cos series extensions. The Asymptotically Ideal Model (Barnett and Jonas, 1983 and Barnett and Yue, 1998) is an application of the framework of Gallant (1981) to the Muntz-Szatz series expansion.

Although many functional forms are available for the economist to use, economic theory does not answer the critical question of which specification is the best one to choose in estimating demand functions using a given data set. Different approaches are proposed in the literature. An intuitive approach consists of estimating different specifications of demand functions given a data set and selecting the one that has the best goodness of fit statistics.

Fisher *et al.* (2001) compared three locally flexible functional forms (the Generalized Leontief, the Basic Translog, and the AIDS), three effectively globally regular functional forms (the Full Laurent model, the QUAIDS, the G.E.F) and two globally flexible functional forms (the Fourier model and the Asymptotically Ideal Model (AIM)). Their comparison was based on criteria such as the Akaike Information criterion, the Bayesian-Schwartz information criterion, the elasticities of substitution and out-of-sample forecasts. Using a data set of quarterly US private consumption, prices and expenditures

that cover 1960 (first quarter) to 1991(fourth quarter), they find that global models perform better than locally flexible functional forms.

A second approach uses the fact that the properties of the demand functions derived from neoclassical preferences are known only in the region where they satisfy regularity conditions. The preferences of a rational consumer should satisfy monotonicity and quasiconvexity. At a particular combination of prices and income, locally flexible functional forms such as the Translog and the Generalized Leontief can recover the elasticities with the appropriate choice of the model's parameters. However, they should satisfy regularity conditions at each possible value of income and prices. Knowing how large the regular region is can help support the choice of a functional form over another. Caves and Christensen (1980) compared the regular region of the GL and TL for two commodities and homothetic preferences. They concluded that the GL has larger regular region when the Allen Uzawz Elasticity of Substitution (AUES) is small and the opposite when the AUES is high. Barnett and Lee (1985) and Barnett and Jonas (1983) used a Monte Carlo study and showed that the regular region of locally flexible functional forms is relatively small.

A third approach uses a Monte Carlo study to focus on the accuracy of the demand model when the true elasticities of substitutions are known. The Translog, Rotterdam and Generalized Leontief models perform well in approximating the correct elasticities when the elasticities are similar and high. The literature in applied economics shows that the AIDS and the Rotterdam are frequently used demand specifications. The success of these two models is partly due to the possibility of estimating some of their specifications without relying on procedure of nonlinear estimation. In addition, theoretical restrictions can be imposed and tested with ease.

3.2.2.2 Empirical econometric models

Different functional forms give parameter estimates that have different economic interpretation. This section looks at the individual functional forms that have been used in empirical consumer behaviour analysis.

Linear and Translog models

Linear models specify a linear relationship among economic variables to give approximate description of some economic behaviour. An alternative approach is to consider a linear relationship among log-transformed variables. This is a *log-log* model - the dependent variable and all explanatory variables are transformed to logarithms. Since the relationship among the log variables is linear, some researchers call this a *log-linear* model**.** In some cases, only the variables at one side of the equation are transformed into logarithms; such models are referred to as semi log models.

The parameters of the linear model have an interpretation as marginal effects. The elasticities will vary depending on the data. In contrast the parameters of the log-log model have an interpretation as elasticities. So the log-log model assumes a constant elasticity over all values of the data set. The log transformation is only applicable when all the observations in the data set are positive. Despite this theoretical shortcoming, the double-logarithmic function is often the demand function of choice in applied demand analysis because of ease of estimation and generally superior fit. The drawback to double-logarithmic demand functions is that they are not theoretically plausible, in that they are neither consistent with an underlying utility function nor additive (in the sense of satisfying the budget constraint). Taylor (2005) introduced a double-logarithmic demand system that is additive. This is accomplished through an extension of the indirect *addilog* model of Houthakker (1960) that allows for all prices, not just the own-price of a good, to be included in each of the demand functions. He then applied the system to a cross-sectional data set consisting of six exhaustive categories of consumption expenditure from the four quarterly BLS (Bureau of Labour Statistics) consumer expenditure surveys for 1996 augmented with price data collected in quarterly cost ofliving surveys in the UK.

In his development of the indirect *addilog* model, Houththakker (1960) employed a mathematical device that enables any non-additive function θ_i (y) to be made additive in terms of y by the transformation,

$$g_i(y) = \sum_k^{y\theta} \theta^i(y) \quad , \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

since

$$\sum g_i(y) = y$$

The application of this transformation to the double-logarithmic demand function,

$$q_i = A_i Y^{\beta_i} \prod_{j=1}^{n} p^{\gamma_j} \quad , \qquad i, j = 1, \ldots, n \ , \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

then gives an additive system of functions:

$$f_j(y, p) = \frac{A_j y^{\beta_{j+1}} \pi_{k_j=1}^{n} P^{\gamma_k}}{\sum A_j y^{\pi_{k=1}^{n}} P_k} \quad , \quad j = 1, \ldots, n. \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The denominator in this expression for f_j (y, p) is a very complicated function of prices (p) and income (y), indeed so much so that estimation of the functions directly is pretty much intractable. However, following Houthakker's derivation of the indirect addilog model, the messy denominators can be eliminated through division of f_j (y, p) by f_i (y, p), so that:

$$\frac{q_j}{q_i} = \frac{A^j y^{\beta j + 1} \prod P^{\gamma \kappa}}{A i y^{\beta i + 1} \prod P^{\gamma \kappa}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Upon taking logarithms, this expression then becomes:

$$\ln qj - \ln qi = aij + (\beta j - \beta i) Iny + \sum (\gamma jk - \gamma ik) InPk \qquad \ldots . (5)$$

$$i, j, k = 1, \ldots n; \; j \neq i, where \ldots . aij = \ln Aj - \ln Ai$$

Expression (5) is thus seen to consist of (n – 1) double-logarithmic equations, in which the "dependent" variables are logarithmic differences, and the "independent" variables are the logarithms of income and prices. The coefficients that are estimated in these equations are not β_j and $\gamma_j k$, but rather $(\beta_j - \beta_i)$ and $(\gamma_j k - \gamma_i k)$, which would appear to leave the individual β's and γ's unidentified.

The Rotterdam Model

Analysis by Barnett (1984), Byron (1984), and Mountain (1988) show the Rotterdam model is comparable to other popular flexible functional demand specifications like the Almost Ideal Demand System (Deaton and Muellbauer, 1980*a*). A fundamental relationship exists between the effects on demand of the preference variables, prices and income.

Consider the total differential of the first order conditions of the utility maximization problem, which can be written as:

$Udq - pd\lambda = \lambda dp - Vdz$ ……. (1.1a) $p'dq = dx - q'dp,$ …….. (1.1b)

where:

$$U = \square_{\square\square}(\partial^2 u/\partial q_i)\partial q_i \square_{\square\square} \ldots and \ldots V = \square_{\square\square}\square(\partial^2 u/\partial q_i)\partial z \square_{\square\square}.$$

U is the Hessian matrix and V is a matrix indicating how preference variable z affects the marginal utilities. Results of (1.1a) and (1.1b) form a system of equations known as the fundamental matrix equation of consumer demand theory (Barten, 1977).

The specification of the Rotterdam model can be directly derived from fundamental matrix equation (1.1). Key steps in this derivation are shown below. First, multiply (1.1a) by U^{-1} and rearrange to obtain:

$$dq = U^{-1}pd\lambda + \lambda U^{-1}(dp - vdz/\lambda) \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1.2)$$

Result (1.2) provides a preview of a basic relationship between the effects of prices and the preference variable. This result can be viewed as a partial demand system with the second term on the right-hand side showing the effects of prices and the preference variable, given income compensations to hold both real income and the marginal utility of income (λ) constant. The term (λU^{-1}), known as the system's specific price effect (Theil 1975), is common to both price and preference variable effects. This commonality was focused on closely in developing the model.

To obtain a total relationship demand, solve (1.1) and (1.2) for $d\lambda$, substitute this solution into (1.2) and rearrange to find the effects of prices, income and the preference variable on demand ($\partial q/\partial p'$, $\partial q/\partial x$ and $\partial q/\partial z'$). We express these results below as Hicksian or income-compensated demand equations, that is:

$$dq = \partial q/\partial x\,(dx - q'dp) + S\,(dp - Vdz/\lambda), \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1.3)$$

where:

$$\partial q/\partial x = U^{-1}p/\,p'U^{-1}p,\ \partial ?/\partial x = (1/\,p')U^{-1}P, \ldots . and$$

$$S = \lambda U^{-1} - (\partial q/\partial x)(\partial q/\partial x)'(\{\lambda/\partial\lambda\}/\partial x).$$

The term (dx – q′dp) is real income, compensated price effects are indicated by S (known as the price substitution matrix), and uncompensated price effects, $\partial q/\partial p'$, are S - $(\partial q/\partial x)q'$; and the effects of the preference variable, $\partial q/z'$, are $-SV/\lambda$.

The Rotterdam model is compensated demand (1.3) expressed in log changes. Following Barten (1964) and Theil (1975), the i^{th} demand equation for the Rotterdam model can be written as:

$w_i\, d(\log q_i) = \lambda_i\, d(\log Q) + \sum_j p_{ij}\, d(\log p_j) + ß_i\, d(\log z);\ \ i=1, \ldots, n, \qquad \ldots(1.4)$

where $w_i = p_i q_i / x$ is the budget share for good i; $\lambda_i = p_i(\partial q_i/\partial x)$ is the marginal propensity to consume; $d(\log Q) = \sum w_i\, d(\log q_i)$ is the Divisia volume index; $p_{ij} = (p_i p_j/x)\, S_{ij}$ is the Slutsky coefficient, with $S_{ij} = (\partial q_i/\partial p_j + q_j \partial q_i/\partial x)$ being the $(i,j)^{th}$ element of the substitution matrix S; and $ß_i = w_i(\partial \log q_i / \partial z)$ is the preference variable coefficient.

The general restrictions on demand are:

Adding up: $\sum_i \lambda_i = 1;\ \sum_i p_{ij} = 0;\ \sum_i ß_i = 0;$ …….(1.5a)

Homogeneity: $\sum_j p_{ij} = 0;$ …….(1.5b)

Symmetry: $p_{ij} = p_{ji}$. …….(1.5c)

Coefficients λ_i and p_{ij} are usually treated as constants in estimating the Rotterdam model. The coefficient $ß_i$ can also be treated as a constant, but for placing restrictions on preference variable effects, an alternative parameterization could also be considered.

The Almost Ideal Demand System (AIDS) Model

Deaton and Muellbauer (1980*a*), who developed the AIDS model start with the PIGLOG class of preferences which satisfies the necessary and sufficient condition for consistent aggregation across consumers; that is; conditions for the functional form of market demand equations to be consistent with the behavior of a rational representative agent. The AIDS model has a particularly attractive feature: the properties of the preference relations that generate it are known. The AIDS is derived from a known cost function with the desired properties. Results from duality theory support the representation of these preferences using a cost or expenditure function denoted c (u, p) where u stands for utility and p for price vector:

$\log c(u, p) = (1 - u) \log[a(p)] + u \log[b(p)]$ …… .(a)

The utility indicator varies between 0(subsistence) and 1(bliss); a(p) and b(p) are the costs of subsistence and bliss respectively. On the one hand, a(p) and b(p) are chosen to guarantee that the cost function is flexible (i.e. it possesses enough parameters to ensure at any single point, that its derivatives can be set equal to those of any arbitrary cost function). On the other hand, that choice is motivated by the desire to end up with demand functions possessing the appropriate properties. Hence Deaton and Muellbauer (1980a) chose the following forms:

$$\log a(p) = a_0 + \sum_k \alpha_k \log[p_k] + \tfrac{1}{2}\sum_k\sum_j \gamma^*_{kj} \log[p_k]\log[p_j] \quad \ldots\ldots\ldots\ldots (b_1)$$

$$\log b(p) = \log[a(p)] + \beta_0 \prod_{k=1}^{n} p_k^{\beta_k} \quad \ldots\ldots\ldots\ldots (b_2)$$

Back substituting the cost of subsistence and bliss (b) into (a), the cost function becomes

$$\log c(u, p) = \alpha_0 + \sum_k \alpha_k \log[p_k] + \tfrac{1}{2}\sum_k\sum_j \gamma^*_{kj} \log[p_k]\log[p_j] + u\beta_0 \prod_k p_k^{\beta_k} \quad \ldots\ldots (c)$$

The demand functions in budget shares follow from Shephard's lemma:

$$\frac{\partial \log c(up, p)}{\partial \log p_i} = w_i = \alpha_i + \sum_k \gamma_{ik} \log[p_k] + \beta_i u \beta_o \prod_k p_k^{\beta_k} \quad \ldots\ldots\ldots\ldots (d)$$

Equation (d) contains the utility indicator and will be transformed using (c). A utility maximizing consumer will equate total expenditure m to c (p, u), so that log c(p, u) = log m. It follows from (c) that:

$$u^{\beta_o} \prod_k p_k^{\beta_k} = \log m - \log_p$$

and the AIDS demand system in budget shares is:

$$w_i = \alpha_i + \sum \gamma_{ik} \log[p_k] + \beta_i \log\left[\frac{m}{p}\right] \quad \text{……..(e)}$$

where $\gamma_{ik} = \frac{1}{2}(\gamma^*_{ik} + \gamma^*_{ki})$

and the income deflator of the logarithm of income is

$$\log p = \alpha_o + \sum_k \alpha_k \log[p_k] + \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log[p_j] \quad \text{……..(f)}$$

The restrictions on the demand functions can be deduced from the cost function, since it is well known from duality theory that if the cost function is linear homogeneous and strictly increasing in prices, the Hicksian demand functions that are derived using Shephard's lemma satisfy neoclassical conditions. Therefore the following conditions should be imposed on the estimation of the constrained model:

$$\sum_{i=1}^{n} \alpha_i = 1 \quad \text{for adding up;} \quad \text{…….. (g)}$$

$$\sum_{i=1}^{n} \gamma^*_{ij} = 0; \sum_{i=1}^{n} \beta_i = 0 \quad \text{for linear homogeneity} \quad \text{…….(h)}$$

$$\gamma^*_{ij} = \gamma^*_{ji} \quad \text{for symmetry} \quad \text{……(i)}$$

Equation (e) can be interpreted as a Marshallian or uncompensated demand function in budget shares. The Hicksian price elasticities for good i with respect to good j can be derived from the Marshallian price elasticities using the Slutsky equation:

$$\varepsilon^*_{ij} = \varepsilon^H_{ij} = \varepsilon^M_{ij} + w_i \eta_i \quad \text{……(j)}$$

where ε^M_{ij} or ε_{ij} is the Marshallian elasticity for good i with respect to the price of good j, w_i is the budget share for good i and η_i is the income elasticity for good i.

To obtain the price and income elasticities, we know that in general the uncompensated price elasticity can be derived from the Marshallian demand functions expressed in expenditure shares using equation (k),

$$\varepsilon_{ij} = \partial \log q_i / \partial \log p_j = -\delta_{ij} + \frac{\partial}{\partial \log \log w p_i^{i}} = -\delta_{ij} + w\underline{1}_i * \overline{\partial \log \partial w_i p_j} \quad \ldots\ldots\ldots\ldots (k)$$

where δ_{ij} is the Kronecker delta defined as follows:

$\delta_{ij} = 1$ if i = j or

$\delta_{ij} = 0$ if otherwise ……. (l)

Applying equation (k) to the demand function (equation *e*) yields:

$$\varepsilon_{ij} = -\delta_{ij} + w\underline{1}_i (\gamma_{ij} - \beta_i \_\_\_\_\_ \partial \partial \log \log p p_j) \quad \ldots\ldots\ldots\ldots\ldots\ldots (m)$$

By substituting the derivative of the logarithm of the income deflator (equation *f*) with respect to the logarithm of the price of good j, we have:

$$\frac{\partial \log_p p_j}{\partial \log} = \alpha_j + \sum_k \gamma_{kj} \log p_k \quad \ldots\ldots\ldots\ldots\ldots\ldots (n)$$

Substituting (n) into (m), the final expression of the Marshallian price elasticity is:

$$\varepsilon^{M}{}_{ij} = -\delta_{ij} + \underline{w^{1}}_i (\gamma_{ij} - \beta_i (\alpha_j + \sum_k \gamma_{kj} \log p_k)) \quad \ldots\ldots\ldots\ldots\ldots\ldots (o)$$

To derive the income elasticity for the AIDS model, we know that

$\log w_i = \log p_i + \log q_i - \log m$. We use the following relation:

$$\frac{\partial \log q_i}{\partial \log m} = 1 + \frac{\partial \log w_i}{\partial \log m} = 1 + \frac{1}{w_i}\frac{\partial w_i}{\partial \log m} \qquad \ldots\ldots\ldots\ldots\ldots\ldots(p)$$

Applying (p) to (e), we obtain the final expression for the income elasticity for good *i*:

$$\eta_i = 1 + \frac{\beta_i}{w_i} \qquad \ldots\ldots\ldots\ldots\ldots(q)$$

The Allen Uzawa elasticities of substitution generated by the AIDS are recovered from the price elasticities and the budget shares after computing the Hicksian elasticities from the Slutsky equation (j).

Unlike the Rotterdam model, the AIDS model allows for the negative semi-definiteness of the Slutsky matrix to be tested at each data point. Using (j) it is straightforward to check, using the adding-up restriction, that the sum of Hicksian elasticities is unknown unless the expenditure shares are equal $\left(\sum_{i=1}^{n} \varepsilon_{ij}^{H} = \sum_{i=1}^{n} \gamma_{ij} / w_i\right)$; in which case, the Slutsky matrix is negative semi-definite if:

$$\varepsilon_{11}^{H} < 0 \text{ and } \det\begin{pmatrix} \varepsilon_{11}^{H} & \varepsilon_{12}^{H} \\ \varepsilon_{21}^{H} & \varepsilon_{22}^{H} \end{pmatrix} = \varepsilon_{11}^{H} * \varepsilon_{22}^{H} - \varepsilon_{21}^{H} * \varepsilon_{12}^{H} > 0 \qquad \ldots\ldots\ldots\ldots(r)$$

In sum, the uncompensated (Marshallian) own price elasticity (ε_{ii}) and cross price elasticity (ε_{ij}) from empirically estimated models, which measure how a change in the price of one product affects the demand of this product and other products with the total expenditure and other prices held constant, are given by the following expressions respectively:

$$\varepsilon_{ii} = (\gamma_{ii} / w_i) - (\beta_i + 1) \quad \varepsilon_{ij}$$

$$= (\gamma_{ii} / w_i) - \beta_i w_j / w_i$$

The compensated (Hicksian) price elasticities (ε_{ii}^{*} and ε_{ij}^{*}), which measure the price effects on the demand assuming the real expenditure is constant, are given by the following expressions respectively:

$$\varepsilon_{ii*} = \gamma_{ii} / w_i + w_i - 1 \quad \varepsilon_{ij*} = \gamma_{ij} / w_i + w_j$$

Also, the compensated price elasticity (ε_{ij}^{*}) can be derived easily by using the expenditure elasticity (η_i), uncompensated price elasticity (ε_{ij}) and food budget share (w_j) using the following expression:

$$\varepsilon_{ij}^{*} = \varepsilon_{ij} + \eta_i \times w_j$$

The sign of the calculated compensated cross price elasticity (ε_{ij}^{*}) indicates the substitutability or complementarity between the commodities under consideration.

The Linear Approximation of the AIDS model: LA-AIDS

The nonlinearity of the AIDS is often viewed as a technical problem that model builders usually circumvent by using a linear approximation of the income deflator in equation (f). Deaton and Muellbauer (1980a) suggest using the Stone's price index in situations where prices are closely collinear. The Stone's geometric price index is given by equation (s), where w_j is the expenditure share of good j.

$$p = \prod_{j=1}^{n} p^{w_j} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(s)}$$

The estimation of the LA-AIDS model has a potential simultaneous bias problem because the expenditure share w_j is in both sides of the demand function for good j in expenditure share. Very often, this problem is ignored. Another issue with the Stone's index is that the gain in estimating the LA-AIDS model is almost offset by the difficulties in deriving the correct elasticities. These weaknesses make the LA-AIDS model unattractive and inappropriate for this study.

The Quadratic Almost Ideal Demand System (QUAIDS) Model

Economists have spent considerable time and effort modeling consumer demand for food and food products. Much of this analysis has used empirically tractable demand systems, including the Linear Expenditure System, the Rotterdam model and the Almost Ideal Demand System. However, a quick scan of the demand analysis literature indicates a great deal of inertia with respect to the chosen functional form. According to Cranfield (2005), few of applied demand studies for food products go

beyond the AIDS and/or Rotterdam models. Such inertia is problematic given the limitations of these models used. The AIDS model is a rank[2] two-demand system, while the Rotterdam model has constant marginal budget shares. Such weaknesses limit the application of these models to data sets that show wide variation in expenditure levels (such as across countries spanning the development spectrum).

Recently developed demand systems offer not only more flexible expenditure responses, but also more flexible price effects. Specifically, Banks *et al* (1997) generalize PIGLOG preferences by introducing a term that is quadratic in the logarithm of real expenditure into Deaton and Muellbauer's (1980a) Almost Ideal Demand System (AIDS) model. They show that for exactly aggregable, rank-three demands, the resulting demand system is quadratic in the logarithm of real expenditure. This Quadratic AIDS (QUAIDS) model allows for more general income effects than the AIDS. Banks *et al*. (1997) also show that if some commodities require extra terms in total expenditure, then parsimony, coupled with utility theory, restricts the nonlinear term to be quadratic in log income (or expenditure). Based on this restriction, they derive an extension of the AIDS model - the quadratic almost ideal demand system (QUAIDS) - which has log total (per capita) expenditure as the leading term in budget share equations and higher order total expenditure terms.

The QUAIDS model assumes that household preferences belong to the following quadratic logarithmic family of expenditure functions:

$$\ln c(u, p) = \ln a(p) + ub(p) / \{1 - \lambda(p)\, b(p)\, u\} \quad \text{………………(i)}$$

where u is utility, p is a vector of prices, a(p) is a function that is homogenous of degree one in prices, b(p) and λ (p) are functions that are homogeneous of degree zero in prices. The corresponding indirect utility (V) function is:

[2] *For all demand systems that are linear in functions of income, demand system rank is the maximum rank of a matrix of coefficients associated with functions of income (or expenditure). More precisely, demand system rank is the "...maximum function space spanned by the Engel curves of the demand system," (Lewbel, 1991). Gorman (1959) proved the rank of such a demand system is at most three; thus, such demand systems are referred to as "full rank demand systems." The concept of rank is useful in developing taxonomy of demand systems according to Engel curve shape. Rank one demand curves, the most restrictive demand systems, are independent of income; rank two demand systems are less restrictive, allowing linear Engel curves not necessarily through the origin; while rank three (i.e., full rank) demand systems are least restrictive, allowing for non-linear Engel responses).*

$$\ln V = \{[\ln x - \ln a(p) / b(p)]^{-1} + \lambda(p)\}^{-1} \quad \text{.....(ii)}$$

where x is total expenditure. The specific functional form for $\lambda(p)$ is:

$$\lambda(p) = \sum_i \lambda_i \ln p_i \quad \text{where } \sum_i \lambda_i = 0 \quad \text{.....(iii)}$$

and *where* $i = 1, \ldots, k$ *and* k denotes the number of goods entering the demand model.

Application of Shepard's lemma to the cost function (i) or Roy's identity to the indirect utility function (ii) gives the QUAIDS model in budget shares form:

$$w_i = \alpha_i + \sum_j^k \gamma_{ij} \ln p_j + \beta_i \ln [x/a(p)] + \lambda_i / b(p) \{\ln [x/a(p)]\}^2 \quad \text{.....(iv)}$$

where α, β, γ, and λ are parameters.

As can be seen from the budget share equation (iv), the QUAIDS model reduces to AIDS when all of the λ's are zero across all equations. Hence, the AIDS model is nested within QUAIDS and the AIDS specification can be tested based on the statistical significance of the λ's. The theoretical restrictions of adding-up, homogeneity, and symmetry in the QUAIDS model are expressed in terms of its parameters as in the case of the original AIDS model.

The parameter α_i in the QUAIDS model can be interpreted as the share of an item in the budget of a subsistence household (i.e., the case of $u = 0$) at the base year prices (Meenkashi and Ray, 1999). The expression $\beta_i + 2 (\lambda_i / b(p))[\ln (x/a(P))]$ measures the impact of a 1% increase in real expenditure on the budget share of commodity i. Unlike the AIDS model where $\lambda_i = 0$, this expression is capable of changing signs depending on the point in the expenditure spectrum. In other words, the QUAIDS model allows the possibility of normal goods becoming inferior or inferior goods becoming normal, as one moves along the expenditure spectrum of households. In contrast, expenditure elasticities are all constant in the AIDS model (Bopape, 2006). Formulae for the QUAIDS expenditure and price elasticities are derived by differentiating the budget share equation (iv) with respect to ln x and ln p_j, respectively.

The Rational Rank Four AIDS (RAIDS) Model

Lewbel's (2003) RAIDS model is a further generalization of the QUAIDS model by Banks *et al* (1997). Lewbel (2003) showed that utility derived, budget share based demands can be expressed as a general polynomial of deflated expenditure. The RAIDS model is a rank four demand system that nests the QUAIDS and AIDS models as special cases that can be tested with linear restrictions on estimated parameters. The value of using the RAIDS model relates to its flexible (and more general) price and expenditure responses. Such flexibility is advantageous when modeling international demand patterns, as one may suspect that scope exists for different preference structures according to a country's position in the development spectrum. Such differences might arise from cultural differences, differences in the scope and nature of goods available in the market place, and other institutional and development based features. Lewbel's RAID model is quite complicated (see Cranfield, 2005 for the mathematical expression).

Cranfield *et al* (2002 and 2003) and Cranfield (2005) conducted a study where a Rational Rank Four AIDS model (RAIDS) was used to estimate consumer demands for final goods and services in countries spanning the development spectrum. The data were from the 1996 International Comparison's Project (ICP), which contains expenditure data for many final goods and services in countries spanning the development spectrum. RAIDS was estimated using the entire sample and sub-samples based on the country's level of per capita expenditure. Results indicate selection of nested functional form differed by sub-sample. AIDS was selected for the low per capita expenditure countries, while QUAIDS was selected for the middle and high per capita countries, and when the whole sample was considered. RAIDS was rejected in favour of either AIDS or QUAIDS.

3.3 Empirical comparison of flexible functional forms

The demand-systems approach provides an effective method to impose and test neoclassical restrictions on individual behaviour; specifically the monotonicity and curvature restrictions. A functional form is selected to approximate the indirect utility or cost function and then the corresponding demand or share equations are derived using Roy's identity or Shephard's lemma. There are, however, many functional forms that can be used. These flexible functional forms differ in

their specific parameterization and approximation properties. Among the most popular of the earliest *locally flexible* functional forms are the generalized Leontief, translog, and Almost Ideal Model (AIDS) specifications. These locally flexible functional forms initially showed some promise but they have some limitations. For example, Caves and Christensen (1980), and Barnett *et al*. (1985) show that the regularity regions of local flexible functional forms can be relatively small. Furthermore, the Monte Carlo analyses of Guilkey and Lovell (1980) and Guilkey *et al*. (1983) find that the generalized Leontief and the translog fail to provide a satisfactory approximation to the true data-generating process for the moderate and even large elasticities of substitution that often arise in applications. Another drawback is that the translog model can classify goods as complements when they are actually substitutes. Finally, an important reason for the failure of these locally flexible forms is that they can only provide a local approximation to the true data-generating function at a single point in a delta neighborhood.

These problems led to the development of locally flexible functional forms that have larger regularity regions and higher rank models that can better approximate non-linear Engel curves. Cooper and McLaren (1996) discuss functions that have larger regularity regions that include all data points in the domain, as well as real expenditures, calculated from any combination of prices and nominal expenditures, exceeding the minimum value in the sample. Examples of these functions include the Laurent models introduced by Barnett (1983, 1985), and Barnett *et al*. (1985, 1987) and the General Exponential Form (GEF) of Cooper and McLaren (1996). The rank of a demand system as discussed in Lewbel (1987a&b, 1990, 1991), has implications for aggregation and the nonlinearity of Engel curves. Higher rank models, such as the Quadratic Almost Ideal Demand System (QUAIDS) of Banks *et al*. (1997) which is rank 3, can approximate more non-linear Engel curves often found in empirical analysis. They note that at sufficiently high expenditure levels, a QUAIDS budget share may violate the zero-to-one range. Nonetheless, it appears as though the regular region is considerably larger than the locally flexible forms and thus they classify the QUAIDS model as effectively globally regular. While these models provide a better approximation over the initial flexible forms, they may not be asymptotically regular and may fail to provide an effective approximation of the derivatives- and hence the curvature of the true data-generating function. Seminon-parametric (SNP) functions can provide an asymptotically global approximation for complex economic relationships. These SNP functions provide global approximations to the true data generating process and its partial derivatives. By *global approximation,* it is implied that the flexible functional form is capable, in the limit, of approximating

the unknown underlying generating function at all points and thus of producing arbitrarily accurate elasticities at all points. Two such SNP functions are the Fourier flexible functional form (FFF) and the Asymptotically Ideal Model (AIM).

Fisher *et al* (2001) provides a theoretical comparison of eight different functional forms by grouping them into three sets that have broadly similar characteristics. These sets are (1) locally flexible forms (The Generalized Leontief –GL, The Basic Translog –BTL, The Almost Ideal Demand System – AIDS), (2) effectively globally regular forms (The Full Laurent Model, Quadratic AIDS –QUAIDS, The General Exponential Form – GEF), and (3) asymptotically globally flexible (The Fourier Model, The Asymptotically Ideal Model –AIM). They selected these eight forms, even though there are many other possibilities, because they provide a representation of the three groups of functional forms that are in the widest use in consumer studies.

Caves and Christensen (1980) show that the GL has satisfactory local properties when preferences are nearly homothetic and substitution is low, implying that the GL can approximate Leontief preferences well. However, when preferences are not homothetic and substitution increases, they show that the GL has a rather small regularity region.

The BTL introduced by Christensen *et al*. (1975) approximates the reciprocal of the indirect utility function using a second-order Taylor series expansion. Guilkey *et al*. (1983) show that the translog is globally regular if and only if preferences are Cobb–Douglas, meaning that the translog performs well if substitution between all commodities is close to unity. They show that the regularity properties deteriorate rapidly when substitution diverges from unity. The AIDS model of Deaton and Muellbauer (1980a) is a widely used flexible demand specification obtained from the PIGLOG (price-independent generalized logarithmic) expenditure function. The approximation performance of the AIDS model may be poor because it is a locally flexible form and may have a relatively small regularity region.

Models such as the GL, BTL, and AIDS are locally flexible but may have a relatively small regular region. A partial solution to the problem of small regular region has been provided by Barnett (1983), Banks *et al*. (1997), Cooper and McLaren (1996), and others. These authors developed locally flexible functional forms with larger theoretical regularity regions that are capable of approximating more general Engel curves. These functions are labeled by Cooper and McLaren as "effectively globally regular". The share equations for the Full Laurent model (see Barnett, 1983) are homogeneous of

degree zero in the parameters and require an arbitrary normalization. Banks *et al*. (1997) developed a rank three demand system extension of the AIDS model, the Quadratic AIDS model. Constraints are imposed so that the estimated demands satisfy the budget constraint and are homogeneous of degree zero in prices and total expenditure. Another flexible form that increases the range of Engel curves responses is the General Exponential Form (GEF) of Cooper and McLaren
(1996).

The functional forms considered so far are capable of approximating an arbitrary function locally at a single point in a delta neighbourhood of an often small but unknown size. A more general approach to approximating the true data-generating function is to use functional forms that have global properties. The idea behind these semi-non-parametric (SNP) functions is to expand the order of the series, as the sample size increases, until the SNP function converges asymptotically to the true data-generating process and therefore to the true elasticities of substitution. Two such functional forms in general use are the Fourier flexible functional form and the Asymptotically Ideal Model (AIM). Monte Carlo studies by Fleissig *et al*. (1997), Terrell (1995) and Chalfant and Gallant (1985) show that the regularity region of the AIM and Fourier are much larger than that of the GL and BTL.

The various tests performed by Fisher *et al* (2001) show that the BTL, AIDS and Laurent models had relatively more violations of concavity than the GL, GEF, QUAIDS, AIM, and Fourier models.
Whether a time trend was included or not, the GEF and QUAIDS models always had no violations of concavity for all samples. Recall that the regular region for these models grows as income grows, which probably occurred over much of the sample even though GARP is rejected over the entire sample. Thus, the GEF and QUAIDS models found the data consistent with rational consumer behaviour even though the data failed the GARP test. On the basis of this test, it appeared that the QUAIDS, GEF, AIM and Fourier are the better models.

In their tests, Fisher *et al* (2001) used standard information criteria for comparing the models.
Reports of the Akaike Information Criterion (AIC) and Bayesian-Schwarz Information Criterion (SIC) for these tests, for which a low value is desirable, showed that the GEF was superior but the differences among the models were often small. This is an important result because then one might be more likely to prefer the effectively global forms over the AIM and FFF since the latter are more parameter intensive than the other functions. Theoretical results imply that both the AIM and Fourier will

approximate the true data-generating function asymptotically, but the results can be different in small samples. On the other hand, the effectively globally regular GEF and QUAIDS specifications are not asymptotically globally regular so that both asymptotic and small sample results may differ.

Next, Fisher *et al* (2001) provide a simple way of comparing how the eight functional forms measure income responses by examining how the models fit the three smallest and largest values over the estimated sample (1960–80). They test to see if the fitted value is statistically significantly different from the realized value for the Wald statistic using the delta method. At the 5% level of significance, they looked for large p-values as evidence in favour of a particular specification. Accordingly, for the 36 'observations' (taking 'time' and 'non-time' as separate tests), they had 23/36 instances in which the QUAIDS model successfully fit the extreme observations. This was the best performance, but the two other effectively global models (the Laurent and the GEF) did almost as well, as did the AIM model. They were not surprised at the performance of the QUAIDS model, since this rank 3 model was designed to deal with non-linear Engel curves.

The final issue for Fisher *et al* (2001) was how to choose among the GEF, QUAIDS and the two global models, the AIM and the Fourier. A method of comparing the informational content of the parameter estimates was to look at the behaviour of the output of the models in the form of the elasticities of substitution. Here they were looking for inconsistencies in the pattern of elasticities from one model to the next.

Pursuing the issue of the expenditure elasticities, they first looked at those for non-durables. They concentrated on expenditure elasticities from the GEF, QUAIDS, AIM and Fourier flexible forms since these appear to be the functions that gave the best approximations on these data. These expenditure elasticities, calculated without a time trend, ranged from 0.4 to 1.1 with the AIM and Fourier estimates, for the most part, slightly smaller estimates. They had no firm priors about these elasticities, although they found the estimated expenditure elasticities of less than unity for nondurables a reasonable finding. It was noted that the two globally flexible functions showed rising expenditure elasticities through the 1960s, while the two effectively global functions tested did not. They, however, suspected that the rising elasticities were possibly correct, as per capita incomes rose considerably during the period.

A final way to evaluate contrasting models of the same phenomenon was to compare their out-ofsample forecasting performance. There are actually numerous ways to compare the forecasting capabilities of econometric models. Fisher *et al* (2001) followed Mathews and Diamantopoulos (1994) who suggest four measures based on an extensive evaluation of many methods for evaluating forecasts. They propose using the following metrics: the average absolute percentage error, root mean square error, mean absolute error, and R-Square. All eight functional forms were estimated over the period 1960:1–1980:4 and then forecasted to 1983:4 for one-, two-, and three-period intervals. Overall, no flexible form appeared to be statistically better than the others in this list.

All models were estimated using US aggregate consumption data that was found to be consistent with a well behaved utility function over much of the sample. The global models, especially the QUAIDS, FFF, and AIM seem to have dominated on these tests. All the models fit the data well, but a preference should be expressed for the more parametrically parsimonious functions; these are the GL and the AIDS models. Over the GARP consistent data set, quasi-concavity tests indicated that the QUAIDS, GEF, AIM, FFF, and GL performed well, with and without the time trend. The SIC and AIC tests favoured the GL, AIDS, GEF, and QUAIDS models, with the GEF being superior. The Laurent, GEF, and particularly the QUAIDS model fit the extreme levels of expenditures best; the AIM model also did well in this test. Looking at substitution elasticities, they found those from the globally flexible AIM and FFF most plausible, with the GL least plausible. Finally, more support was obtained for the forecasting performance of the AIM, FFF, and Laurent models, although the GL was best in one category.

Across all tests, three specifications seem to stand out. These were the QUAIDS, FFF, and AIM models, the first being effectively global and the latter two being asymptotically global. The GEF model (also an effectively global specification) also did well on most tests. If nothing else, the importance of employing a globally regular model is convincingly demonstrated in the work of Fisher *et al* (2001). They could, however, not say whether this should be achieved ‘effectively’ or ‘asymptotically’ on the evidence, but if one worries about parametric parsimony, then the effectively global methods (QUAIDS and GEF) might be preferable.

3.4 Summary on the econometric models

Numerous Engel curve and demand system studies confirm that budget shares are well approximated by low order polynomials (e.g. Deaton and Muellbauer, 1980a; Lewbel, 1991; Blundell et al, 1993).

Recent theoretical and empirical work (Banks *et al*, 1997) suggesting that the rank of the demand system need not be greater than three have rendered rank-3 systems popular tools for empirical demand analysis. Also in his study to compare and contrast the quadratic and modified AIDS and a rational rank four demand system using Canadian food demand data, Cranfield (2005) concluded that economists should go beyond the Almost Ideal Demand System (AIDS) , at least when modeling demand for food (also see Cash and Goddard, 2006). Popular flexible functional form demand systems, such as the Almost Ideal (AIDS) model of Deaton and Muellbauer (1980a) and the Translog (TL) model of Christensen *et al* (1975) may not be statistically adequate for empirical demand analysis based on individual household data. They explained that it is so because such models do not contain higher order expenditure terms to capture nonlinearities in the utility effects pertaining to these data, which have been found by a number of parametric and nonparametric studies to be significant for certain expenditure share equations. For this reason investigators have recently been using rank-3 demand systems derived from the Quadratic Logarithmic (QL) cost function, which are quadratic functions of the logarithm of expenditure or income, such as the Quadratic Almost Ideal Demand System (QUAIDS) of Banks *et al.* (1997) and the Almost Ideal Quadratic Logarithmic (AIQL) model of Pashardes (1993).

Lewbel (2003) studied the rank of demand systems and compared the rank four demand system with the rank three (QUAIDS). The data set is the same one used by Banks *et al.* (1997) to estimate the integrable Quadratic Almost Ideal Demand System (QUAIDS), a quadratic logarithmic rank three functional form. These data are a demographically homogeneous subsample of the UK Family Expenditure Survey. Here nondurable expenditures were divided into food, fuel, clothing, alcohol, and others. Nondurable expenditures were assumed to be separable from other components of utility (such as durables and leisure). Only the demands generated by a sub-utility function over these five components of nondurables were estimated, and hence only the rank of this subsystem was tested. The rank of a sub-utility function is a lower bound on the rank of the entire utility function. Using both parametric and nonparametric tests, Banks *et al.* (1997) empirically show that quadratic logarithmic utility appears to be the best rank three functional form for modeling demands.

Cranfield *et al* (2002) estimated consumer demand across the development spectrum and the results of their study also formally failed to reject rank three demand models at the 95% level. They concluded that empirical estimates of the Engel curves in their study generally confirm the results found in previous studies that demands appear to be rank three, although they found some evidence for the possibility of rank four, which may prove useful for estimation in contexts where demands of high rank are suspected, such as systems having a large number of diverse goods.

Molina and Gil (2005) modeled the demand behaviour of consumers in Peru. They estimated a demographic version of the Quadratic Almost Ideal Demand System (QUAIDS) using one Peruvian cross-section from 1997. Study results indicated that the rank two AIDS (the normal AIDS) model was rejected in favour of the rank three QUAIDS model. Bopape (2006) compared the AIDS and QUAIDS models in his analysis of food expenditure patterns in South Africa. He found out that on average, the AIDS expenditure elasticity estimates tended to be larger than the estimates based on QUAIDS. The AIDS model was also found to systematically overstate the welfare gains of the tax reform considered in his study, particularly for households with large expenditure levels. He recommended QUAIDS ahead of AIDS.

Recently, several demand studies have emerged that confirm the appropriateness of QUAIDS in modeling preferences. Examples using developed country data include Abdulai (2002) who applied QUAIDS to the food expenditure data from Switzerland, Moro and Sckokai (2000) who used Italian food expenditure data, Banks *et al*. (1997) and Blundell & Robin (1999) who both used expenditure data on broad consumption goods from the U.K., and Fisher *et al*. (2001) who applied QUAIDS to the U.S. aggregate consumption data. A number of studies in developing countries are also emerging that support QUAIDS. However, these studies are fewer compared to those from developed countries. Apart from Bopape's (2006) study in South Africa, other examples include Abdulai and Aubert (2004) using Tanzanian food expenditure data, Meenkashi and Ray (1999) using Indian food expenditure data, Gould and Villarreal (2006) using food expenditure data from urban China, and Molina and Gil (2005) using aggregate consumption data from Peru.

On the basis of the advantages QUAIDS and AIDS have over other functional forms and the overwhelming support they enjoy among economists in the area of consumer behaviour analysis, this

study adopted these functional forms to analyse household yam consumption patterns in Ghana. An attempt was also made to estimate the semi-log and double-log models to enable a comparison of the parameter estimates from various functional forms in the Ghanaian context. The regression analysis was conducted in two stages. In the first stage the composite model was run with household food budget share for all yam products as dependent variable. In the second stage, separate yam budget share models were built for households in the different urban centers covered in the study. By disaggregating in this fashion, greater attention was given to the extent to which household characteristics, personal and socio-cultural factors influence yam expenditure patterns across seasons and urban centers in Ghana.

3.5 Chapter Summary

The chapter discussed the study area and the methodology for the study. Both diary survey and personal recall interview with the use of structured questionnaire were employed to gather data for the study. The Almost Ideal Demand System (AIDS) and Quadratic Almost Ideal Demand System (QUAIDS) were used to estimate the various consumption models in the study by employing the Ordinary Least Squares (OLS) method. The semi-log and double-log models were also used to estimate yam expenditure models to allow for comparison. Apart from the composite model, the yam budget share models were run for different urban centers, income groups and across seasons. Chapter Four, which follows, provides a discussion on the characteristics of the respondents and household expenditure with emphasis on yam budget shares analysis.

CHAPTER FOUR

4.0 RESPONDENT CHARACTERISTICS AND HOUSEHOLD FOOD EXPENDITURE ANALYSIS

4.1 Introduction

This chapter provides a descriptive analysis of household expenditure patterns in the selected urban centers with special focus on food budget shares analysis. The emphasis in all these analyses was placed on yam as compared to related food commodities.

4.2 Characteristics of Respondents

Respondents selected for the study had diverse characteristics which were expected to influence their purchasing and consumption behaviour.

4.2.1 Gender

As shown in Table 4.1, about 55% of all households interviewed were male-headed. This is a reflection of the national situation where majority (70.5%) of households in Ghana are male-headed (GSS, 2008). In Accra, Kumasi and Tamale, more than 50% of the households were male-headed. However, in Techiman females formed the majority (61%) of household heads.

Table 4.1: Gender Distribution of Respondents

Sex	Accra		Kumasi		Techiman		Tamale		Pooled	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Male	84	58.3	69	64.5	47	39.2	67	56.8	267	54.6
Female	60	41.7	38	35.5	73	60.8	51	43.2	222	45.4
Total	**144**	**100.0**	**107**	**100.0**	**120**	**100.0**	**118**	**100.0**	**489**	**100.0**

Source: Field survey, 2006/2007.

4.2.2 Age

Respondents for the study have been categorized into different age groups by the author in Table 4.2. In all study communities, the middle aged consumers (30 - 65 years age group) formed the majority in the sample. For the pooled sample, this group of consumers constituted 77% and consumers below 30 years constituted 15%.

Table 4.2: Age Distribution of Respondents

Age (Years)	Accra		Kumasi		Techiman		Tamale		Pooled	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
< 30	18	12.9	17	15.9	19	15.8	19	16.1	73	15.1
30 - 65	118	84.3	88	82.2	81	67.5	88	74.6	375	77.3
> 65	4	2.9	2	1.9	20	16.7	11	9.3	37	7.6
Total	**140**	**100.0**	**107**	**100.0**	**120**	**100.0**	**118**	**100.0**	**485**	**100.0**

Source: Field survey, 2006/2007.

4.2.3 Educational level

Table 4.3 provides the distribution of respondents according to their level of education. Majority (40%) of the pooled sample had either no formal education or attained only basic formal education.

Generally, the consumers were evenly distributed across the three categories of educational level in the Table.

Table 4.3: Distribution of Respondents by Educational Level

Educational Level	Accra		Kumasi		Techiman		Tamale		Pooled	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Basic/No formal education	34	23.8	47	43.9	68	56.7	47	39.8	196	40.2
Secondary/ Pre-tertiary	53	37.1	25	23.4	44	36.7	32	27.1	154	31.6
Tertiary	56	39.2	35	32.7	8	6.7	39	33.1	138	28.3
Total	**143**	**100.0**	**107**	**100.0**	**120**	**100.0**	**118**	**100.0**	**488**	**100.0**

Source: Field survey, 2006/2007.

4.2.4 Income Level

Income level in the study was defined as cash income earned or received by households. Consumers considered in the study fell within different monthly income groups as shown in Table 4.4. An analysis of per capita expenditure figures in GLSS5 suggest that households in Ghana could be put in three main income groups (low, Middle and high). Low income households have an average of GHC58.00 as per capita monthly income. The middle income group has average per capita income of about GHC200.00 per month (GSS, 2008). It could be deduced from Table 4.4 that consumers in the middle income category (GH¢101 – 500) formed majority (52%) of the pooled sample; low income (< GH¢100) consumers formed about 37% of the pooled sample; and 11% were in the high income (> GH¢500) group. High income consumers formed less than 10% of the sample from all the study communities, except in Accra where 27% of respondents was in the high income group.

Table 4.4: Distribution of respondents by Income level

Monthly Income (GH¢)	Accra		Kumasi		Techiman		Tamale		Pooled	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
< 20	5	3.5	3	2.8	2	1.7	12	10.2	22	4.5
20 – 50	5	3.5	11	10.3	11	9.2	20	16.9	47	9.7
51 – 100	11	7.7	37	34.6	34	28.3	30	25.4	112	23.0
101 – 200	36	25.4	42	39.3	34	28.3	23	19.5	135	27.7
201 – 500	47	33.1	13	12.1	34	28.3	25	21.2	119	24.4
> 500	38	26.8	1	0.9	5	4.2	8	6.8	52	10.7

Total	**142**	**100.0**	**107**	**100.0**	**120**	**100.0**	**118**	**100.0**	**487**	**100.0**

Source: Field survey, 2006/2007.

4.2.5 Religious affiliation

Table 4.5 provides the distribution of the respondents according to their religious affiliations. Christians and Muslims constituted 63% and 32% of the pooled sample respectively. Traditional believers and those who did not belong to any religion together formed only about 5% of the pooled sample. These proportions reflect the respective population strengths of the various religious groups in Ghana. According to GSS (2008), Christians constitute majority (66.7%) of the Ghanaian population followed by Islam (16.5%) and Traditional believers (9.2%). In Tamale, Muslims formed 66% of the sample. However, in the other study communities Christians constituted majority of the respondents.

Table 4.5: Distribution of respondents by religion

Religion	**Accra**		**Kumasi**		**Techiman**		**Tamale**		**Pooled**	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
Christianity	123	86.0	65	60.7	80	66.7	37	31.4	305	62.5
Islam	11	7.7	38	35.5	31	25.8	78	66.1	158	32.4
Traditional	6	4.2	2	1.9	4	3.3	3	2.5	15	3.1
No Religion	3	2.1	2	1.9	5	4.2	-	-	10	2.0
Total	**143**	**100.0**	**107**	**100.0**	**120**	**100.0**	**118**	**100.0**	**489**	**100.0**

Source: Field survey, 2006/2007.

4.2.6 Ethnic affiliation

By birth, Ghanaians belong to various ethnic groups across the country. A summary of the tribal distribution of respondents has been provided in Table 4.6. *Akans* and people of Northern Ghana extraction formed 42% and 32% of the pooled sample respectively. These two groups are made up of several different tribes and members of these groups formed the majority of the Ghanaian population. In the Ghana Living Standards Survey Round 5 report, GSS (2008) noted that majority of household heads in Ghana are *Akans* (52.7%) followed by *Mole-Dagbani* (12.4%) and Ewes (12.4%). The *Akan* group is made up of specific tribes like Ashanti, *Akuapim, Akyem, Fante, Sefwi,*

Nzema, etc. In the subsample for Tamale, people who belong to Northern Ghana tribes or MoleDagbani ethnic affiliation (*Dagomba, Sissala, Mamprusi, Dagaba, Konkomba, Bimoba*, etc.) formed the majority (69%) of the respondents. Accra is the most cosmopolitan of all the cities in the country and in that subsample, *Ewes* and *Akans* were more than *Gas* who are the indigenes.

Table 4.6: Distribution of respondents by tribe

Tribe	Accra		Kumasi		Techiman		Tamale		Pooled	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
Akan	51	35.7	54	50.5	86	71.7	12	10.2	203	41.6
Ga	25	17.5	5	4.7	7	5.8	0	0.0	37	7.6
Ewe	46	32.2	11	10.3	1	0.8	5	4.2	63	12.9
Northerner	15	10.5	37	34.6	24	20.0	81	68.6	157	32.2
Others	6	4.2	-	0.0	2	1.7	20	16.9	28	5.7
Total	**143**	**100.0**	**107**	**100.0**	**120**	**100.0**	**118**	**100.0**	**488**	**100.0**

Source: Field survey, 2006/2007.

4.3 Household Preferences for yam varieties, processed forms and substitutes

Table 4.7*a* and 4.7*b* provide the distribution of respondents according to their most preferred yam varieties and the reasons for their preferences. It may be evident from Table 4.7*a* that at least eighty (80) per cent of households in all the four urban communities preferred white yam to yellow yam and water yam varieties. It is important to stress the point that there are so many local cultivars which make up the white yam variety. Some of these cultivars include *Serwaa, Nkasee bayere, Denteh, Labreko, Pona*, among others. Generally, *Pona* and *Labreko* were the most preferred white yam cultivars by many Ghanaian consumers due to their superior taste. Apart from the fact that white yams were more readily available on the Ghanaian market than the other varieties, they also had superior qualities for *fufu* and a*mpesi*, the two most important and common food products prepared from yam. Mainly for these reasons, the majority of Ghanaian urban consumers preferred white yam variety to water yam and yellow yam. This finding is consistent with the results of a study in Nigeria by Ojofeitimi and Olufokunbi (2003) which identified white yam as the most preferred yam variety among about 70% of root and tuber crop consumers.

Water yam was the least preferred yam variety. However, due to its relatively long shelf life it was the variety that was readily available during the lean season when other yam varieties were scarce. During this period, almost all yam consumers consumed water yam. After long storage, water yam looses most of its high water content and that improves the taste.

Table 4.7a: Household distribution by most preferred yam varieties

Yam Variety	Accra		Kumasi		Techiman		Tamale		Pooled Sample	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Yellow yam	9	6.3	7	6.7	19	15.8	7	6.0	42	8.7
White yam	130	90.3	91	87.5	100	83.3	110	94.0	431	88.9
Water yam	5	3.5	6	5.8	1	0.8	-	-	12	2.5
Total	**144**	**100.0**	**104**	**100.0**	**120**	**100.0**	**117**	**100.0**	**485**	**100.0**

Source: Field Survey, 2006/2007.

Even though yellow yam has good taste it is relatively scarce than all the yam varieties. Majority of the respondents had never seen or consumed yellow yam. For those who preferred yellow yam to other yam varieties, they were either cultivating it themselves (in the case of Techiman) or they had been exposed to it before in their villages and had come to the cities with those preferences. They all attested to yellow yam's superior taste when boiled as *ampesi* or when roasted.

Table 4.7b: Reasons for yam variety preference

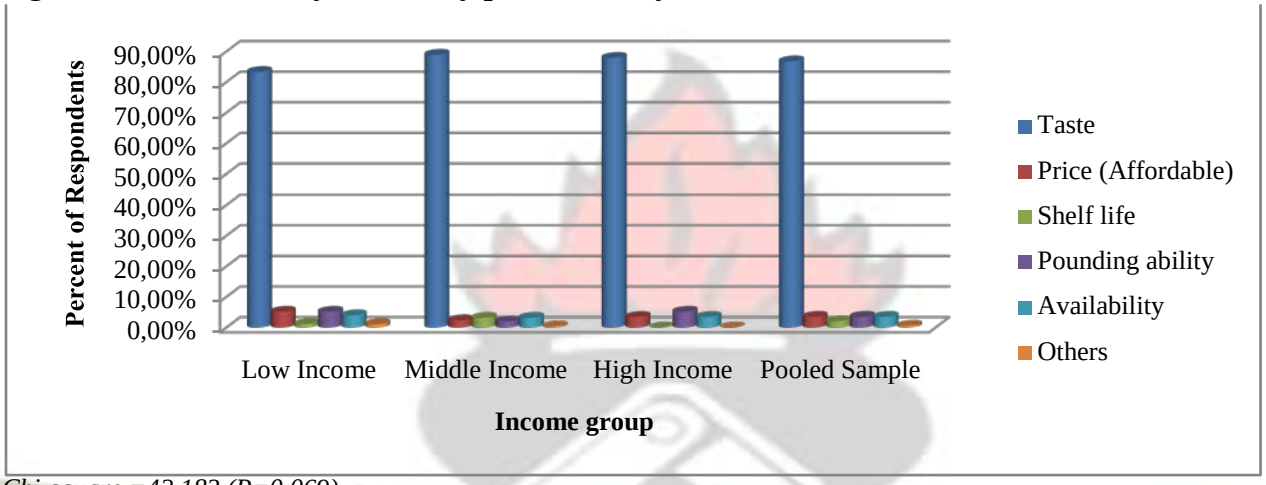
Reason	Accra		Kumasi		Techiman		Tamale		Pooled Sample	
	Freq	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Taste	128	89.5	90	85.7	104	88.9	99	84.6	421	87.3
Price (affordable)	8	5.6	5	4.8	1	0.9	1	0.9	15	3.1
Longer shelf-life	5	3.5	1	1.0	1	0.9	3	2.6	10	2.1
Pounding ability	0	0.0	2	1.9	5	4.3	12	10.3	19	3.9
Availability	2	1.4	4	3.8	4	3.4	2	1.7	12	2.5
Others	-	-	3	2.9	2	1.7	-	-	5	1.0
Total	**143**	**100.0**	**105**	**100.0**	**117**	**100.0**	**117**	**100.0**	**482**	**100.0**

Source: Field Survey, 2006/2007.

It may be found in Table 4.7b that taste was the single most important factor that determined the type of yam variety purchased and consumed by households. Eighty-seven (87) percent of the respondents indicated that their choice of a particular yam variety was a function of the taste of the variety. Other

factors considered before a particular yam variety was consumed included ability of yam variety to be used to pound *fufu* (3.9%), affordability (3.1%) and availability (2.5%). Figure 4.1 depicts the relationship between income level and reasons for the preference of a particular yam variety for the pooled sample (all the respondents in the study).

Figure 4.1: Reason for yam variety preference by Income level –all consumer locations



Chi-square =42.183 (P=0.069)

Source: Field Survey, 2006/7.

Following a Chi-square test of independence conducted, the null hypothesis of independence was accepted, implying that the reason for household yam purchase habits and income level are not related. Whether poor or rich, almost all households bought a particular yam variety based mainly on their own assessment of the taste of the variety.

Table 4.8 provides the distribution of respondents according to most preferred yam product (processed form). The four yam products or processed forms mostly consumed in the four urban centers were found to include boiled yam (*ampesi*), pounded yam (*fufu*), fried yam/chips, and roasted yam. Boiled yam (*ampesi*) ranked first as the most preferred yam product. About 72% of households in the pooled sample preferred to consume yam in the boiled form with stew or gravy. In three of the urban centers considered in this study, majority (at least 63%) of households preferred boiled yam to the other processed forms. In Tamale, however, majority (52%) of the households preferred to take yam in the pounded form (*fufu*) with soup.

Table 4.8: Household distribution by most preferred yam product

Processed yam Product	Accra		Kumasi		Techiman		Tamale		Pooled Sample		Rank
	Freq	%	Freq	%		Freq.	%	Freq.	Freq.	%	

Boiled (*Ampesi*)	138	95.8	87	82.9	76	63.3	47	40.2	348	71.6	*1*
Pounded (*Fufu*)	6	4.2	13	12.4	43	35.8	61	52.1	123	25.3	*2*
Fried/Chips	-	-	3	2.9	1	0.8	8	6.8	12	2.5	*3*
Roasted	-	-	2	1.9	-	-	1	0.9	3	0.6	*4*
Total	**144**	**100.0**	**105**	**100.0**	**120**	**100.0**	**117**	**100.0**	**486**	**100.0**	**-**

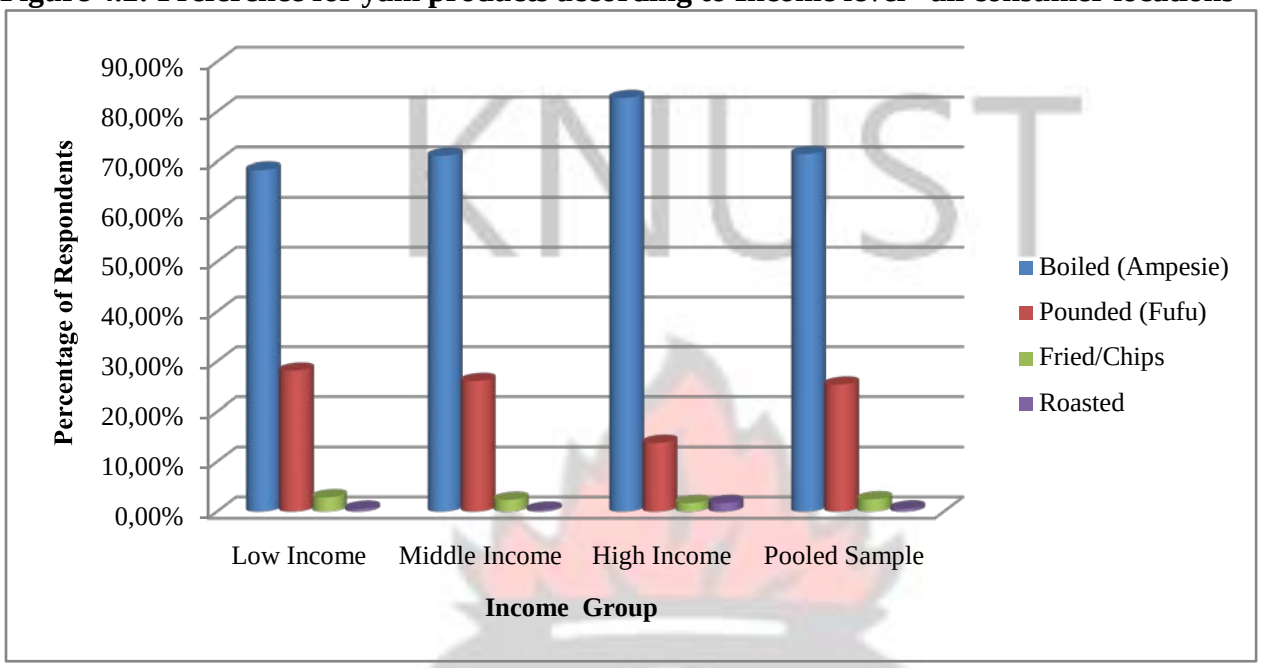
Source: Field Survey, 2006/2007.

It could be deduced from the table that many more households (at least 36%) in the producing urban centers (Techiman and Tamale) preferred pounded yam as compared to purely yam consuming urban centers (Accra and Kumasi) where, at most, only 12% of households preferred pounded yam to the other processed forms. Cassava is traditionally used to prepare *fufu* in Southern Ghana where cassava is relatively common and less expensive when compared with yam. Pounded yam is a timeintensive activity and could explain the difference in the preference between urban and countryside consumers.

In all the four urban centers, roasted yam was the least preferred processed form of yam. Yam flour was not mentioned by any respondent as the preferred yam product; the product is not common in Ghana.

Figure 4.2 depicts the relationship between the most preferred yam products and income level. The graph reveals that a high percentage of high income households preferred boiled yam (*ampesi*) compared to low income households; and a high percentage of low income households preferred pounded yam (*fufu*) as compared to high income households. Following a Chi-square test of independence the null hypothesis was rejected, implying that yam variety preference and income level were somehow related. The Kendall's *tau b* test conducted gave a value that was significant at the 5 percent level, supporting the proposition that there was a significant relationship between income level and the most preferred yam product.

Figure 4.2: Preference for yam products according to Income level –all consumer locations



Chi-square =22.926 (Prob. = 0.314); Kendall's tau b = -0.086 (Prob. =0.029).

Source: Field Data, 2006/7.

Table 4.9 provides a distribution of the households according to the most preferred yam substitute in case yam is not available or when yam is too expensive. Among all the yam substitutes considered in the study, rice ranked first as the most preferred food commodity when there was no yam or when yam was very expensive.

About 41 percent of the households in the pooled sample indicated that they preferred rice as yam substitute. The other three important yam substitutes were found to be plantain (26%), maize (16%) and cassava (6%). Yam was mainly consumed in the boiled form (a*mpesi*) probably due to the easy and less time intensive nature of its preparation. Rice is also easy and less time consuming to prepare; therefore, it may not be surprising that urban households considered rice as the most preferred substitute for yam. In urban centers because of pressures from work and the high opportunity cost of time household members do not normally have the luxury of time to prepare meals that take time to cook at home.

Table 4.9: Household distribution by most preferred yam substitute

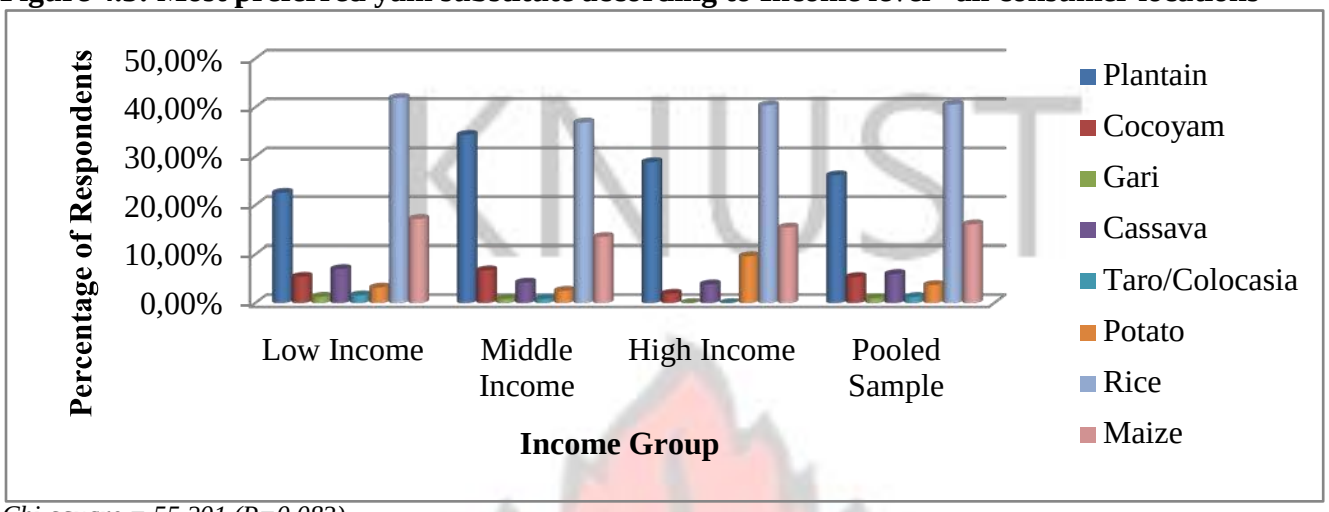
Yam Substitute	Accra		Kumasi		Techiman		Tamale		Pooled Sample		*Rank*
	Freq	**%**	**Freq.**	**%**		**Freq.**	**%**	**Freq.**	**Freq.**	**%**	
Plantain	41	28.5	19	18.1	57	47.5	10	8.5	127	26.1	*2*
Cocoyam	7	4.9	10	9.5	8	6.7	1	0.8	26	5.3	*5*
Gari	2	1.4	1	1.0	0	0.0	2	1.7	5	1.0	*8*
Cassava	5	3.5	4	3.8	3	2.5	17	14.4	29	6.0	*4*
Colocasia	1	0.7	4	3.8	0	0.0	1	0.8	6	1.2	*7*
Potato	12	8.3	2	1.9	0	0.0	4	3.4	18	3.7	*6*
Rice	55	38.2	49	46.7	36	30.0	59	50.0	199	40.9	*1*
Maize	21	14.6	16	15.2	16	13.3	24	20.3	77	15.8	*3*
Total	**144**	**100.0**	**105**	**100.0**	**120**	**100.0**	**118**	**100.0**	**487**	**100.0**	**-**

Source: Field Survey, 2006/2007.

In Accra, Kumasi, and Techiman, cocoyam was more important as yam substitute than cassava. It may be evident from Table 4.9 that in Techiman, plantain was the most important yam substitute, followed by rice, maize and cocoyam. In Tamale, however, the most important yam substitute was rice followed by maize, cassava and plantain. Gari, taro/colocasia and potato were identified as the least preferred yam substitutes in Ghanaian urban centers.

Figure 4.3 depicts the relationship between income level and the type of food commodities preferred by households as yam substitute. The Chi-square value of 55.201 was found to be significant at the ten percent level. This implies that the hypothesis of independence between income level and most preferred yam substitute was accepted. This finding suggests that rather than income level, other factors like taste, price and availability might be the more important factors that consumers considered before choosing a particular food commodity as a substitute for yam.

Figure 4.3: Most preferred yam substitute according to Income level –all consumer locations



Chi-square = 55.201 (P=0.083).

Source: Field Survey, 2006/7.

4.4 Household consumption expenditure and yam budget share analysis

This section discusses items on which households made day-to-day (recurrent) expenses with emphasis on yam budget shares.

4.4.1 Household recurrent expenditure

In this study recurrent expenditure items, as provided in Table 4.10*a*, were items on which household members made frequent expenses to ensure their survival and they included: food, child education, health care, utilities, communications and other social expenditure items like donations at funerals and Church/Mosque.

It may be seen from Tables 4.10*a* & *b* that food, utilities, education, fuel and public transportation were the major household expenditure items in Ghanaian urban centers. The average monthly household expenditure on all recurrent items was estimated at GH¢219.30 for the pooled sample with average household size of five. Food alone constituted about 51% of the average monthly household recurrent expenditure. Household expenditure on each one of the other items was less than ten percent (refer to figure 4.5).

Table 4.10*a*: Mean monthly household recurrent expenditure (GH¢) by consumer location

Expenditure Item	Accra	Kumasi	Techiman	Tamale	Pooled Sample
Food	142.38	66.56	101.12	95.99	104.25
Education	42.68	12.53	15.97	12.39	22.96
Medical Care	12.32	7.01	2.15	6.46	7.20
Utilities	67.41	10.36	7.30	16.53	29.29
Communication	28.57	8.59	14.85	5.52	16.39
Funeral	15.36	4.74	5.99	1.42	7.53
Church Donation	11.94	5.28	8.76	1.51	7.79
Lottery	0.81	0.39	6.10	0.34	1.96
Rent	50.87	3.40	6.24	5.31	19.28
Gifts	7.80	2.16	3.40	0.37	3.71
Alcoholic Beverage	8.15	1.15	2.13	0.88	3.43
Nonalcoholic Beverage	9.79	2.05	2.50	2.24	4.56
Transportation	13.41	8.18	25.92	6.58	14.58
Fuel (Own Vehicle)	46.10	15.35	12.57	5.36	22.04
Cigarette	2.99	0.32	2.17	0.08	1.47
Others	8.76	3.88	3.37	0.25	4.73
Total	**412.17**	**138.61**	**211.14**	**167.36**	**219.31**
Household Size	***5.13***	***5.66***	***6.00***	***7.64***	***6.07***

Source: Estimated from Field Data, 2006/7.

Figure 4.4 shows the average monthly household food and recurrent expenditures made by households in the four urban communities considered in this study. It may be seen from the figure that food formed a little more than fifty (50) percent of the total household recurrent expenditure in all the urban centers except in Accra where households spent about 42% of their recurrent budget on food (also refer to Table 4.10*b*). However, in absolute terms households in Accra spent more on food (GH¢140.00) and total recurrent items (GH¢410.00) in a month than households in the other locations. Monthly household expenditure on food and recurrent items was found to be least in Kumasi as compared to the remaining three urban centers. This may not be surprising since food and other recurrent items are generally cheaper in Kumasi than all other regional capitals in Ghana due to the strategic central position of Kumasi in the country. Kumasi serves as the center from where food commodities brought from the major producing centers of the country are distributed to other urban communities. As a result, food is normally abundant in Kumasi throughout the year and at relatively cheaper prices.

Table 4.10*b*: Household recurrent budget shares (%) by consumer location

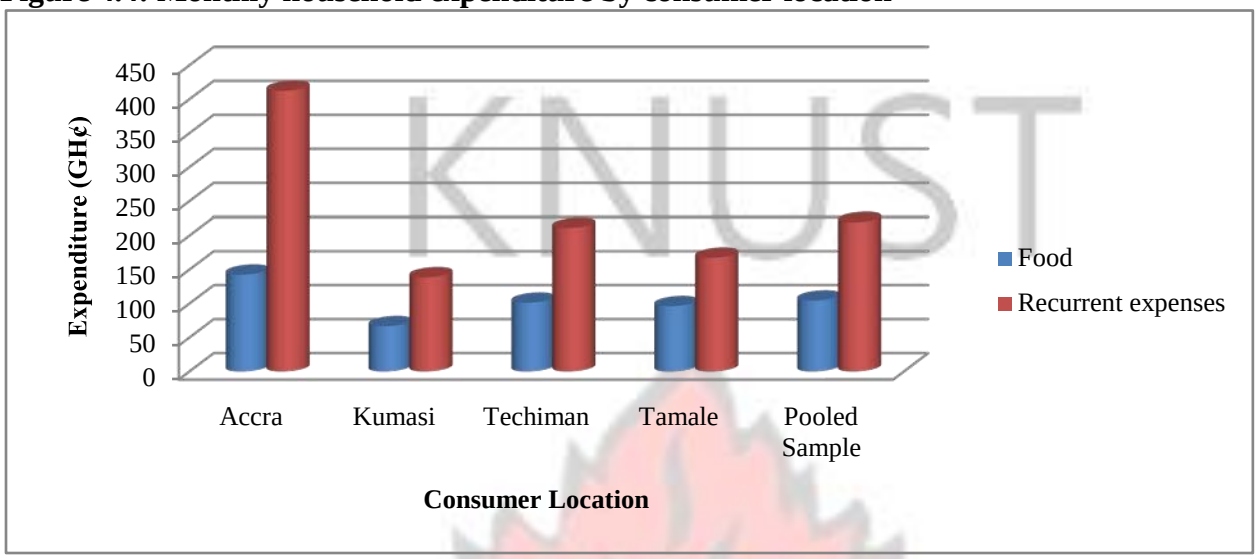
Expenditure Item	Accra	Kumasi	Techiman	Tamale	Pooled Sample

Food	41.96	51.14	53.28	58.15	51.13
Education	10.13	7.31	7.10	7.48	8.01
Medical Care	4.26	4.83	1.29	3.58	3.49
Utilities	8.96	7.81	4.25	7.56	7.15
Communication	4.38	4.89	5.76	3.70	4.68
Funeral	2.13	3.27	4.79	0.96	2.79
Church Donation	3.46	3.86	3.14	1.43	2.97
Lottery	0.39	2.64	2.21	0.96	1.55
Rent	6.93	3.29	3.81	2.15	4.05
Gifts	0.84	1.65	1.87	0.21	1.14
Alcoholic Beverage	0.31	0.88	0.91	0.54	0.66
Nonalcoholic Beverage	2.89	1.32	1.35	2.53	2.02
Transportation	5.56	3.82	4.92	3.85	4.54
Fuel (Own Vehicle)	6.57	2.57	3.22	4.57	4.23
Cigarette	0.59	0.35	0.61	0.96	0.63
Others	0.64	0.37	1.49	1.37	0.97
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Source: Computed from field data, 2006/7.

From Table 4.10*b*, food budget share of total household recurrent expenditure was highest for Tamale (58%) followed by Techiman (53%), Kumasi (51%) and Accra (42%). GSS (2008) estimated household food budget share of 39.6% for Greater Accra Region, 46.5% for Ashanti Region, 55.5% for Brong Ahafo Region and 65.2% for Northern Region. From economic theory it 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; Bopape, 2006). On the average, households in Accra and Kumasi are richer than their counterparts in Techiman and Tamale. Mean annual per capita expenditure (used as a proxy for income) was estimated at GHC 1050.00 for Greater Accra Region, GHC 682.00 for Ashanti Region, GHC514.00 for Brong Ahafo Region and GHC 362.00 for Northern Region (GSS, 2008). The relatively high income levels in Accra and Kumasi explain why households in these consuming urban centers spend relatively smaller proportion of their recurrent budget on food as compared to their counterparts in the yam producing urban centers (Techiman and Tamale).

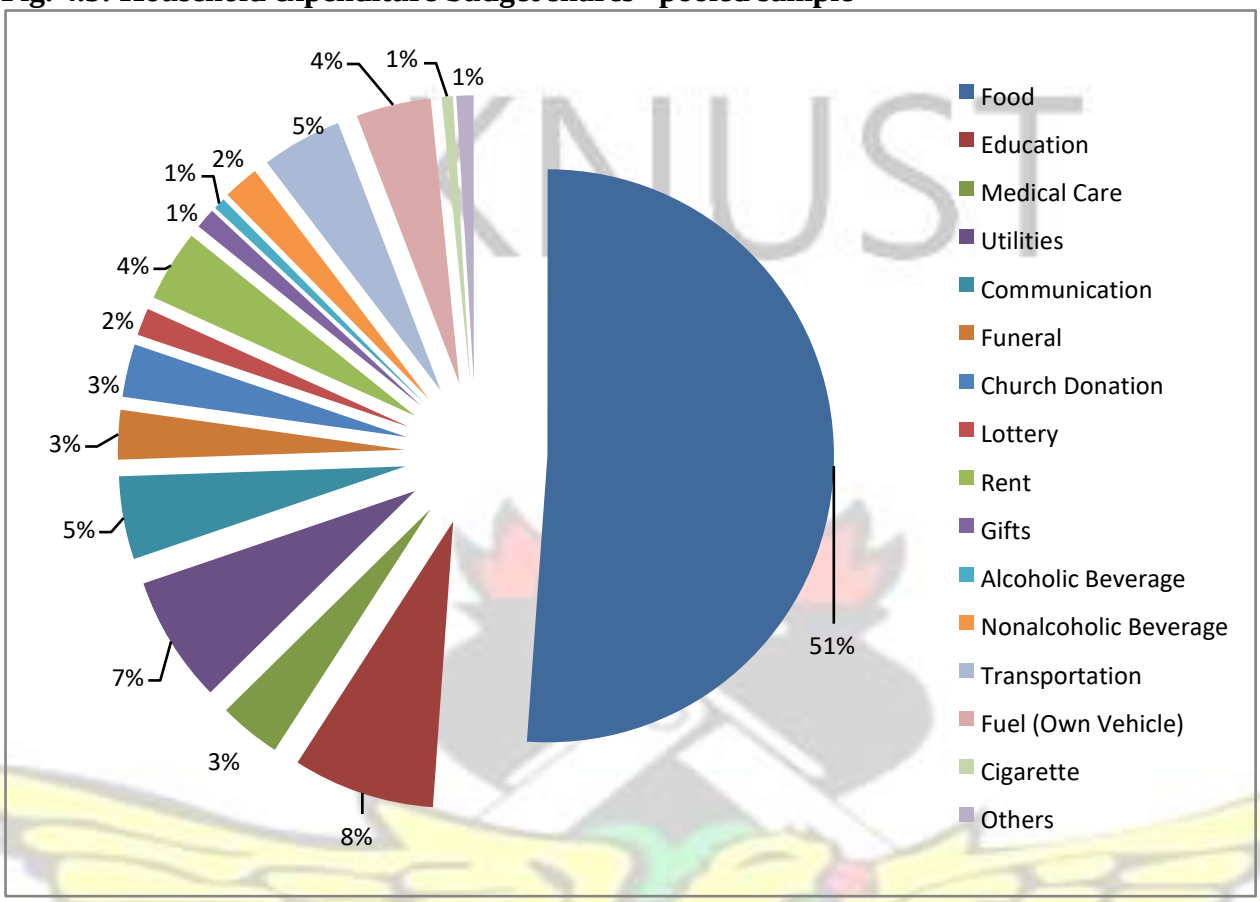
Figure 4.4: Monthly household expenditure by consumer location



Source: Generated from field data, 2006/7.

Figure 4.5 gives the pictorial presentation of household budget shares spent on the various recurrent expenditure items for the pooled sample. On the average, households in Ghanaian urban centers spent about 51% of their recurrent budget on food. This figure is very close to the GSS (2008) estimate of 50.9% budget share for actual and imputed food expenditures combined for a typical household in Ghana. The estimated average household food budget share for the current study is also close to the figure estimated for South Africa (52%) in 1993 by Bopape (2006). Asumugah *et al* (2008) also noted that food budget shares for Nigerian households range between 36% and 63% for high and low income earners respectively.

Fig. 4.5: Household expenditure budget shares –pooled sample



Source: Estimated from field data, 2006/2007.

4.4.2 Household food expenditure

This subsection deals with expenditures on specific food commodities in the four study communities. Table 4.11 shows the average amount spent on the various food commodities in the selected urban centers per month. As also shown in Table 4.12 and Figure 4.7, the most important food items in Ghanaian urban communities as far as household food budget shares for the pooled sample were concerned included: meat (15%), Cereals (14%), fish (12%), yam (11.65%), and fruits and vegetables (11.56%). On the average, households in the pooled sample spent about GH¢10.50 per month on yam as compared to GH¢17.00 on meat, GH¢14.80 on cereals and GH¢12.60 on fish for an average of six household members.

Table 4.11: Mean monthly household food expenditure (GH¢) by consumer location

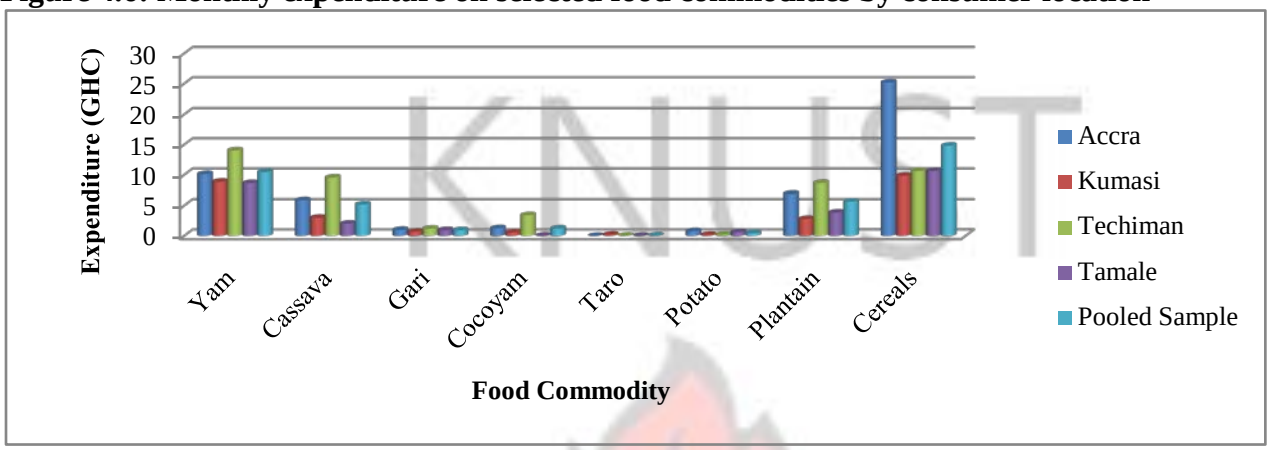
Food Item	Accra	Kumasi	Techiman	Tamale	Pooled Sample
Yam	10.15	8.88	14.07	8.65	10.48
Cassava	5.90	3.00	9.57	2.03	5.21
Gari	1.01	0.70	1.21	0.97	0.96
Cocoyam	1.27	0.57	3.44	0.03	1.23
Taro	0.00	0.22	0.05	0.00	0.07
Potato	0.79	0.19	0.20	0.64	0.46
Plantain	6.90	2.80	8.67	3.86	5.69
Fruits & Vegetables	22.76	5.31	7.39	13.85	13.01
Cereals	25.22	9.85	10.66	10.67	14.84
Meat	22.10	12.42	16.40	15.60	17.01
Fish	18.82	9.09	11.93	8.93	12.61
Dairy products & Confectionery	9.04	3.92	3.11	4.54	5.45
Eggs	4.14	2.27	2.14	3.29	3.04
Cooking Oils	5.51	2.41	5.32	7.58	5.29
Total	142.38	66.56	101.12	95.99	104.25

Source: Field Survey, 2006/7.

In Accra, cereals and fruits & vegetables took bigger shares (18% and 16% respectively) of household food budget than meat (15%), fish (14%) and yam (7.8%). In Kumasi and Techiman, however, meat and yam accounted for higher shares of household food budget. For households in Tamale, meat and fruits & vegetables were the most important food commodities as far as household food budget shares were concerned.

Figure 4.6 provides the mean monthly expenditures on roots and tubers according to consumer location. From the Figure and Table 4.11, it may be seen that households in Techiman spent more on yam (GH¢14.01 per month) in absolute monetary terms followed by households in Accra (GH¢10.15), Kumasi (GH¢8.88) and Tamale (GH¢8.65). In budget share terms, households in Techiman and Kumasi spent higher proportions of their food budgets on yam than households in Tamale and Accra (also refer to Table 4.12).

Figure 4.6: Monthly expenditure on selected food commodities by consumer location



Source: Field survey, 2006/7.

It could be deduced from Figure 4.6 and Table 4.12 that households in Techiman spent more in absolute terms and in budget share terms on cassava, gari, cocoyam and plantain than households in the other urban communities. With respect to cereals, however, households in Accra spent more in budget share and absolute monetary value terms than households in Kumasi, Techiman and Tamale.

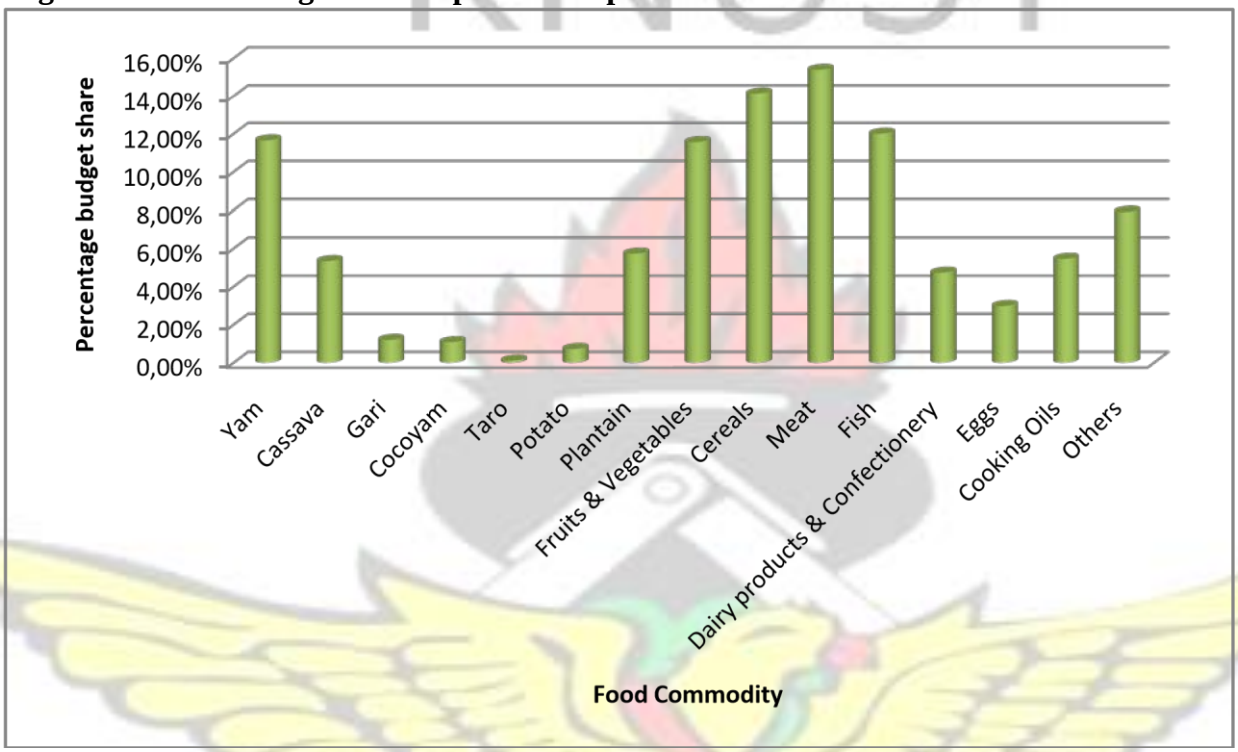
Table 4.12: Household food budget shares (%) by consumer location

Food Item	Accra	Kumasi	Techiman	Tamale	Pooled Sample
Yam	7.86	14.45	14.92	10.35	11.65
Cassava	4.36	5.00	9.90	2.08	5.34
Gari	0.85	1.47	1.22	1.24	1.20
Cocoyam	0.99	0.84	2.75	0.03	1.08
Taro	0.00	0.38	0.06	0.00	0.11
Potato	0.54	0.40	0.19	1.50	0.72
Plantain	5.45	4.46	8.76	4.12	5.73
Fruits & Vegetables	15.99	8.85	7.16	13.13	11.56
Cereals	18.23	13.30	10.25	13.67	14.14
Meat	14.66	16.25	15.92	14.99	15.39
Fish	14.06	12.87	12.24	8.49	12.00
Dairy Pdts & Confectionery	5.71	5.82	2.84	4.15	4.73
Eggs	3.12	3.49	2.22	3.05	2.98
Cooking Oils	4.23	3.95	5.51	8.22	5.46
Others	3.95	8.47	6.06	14.98	7.91
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Source: Estimated from Field Data, 2006/07.

The food budget share for cereals in the pooled sample was estimated at 14.14% which compares favourably with the budget share for cereals in 1997 for Japan and USA which were found to be 14% and 16% respectively (See Chern *et al*, 2003).

Figure 4.7: Food budget shares -pooled sample



Source: Field Survey, 2006/7.

Meat and meat products constituted 15% of household food budget and this figure is higher than the 1997 figure for Japan (12%) but lower than the US meat budget share for 1997 (22%). However, with respect to fish budget share, the estimated figure for Ghanaian urban centers (12%) is lower than the 1997 figure for Japan (18%) but higher than the 1997 figure for USA (3%). The estimated fruits & vegetable budget share for the pooled data (12%) is lower than the 1997 figures for both Japan (23%) and USA (16%) (See Chern *et al*, 2003). In South Africa the budget share for grains was found to range between 35% in 1993 and 31% in 2004; and that for fruits & vegetables was found to range between 17% in 1993 and 19% in 2004. For meat and fish products, average household budget share was estimated to be 21%, 25% and 22% in 1993, 1998 and 2004 respectively (Bopape, 2006).

4.4.3 Household yam expenditure analysis

This subsection is devoted to analysis of household expenditure on yam in relation to household characteristics. It focuses on yam budget share analysis and household expenditure on various yam varieties.

4.4.3.1 Yam budget shares

Yam budget share refers to the proportion of household food budget spent on yam. Table 4.13 provides the distribution of yam budget shares for households based on household characteristics and certain personal characteristics of the household head. It may be evident from the table that for the pooled sample female headed households spent a higher proportion of their food budget (12.5%) on yam as compared to male-headed households who spent 10.9% of their food budget on yam. An Analysis of Variance (ANOVA) test (*F = 2.302, df =486*) indicated that the difference did not occur by chance, and that gender of household head influences household yam budget share at the ten (10) per cent level; but the difference was not significant at the five (5) per cent level. However, in Accra and Kumasi (yam consuming urban centers that do not produce yam) male headed households spent a higher proportion of their food budget on yam than their counterparts headed by women.

Evidence from Table 4.13 also shows a negative relationship between age and household yam budget share. Households in the pooled sample headed by younger people (<30 year olds) spent about 13% of household food budget on yam as compared to 11% by households headed by aged people (> 65 year olds). The same pattern was observed for the households in all the four urban centers considered in this study. An ANOVA test (*F-value = 1.514, df =482*), however, led to the conclusion that the difference was rather due to chance at the 10% level and thus a household's yam budget share did not necessarily depend on the age of the household head.

Table 4.13: Yam budget share across consumer locations by consumer characteristics

Consumer Characteristic	Accra	Kumasi	Techiman	Tamale	Pooled Sample
Gender:					
Male	0.0801	0.1597	0.1170	0.0877	0.1089
Female	0.0764	0.1172	0.1708	0.1216	0.1253
Age Group (years):					
< 30	0.0874	0.1515	0.1929	0.1102	0.1343
30 – 65	0.0788	0.1432	0.1419	0.1026	0.1133
> 65	0.0508	0.1420	0.1369	0.0792	0.1125
Income Group (GH¢):					
< 20/month	0.1030	0.1012	0.1424	0.1453	0.1248
20 – 50/month	0.0326	0.2088	0.2462	0.1325	0.1668
51 – 100/month	0.1002	0.1158	0.1483	0.1132	0.1234
101 – 200/month	0.0840	0.1524	0.1580	0.1061	0.1275
201 – 500/month	0.0798	0.1650	0.1253	0.0694	0.0999
> 500/month	0.0674	0.0372	0.0912	0.0554	0.0683
Educational Level:					
No formal/Basic	0.0749	0.1338	0.1609	0.1027	0.1261
Secondary/pre-tertiary	0.0821	0.1580	0.1427	0.1321	0.1221
Tertiary	0.0793	0.1492	0.1005	0.0797	0.0981
Religion:					
Christianity	0.0742	0.1793	0.1525	0.1115	0.1216
Islam	0.0996	0.0852	0.1405	0.0995	0.1041
Traditionalist	0.1045	0.1506	0.1253	0.0995	0.1152
No Religion	0.1282	0.1501	0.1770	-	0.1519
Tribe:					
Akan	0.0769	0.2103	0.1556	0.1310	0.1429
Ga	0.0816	0.1266	0.1482	-	0.1230
Ewe	0.0677	0.0979	0.1134	0.1210	0.0792
Northerner	0.1102	0.0776	0.1035	0.0937	0.0917
Others	0.1042	0.0813	0.0829	0.1199	0.0981
Total Sample (*Average*)	**0.0786**	**0.1445**	**0.1492**	**0.1035**	**0.1165**

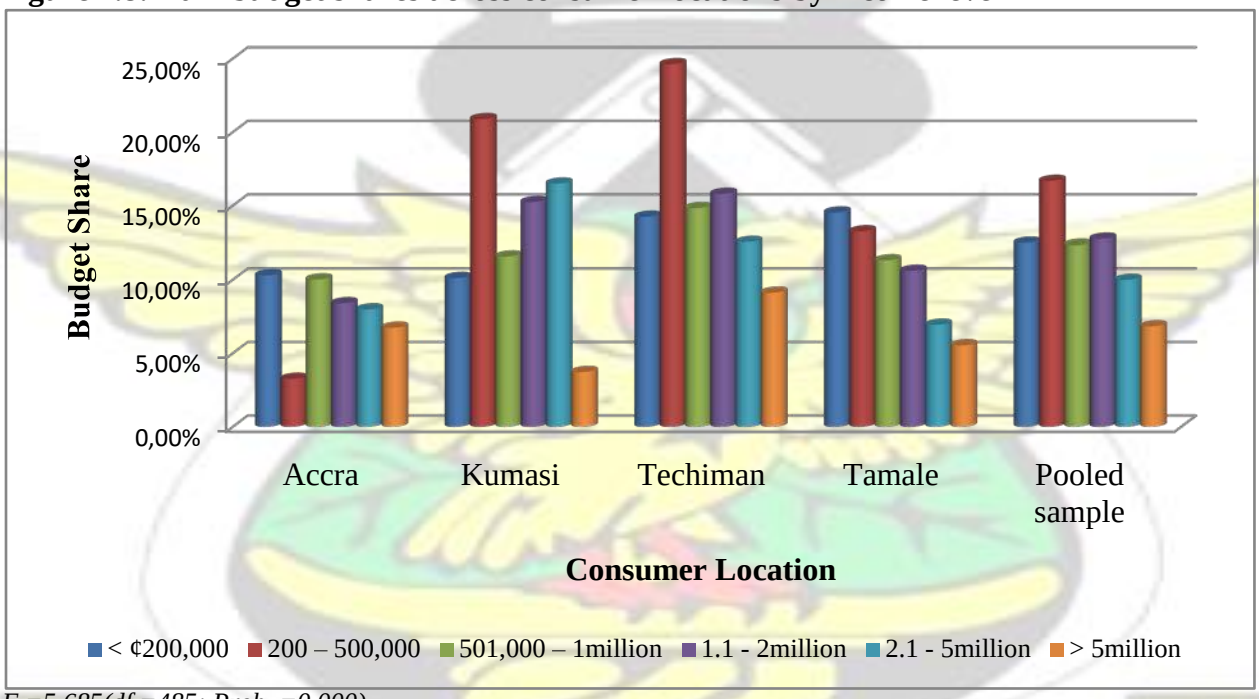
Source: Estimated from field data, 2006/2007.

Figure 4.8 depicts the relationship between income level and yam budget shares across the four urban centers. Higher income households spent a smaller proportion of their food budgets on yam as compared to low income households and it implies lower expenditure elasticity at higher income levels. An ANOVA test of the difference between means led to the rejection of the null hypothesis that there was no difference in yam budget shares for the various income groups at the one percent level. This implies that household yam budget share was affected by the income level of the household

head; low-income households devoted a larger proportion of their household budget to yam consumption than high-income households.

Due to the relatively high price of yam on the market, yam expenditure formed a greater proportion of the smaller food budgets of poorer households, *ceteris paribus*. This observation is consistent with economic theory which posits that the higher a household's income level, the smaller the proportion of its budget spent on food. For poorer households, survival was more important to them and thus they normally spent a larger share of their recurrent budget on food. It does not, however, mean that low income households spent more on food (yam in this case) than high income households in absolute monetary terms.

Figure 4.8: Yam budget shares across consumer locations by income level



F =5.685(df =485; Prob. =0.000).

Source: Field Survey, 2006/7.

With respect to educational level it could be seen from Table 4.13 that households with more years of formal schooling (tertiary education) spent relatively smaller proportion of their food budget on yam compared to households headed by less educated people. The ANOVA test (*F=2.842, df =482*) led to the conclusion that educational level of household head significantly influenced household yam budget share at the five (5) percent level. Further analysis of the relationship between educational level and

income level showed a strong degree of association. A chi-square statistic of 89.65 (*df =18*) suggests that the income level of household heads depended on their educational level. Therefore, the effect of education on yam budget shares was as a result of the more general coincidence between higher level formal education and income. Controlling for income, educational level and yam budget share were not related at the one percent level.

There were slight differences in the observed yam budget shares for households belonging to the different religions. However, the ANOVA test (*F=1.542, df =485*) led to the affirmation of the null hypothesis that there was no difference among the religions even at the ten (10) percent level as far as household yam budget shares were concerned. The outcome of the test was to be expected since yam is not a food commodity that is discriminated against by any particular religion.

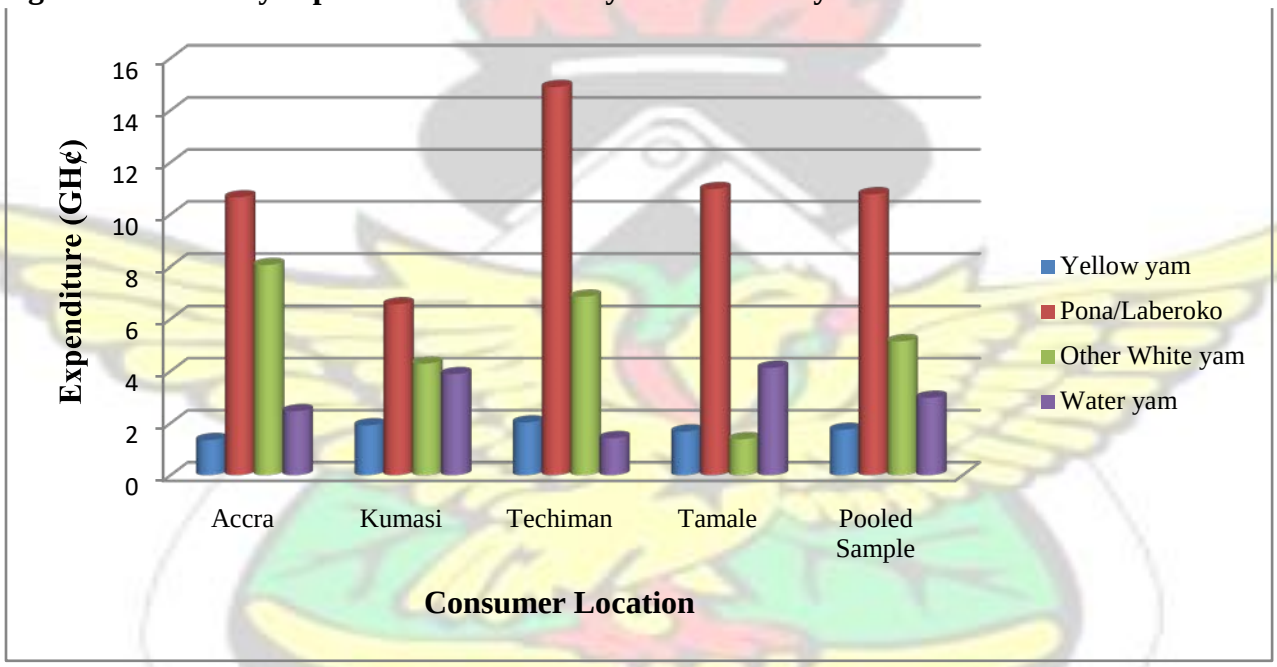
Ethnic affiliation was classified into *Akans, Gas, Ewes,* and *Northerners* (Tribes in the three Northern Regions). An ANOVA test (*F=7.438, df =484*) led to the rejection of the null hypothesis of no difference at the one percent level. This means that the ethnic affiliation of the household head had a significant effect on household yam budget shares. In Akan communities, it is known among the elderly that members of a subculture called *Bosompra* do not consume water yam. However, none of such people was identified in the survey; it appeared the average urban yam consumer did not know about this cultural discrimination against water yam. It needs to be emphasized also that other yam varieties were readily available on urban markets and thus whoever did not consume a particular variety had a substitute yam variety to purchase and consume.

4.4.3.2 Household expenditure on various yam varieties

The three yam varieties considered in the study were yellow yam, white yam and water yam. Like water yam, several cultivars of the white yam variety are available on Ghanaian urban markets. However, the most popular and most patronized cultivars were *pona* and *labreko*. As such these two cultivars were separated from the other white yam cultivars in the household expenditure analysis. Figure 4.9 gives the mean monthly expenditures on the various varieties by households in the four urban centers.

From the Figure, households spent more on white yam than water yam and yellow yam. Average monthly household expenditure on *pona* and l*abreko* (GH¢10.70) was higher than expenditure on all other white yam cultivars (GH¢5.10). Many households had high preference for *pona/labreko* ahead of the other cultivars; and prices of *pona*, in particular, were usually higher than that of all other yam cultivars. This explains the high household expenditure on *pona* and *labreko*; it does not mean that households spent more on *pona* and *labreko* in terms of quantities. In all urban centers, household expenditure on water yam was found to be higher than that on yellow yam. Average monthly household expenditure on water yam was estimated at GH¢2.90 and that on yellow yam was GH¢1.70 for the pooled sample and the difference was significant at the one percent level.

Figure 4.9: Monthly expenditure on various yam varieties by consumer location



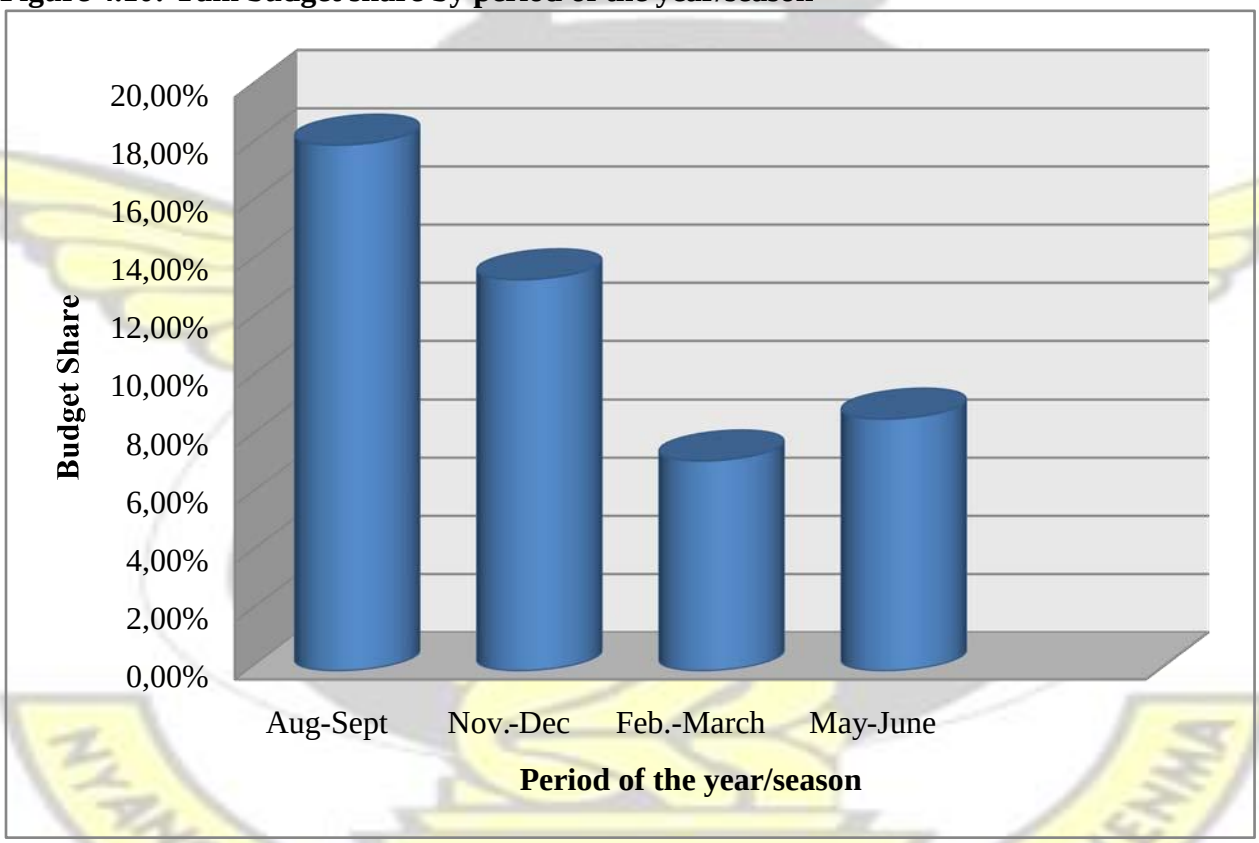
Source: Field Survey, 2006/7.

4.4.3.3 Seasonal analysis of yam expenditure

This subsection deals with yam expenditure patterns across four quarters of a complete yearly yam cycle or season. The quarters were demarcated in line with the availability of white yam (the most common yam variety on the market) across various months in the year. The quarters included the peak harvest and more abundant period (August-September-October), the relatively less abundant period

(November-December-January), the land preparation/planting period (February-March-April) and the near-harvest/scarce period (May-June-July). Figure 4.10 gives the household food budget share spent on yam by respondents across the various periods in a typical yam cycle. Yam budget shares typically increased during the peak harvest season (August – September) and dropped during the lean season when planting was taking place (Feb-March). Yam prices (especially white yam) were generally low during the peak harvest season; households therefore increased their yam consumption and hence the high yam budget share recorded for the period August-September (18%). Household yam budget share dropped to about 13% during November-December. During this period yam prices were quite high compared to the previous period; however, the consumption of the crop was quite high due to the Christmas and New Year festivities.

Figure 4.10: Yam budget share by period of the year/season



Source: Field Survey, 2006/7.

Household yam budget share dropped to a low of about 7% during the planting season (FebruaryMarch). During this period white yam was relatively scarce and quite expensive. During May –June, yam was very scarce. 'Early yam' harvested through 'milking' and water yam were

normally available but at a relatively high price. During this period, which marked the end of the 'hunger period', price of yam appeared not to be so important in shaping household demand for yam. Thus, household yam budget share increased to about 9% during the period.

Table 4.14 shows yam expenditures and budget shares for the various urban centers across seasons. Food budget shares that households allocated to yam generally increased during harvest season and dropped during lean season across all urban centers in Ghana. This could imply that during the lean season when yam was relatively scarce, households rather increased their budget shares for other substitutes like cereals and 'low cost' roots and tubers like cassava and cocoyam.

Table 4.14: Seasonal yam expenditure and budget shares by consumer location

Consumer Location	Aug-Sept, 2006		Nov-Dec, 2006		Feb-March, 2007		May-June, 2007	
	Monthly yam Exp. (GH¢)	*Budget share (%)*	*Monthly yam Exp. (GH¢)*	*Budget share (%)*	*Monthly yam Exp. (GH¢)*	*Budget share (%)*	*Monthly yam Exp. (GH¢)*	*Budget share (%)*
Accra	13.85	12.83	12.48	9.18	7.42	5.98	8.57	6.43
Kumasi	13.52	21.73	12.15	18.76	7.02	8.03	8.22	10.24
Techiman	12.02	21.40	10.65	18.07	5.77	10.02	6.83	11.03
Tamale	17.44	16.63	16.07	11.75	10.75	6.08	12.07	7.32
All Areas	**13.35**	**18.07**	**12.78**	**13.44**	**6.72**	**7.23**	**9.17**	**8.67**

Source: Estimated from field data, 2006/07.

4.5 Household expenditure on food away from home

This section covers away-from-home expenditure on selected food groups by households in the four urban centers with particular emphasis on yam. Table 4.15 and Figure 4.11 show the average monthly household expenditure on food away from home (FAFH). On the average, a household in the pooled sample spent about GH¢6.80 per month on FAFH; about 13% of which was spent on yam. In absolute monetary terms, households in Kumasi spent more (GH¢17.70) on FAFH followed by Techiman (GH¢13.00), Accra (GH¢7.90) and Tamale (GH¢4.40). Except in Accra, households in all the urban centers spent between 10% and 20% of their FAFH budgets on yam with Techiman recording the highest budget share of 19%. Households in Accra spent only 6% of their FAFH budget on yam.

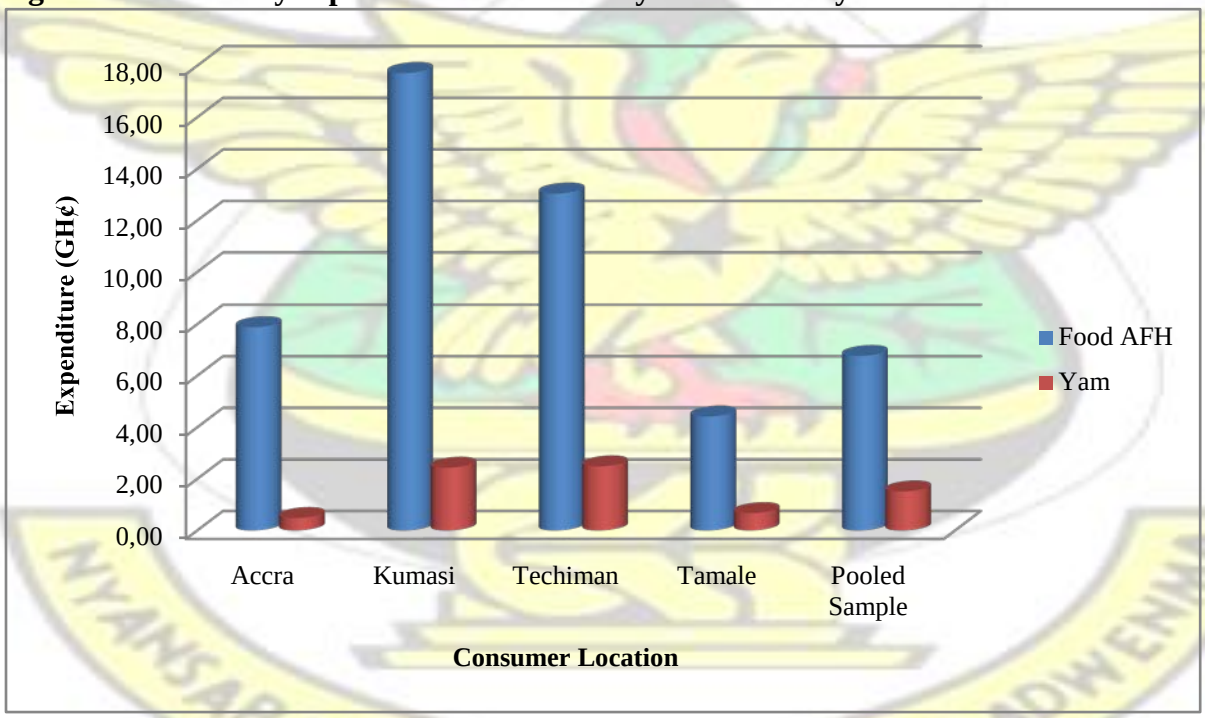
Table 4.15: Mean monthly away-from-home expenditure (GH¢) on selected food groups

Food Item	Accra	Kumasi	Techiman	Tamale	Pooled Sample
Yam	0.48	2.43	2.48	0.67	1.52
All roots & Tubers	1.69	4.34	3.77	1.26	2.59
Fruits & Vegetables	1.29	1.28	1.54	0.78	1.21
Cereals	1.96	2.07	2.26	0.33	1.62
Meat	1.29	2.88	2.42	0.72	1.73
Fish	1.20	4.16	2.34	0.43	1.91
Total	7.88	17.71	13.04	4.42	6.76

Source: Field Data, 2006/7.

Yam also constituted between 50 and 66 percent of household expenditure on roots and tubers away from home in all urban areas except Accra where yam formed only 28% of household expenditure on roots and tubers outside home. For the pooled sample, households spent an average of GH¢1.50 per month on yam away from home.

Figure 4.11: Monthly expenditure on food away from home by consumer location



Source: Field Survey, 2006/7.

CHAPTER FIVE

5.0 EMPIRICAL RESULTS

5.1 Introduction

This chapter presents results from the econometric analysis of household yam consumption expenditure patterns. The first section provides summary statistics of the quantitative variables entering the models. Section 5.3 looks at the yam expenditure models for the aggregate/composite (pooled) data from all the four urban centers. The subsequent sections discuss yam expenditure models for Accra, Kumasi, Techiman and Tamale. The last section deals with the expenditure elasticities for the four urban centers according to income level and season.

5.2 Models for yam expenditure patterns in Ghanaian urban centers

Table 5.1 provides a summary of the description of variables used in the regression analysis, some selected statistics for the pooled sample and their expected impacts on yam consumption patterns. Included in the table are the covariance and skewness statistics to judge the normality or otherwise of the distributions. Skewness is a measure of the asymmetry of a distribution; a normal distribution is symmetric and has a skewness value of zero (0). As a guideline, a skewness value more than twice its standard error is taken to indicate a departure from symmetry and normality. Using this guideline, it may be seen from Table 5.1 that only educational level, female share of household income and male share of household income had normal distributions. For the other variables, the arithmetic mean might not be a good measure of central tendency because of their asymmetric distributions. As a result, the median values (also shown in the table) are better indicators of central tendencies.

The average household head spent about 11 years in school, which means the household head had completed Junior Secondary School (now Junior High School). The highly educated household head had spent sixteen (16) years in formal educational institutions which is equivalent to tertiary educational level. Some household heads had never had any formal education before.

Table 5.1: Summary statistics of the variables entering the regression models

Variable	N	Min.	Max.	Mean	Std. Deviation	Cov. (%)	Median	Skewness	Std Error of Skewness	Expected sign of influence
Actual number of years spent in school	478	0.0	16	10.88	7.15	65.7	12	-0.05	0.11	+

Household size	489	1	15	6.07	3.39	55.8	5	3.5	0.11	- +
No. of Dependants (<18 and >65 yr olds)	469	0.0	7	2.08	2.00	96.1	2	3.0	0.11	- +
No. of income earners in the household	488	0.0	9	1.85	4.51	243.8	2	20.6	0.11	+
Active female in the household (15 -65yrs)	485	0.0	6	2.07	1.32	63.8	2	2	0.11	+
Females in full time employment	475	0.0	4	0.83	0.67	80.7	1	1	0.11	-
Active males (15 -65yrs)	485	0.0	9	1.97	1.76	89.3	1	3	0.11	-
Males in full time employment	476	0.0	7	0.88	0.76	86.4	1	2	0.11	-
Total monthly female income in household (GH¢)	242	0.0	700.00	179.20	429.78	239.8	100.00	15.00	0.12	- +
Females' share of household income (%)	242	0.0	1.00	0.52	0.34	65.4	0.44	0.26	0.16	- +
Males' share of household income	242	0.0	1.00	0.48	0.34	70.8	0.56	-0.26	0.16	+
Expenditure on food at home (GH¢)	431	3.50	600.00	110.97	127.33	114.7	84.00	6	0.12	+
Expenditure on Food Away From Home (GH¢)	491	0.00	251.60	6.76	17.40	257.4	1.55	8	0.10	-
Total Household recurrent Expenditure (GH¢)	491	12.00	1,117.00	219.31	309.74	141.2	142.30	5	0.11	+
Per capita household expenditure (GH¢)	491	12.00	379.25	43.27	65.36	151.1	27.64	7	0.11	+

Source: Field Survey, 2006/7.

The pooled sample was found to have an average household size of six (median was five) persons and average dependants of two (2) persons per household. This implies that, at least, four (4) household members were very active economically (18 – 65 years) and thus could earn income to augment household income. However, Table 5.1 shows that the average income earners in the household were only two persons. Implication is that even though there may be many active people in the household,

many were either unemployed or engaged in unpaid or non-income generating jobs. The average number of fully employed[3] males and females was found to be one person per household in each case.

The Table shows that for the pooled sample, 52% of household income was under the control of females/women and the remaining 48% was under the control of males. On the average, the income under the control of women in the household was estimated at GH¢180.00 and the median was GH¢100.00 per month. Apart from Kumasi, women's share of household income was found to be more than 50% in all the urban centers considered in the study. Average household expenditure on food was estimated at GH¢110.00 per month. Given an average household size of six (6), average per capita food expenditure was calculated to be GH¢18.50 per month, translating into a daily expenditure of GH¢0.60 per capita. However, there was so much variation in the distribution, ranging from as low as GH¢ 3.50 to a high of GH¢600.00 per month. The median expenditure on food was estimated at GH¢84.00 per month, which translates into a daily per capita expenditure of GH¢0.47.

It may be seen from Table 5.1 that the average per capita expenditure on recurrent[4] items was found to be GH¢43.27 per month, translating into GH¢1.40 per day. Apart from food commodities, other expenditure items that made up the recurrent expenses included: utilities, child education (not including fees, books and clothing), medical care/drugs, communication, transportation, alcoholic beverages, lottery, rent, and tobacco/cigarette. Others included social contributions at funerals, church/mosque, and gifts/alms.

5.3 Estimated yam consumption models for all urban areas combined (pooled sample)

The models in this study were estimated using the Ordinary Least Squares (OLS) Method. Table 5.2 shows the results of three estimated equations for yam consumption expenditure with different dependent variables but the same explanatory variables. The first model (I) expressed yam budget share as a function of consumer location, gender, educational level, household size, per capita household expenditure and other household variables as contained in the table.

[3] *In this study, a person who spent at least six hours a day in the labour market for at least three continuous months and received remuneration for his services was considered an active participant in the labour market and thus fully employed.*

[4] *In this study, recurrent expenditure items refer to items on which the household made day-to-day expenses for survival and satisfaction.*

Table 5.2: Yam expenditure models – pooled data

Explanatory Variable	Dependent Variable			Tolerance Statistic	Variance-Inflation Factor (VIF)
	Yam Budget Share (I)	*Yam Expenditure (II)*	*Ln Yam Expenditure (III)*		
(Constant)	-2.120 (-1.632)	-4812031 (-3.801)**	-41.567 (-3.780)**	-	-
Consumer location (0=Techiman and Tamale, 1= Kumasi and Accra)	0.128 (3.472)**	0.165 (4.416)**	0.161 (4.461)**	0.773	1.293
Gender (0=male, 1=Female)	0.064 (2.026)*	0.018 (0.575)	0.067 (2.178)*	0.835	1.197
Age (0=<30yrs; 1=Otherwise)	0.037 (1.255)	0.024 (0.817)	0.035 (1.227)	0.951	1.051
Religion of HH head (0=Christianity, 1= otherwise)	-0.036 (-1.171)	-0.028 (-0.879)	-0.015 (-0.487)	0.848	1.180
Tribe of HH head (0=Akan, 1=Otherwise)	-0.018 (-0.568)	-0.023 (-0.734)	-0.016 (-0.527)	0.875	1.143
Proportion of hh income under the control of females	0.026 (0.877)	0.106 (3.470)**	0.101 (3.439)**	0.892	1.120
Ln Years in school -HH head	-0.047 (-1.544)	-0.021 (-0.666)	-0.041 (-1.346)	0.891	1.123
ln household size	0.032 (0.806)	0.143 (3.544)**	0.168 (4.324)**	0.517	1.932
ln no. of active females in hh	0.079 (2.193)*	0.047 (1.288)	0.039 (1.108)	0.627	1.594
ln females in full time employment	-0.002 (-0.067)	-0.044 (-1.437)	-0.002 (-0.055)	0.892	1.121
ln Yam Price	-0.020 (-1.966)*	0.002 (2.545)*	0.021 (2.203)*	0.892	1.121
ln cassava Price	0.016 (0.517)	0.029 (0.940)	0.009 (0.308)	0.871	1.148
ln Cocoyam Price	0.072 (2.430)*	0.114 (3.799)	0.080 (2.742)**	0.938	1.067
ln plantain Price	0.009 (0.296)	0.094 (3.081)**	0.029 (0.992)	0.920	1.087
ln Maize Price	0.087 (2.686)**	-0.026 (-0.793)	0.081 (2.550)**	0.784	1.275
ln Rice Price	0.113 (3.678)**	0.115 (3.668)**	0.069 (2.283)*	0.856	1.168
ln exp on fruit and vegetables	-0.167 (-4.138)**	0.149 (3.629)**	0.123 (3.108)**	0.577	1.734
ln exp on yam Away From Home	0.172 (5.374)**	0.098 (3.003)**	0.088 (2.789)**	0.918	1.090
ln Meat expenditure	-0.087 (-2.138)*	0.127 (3.072)**	0.167 (4.179)**	0.495	2.020
ln Fish expenditure	-0.098 (-2.425)*	0.039 (0.946)	0.111 (2.804)**	0.508	1.968
ln per capita household expenditure	-2.833 (-2.543)**	-1.663 (-3.060)**	-1.979 (-3.769)**	0.569	1.758
ln Per capita exp squared	-2.926 (-2.537)**	1.712 (3.163)**	2.066 (3.952)**	0.183	*5.464*
R^2	*0.487*	*0.461*	*0.515*		
F (Prob.)	*13.078 (0.000)*	*11.347 (0.000)*	*15.180 (0.000)*		
Standard Error of Regression	*0.07865*	*24541.18*	*0.7112*		

*T-values in parenthesis; ** = Significant @1%, * = Significant @ 5%.*

The second (II) and third (III) equations had actual and natural logarithm of monthly household yam expenditure as the regressands respectively. The log-transformation was employed to minimize potential problems of heteroscedasticity and also to normalize otherwise sub-normal distributions.

Results in the table show that the F-statistics for all the three equations were significant at the one (1) percent level, implying that the independent variables, as a group, were important determinants of yam consumption patterns in all the urban centers combined. Therefore, the hypothesis that none of the explanatory variables was related to yam consumption pattern was rejected. The coefficients of determination (R^2) of the three models ranged between 46 and 52 percent, implying that over 45% of the variation in yam consumption patterns was explained by changes in the levels of the explanatory variables in the equations.

The Standard Error of Regression (SER) was estimated at 0.079 for the budget share model (I), 24541.18 for the semi-log model (II) and 0.7112 for the double log model (III). Of the three models, the budget share equation had the least SER which was also lower than the standard deviation around the sample mean expenditure, indicating that the estimated budget share model was a better predictor of yam expenditure than the sample mean expenditure.

The tolerance statistic and/or Variance-Inflation Factor (VIF) were used to test for multicollinearity in the estimated models. Tolerance statistic measures the proportion of variance in the independent variable that is explained by the other independent variables in the model. 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. When tolerance is close to zero (0) there is high multicollinearity of that variable with other independents and the beta coefficients will be unstable. The more the multicollinearity, the lower the tolerance and the more the standard error of the regression coefficients. Variance-inflation factor (VIF) is simply the reciprocal of tolerance. Therefore, when VIF is high there is high multicollinearity and instability of the beta coefficients;
VIF values equal to or greater than 5.0 suggest a multicollinearity problem (*http://en.wikipedia.org/wiki/Multicollinearity, Accessed in February, 2009*). It may be seen from Table 5.2 that except *per capita expenditure squared*, the tolerance statistics and VIF values of all the explanatory variables were greater than 0.20 and less than 5.0 respectively. These collinearity statistics indicate that there was low incidence of multicolinearity among the explanatory variables implying that the estimated parameters are stable and reliable. In the light of the above statistical and econometric criteria, the budget share model was adjudged the best among the three models and the impacts of the independent variables in that model were, therefore, discussed.

It may be shown from Table 5.2 that consumer location, own price of yam, price of rice, household expenditures on fruits & vegetables, meat, yam expenditure away from home, and per capita household expenditure significantly influenced household yam budget share, at least at the 5% level. Gender of household head, prices of cocoyam and maize, and household expenditure on fish were also found to significantly influence yam budget share at the 5% level.

The positive sign of the coefficient for location in the table indicates that households in the purely yam consuming urban centers (Accra and Kumasi combined) devoted a larger share of their food budget to yam than their counterparts in yam producing urban centers (Techiman and Tamale combined). The model results indicated that, for the aggregate sample, female headed households spent more on yam than male headed households. This finding is consistent with *a priori* expectation. It is also consistent with findings by Hopkins *et al* (1994) and Hoddinott & Haddad (1995) which established a positive relationship between the female headed households and food expenditure. By culture/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. Number of active females (between 15 and 65 years) was found to be positively related to household yam budget share at the five percent level. Active females who were not in full time employment were normally in charge of household food preparation. Accordingly, households with fewer or no females were likely to eat yam and other meals away from home, especially if the meals took a lot of time to prepare. This might be the case especially in urban communities where pressures from workplace limited the number of hours the working class spent at home. Although not significant at the five percent level, the number of females who were in full time employment had a negative relationship with household expenditure on yam products due to the high opportunity cost of time for such households. The Table shows a positive relationship between household size and household yam consumption. For larger households that needed to satisfy their yam requirements there was the need to buy larger quantities of yam and that increased their expenditure on yam; which was probably due also to the expensive nature of yam. This finding is consistent with the findings of Sdrali (2006), Cage (1989), and Kalwij *et al* (1998) who also found a positive relationship between household size and food expenditure. Section 5.10 provides a discussion on yam budget share elasticity with respect to household size.

Own price of yam was found to have a significant positive effect on absolute expenditure on yam by households but a negative effect on household yam budget share. This is consistent with *a priori* expectation and intuition since the higher the price of a commodity, the higher the expenditure made on the commodity, given that the quantity demanded remained constant at a reasonable level. Tsegai and Kormawa (2002) found an inverse relationship between own price of yam and yam consumption in a study on cassava and its substitutes in Nigeria. With respect to budget shares, households reduced their budget share for yam and possibly increased the share of close substitutes when yam prices increased, *ceteris paribus*. Prices of rice, maize, plantain and cocoyam were found to be positively related to household yam consumption expenditure at the five percent level. The positive signs of the coefficients of these variables indicate that an increase in their prices would warrant an increase in household expenditure on yam or food budget share devoted to yam, suggesting substitution relationship between yam on one hand and these food commodities on the other hand. The positive relationship between the prices of these substitutes and yam expenditure is also in consonance with the findings of Tsegai and Kormawa (2002). Cereals (especially rice) are easy to cook and thus urban households can easily substitute them with yam and vice versa. The own price and cross-price elasticities have been calculated and discussed in section 5.9.

There was a significant positive relationship between household yam expenditure on one hand and household expenditures on fruits & vegetables, meat, and fish on the other hand. This may imply that these products were used as complements rather than substitutes for yam in a typical Ghanaian urban household. However, the study found a significant negative relationship between household expenditure on fruits & vegetables, meat and fish on one hand and household yam budget share on the other hand. Even though fruits & vegetables, meat and fish were normally eaten together with yam as complements, their prices were relatively higher and thus given the household's budget constraint, when expenditures on fruits & vegetables, meat and/or fish increased, it caused a reduction in the household food budget spent on yam products.

Household expenditure on yam away-from-home was expected to influence at-home yam expenditure negatively. However, there was a rather positive relationship between household yam budget share and away-from-home expenditure on yam. This could either mean that household members' expenditure on yam away-from-home was not enough to cause a reduction in how much the household

spent on yam at home, or for the aggregate sample, only a few household members consumed yam products away from home.

Per capita household expenditure was used as a proxy for household income. It was found to be negatively related to household yam budget share. This indicates that household yam budget share declined with increases in household income. This is consistent with Engel's law which posits that when household income increases, the proportion of household budget spent on food products decreases. For low income households who are more particular about survival, an increase in income results in an increase in household budget allocated to food (in this case yam). However, for high income households, a further increase in income will most likely be directed away from food purchases, *ceteris paribus*. Household yam expenditure elasticities for the various income groups have been estimated and discussed in section 5.8. The proportion of household income under the control of females was found to be positively related to household yam consumption in Ghanaian urban centers. This result indicates that the higher the proportion of household income under the control of women, the higher the proportion of household food budget spent on yam products. This finding is consistent with the findings of Hopkins *et al* (1994) and Hoddinott & Haddad (1995) who used food in general (not yam) for analysis. However, the result contradicts the findings of Thomas (1997) and Adebayo (2004) who found a negative relationship between women's share of household income and food budget share. The actual yam elasticity with respect to women's income share has been estimated and discussed in section 5.10.

5.4 Estimated model for the determinants of yam expenditure in Accra

This section deals with the factors that determine how much a household spends on yam at-home in Accra. Table 5.3 provides estimates for the budget share model (model I), the semi-log model (II) and the double log model (III).

The F-statistic of the budget share equation was significant at the one percent level, thus the hypothesis that none of the explanatory variables had a significant influence on yam budget share was rejected. The coefficient of determination for the budget share model was 0.570, implying that 57% of the variation in yam budget share was explained by changes in the independent variables combined. The standard error of regression (SER) for the budget share equation was very low, indicating that the

model was a better predictor of yam budget shares in Accra than the estimated mean budget share whose standard deviation was higher than the SER. 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.

It may be seen from the Table that gender of household head, religion, educational level, and expenditure on meat were significant in the budget share model, at least, at the 5% level. Also, household expenditure on cereals, income (per capita expenditure), and women's share of household income were found to be significant in the equation at the 5% level.

The model results indicated that, unlike the composite model discussed earlier, in Accra male headed households allocated a larger proportion of their food budget to yam than female headed households. Male-headed households in Accra had significantly higher incomes (per capita monthly expenditure of GH¢ 97.43) than female-headed households whose average per capita monthly expenditure was GH¢ 67.19. Since yam is an expensive food commodity, especially in Accra, it is likely to be consumed more by high income consumers, all other things being equal.

Religion which was not significant in the aggregate model was found to be significant in the Accra model. Christian households in Accra allocated significantly lower share of their food budget to yam compared to their non-Christian counterparts. This finding is not consistent with *a priori* expectation since yam is not discriminated against by any particular religion; the difference could possibly be due to cultural and personal considerations of household members.

Women's share of household income was found to have a significant positive effect on household yam budget share in Accra. Unlike the aggregate model in which educational level was insignificant at the 5% level, educational level was found to have a significant positive effect on yam budget shares in the Accra model. Since higher education is usually associated with well-paid jobs and high income levels, it is not surprising that the highly educated in Accra spend more on yam products, which are generally considered expensive on the local market. Bobby (2004) also found that an increase in educational level yields an increase in the percent per capita expenditure on all household expenditure items including food.

Table 5.3 Regression model estimates for Accra

Explanatory Variable	Dependent Variable			Tolerance Statistic	Variance-Inflation Factor (VIF)
	Yam Budget Share (I)	*Yam Expenditure (II)*	*Ln Yam Expenditure (III)*		
Constant	0.506 (9.817)**	-479922.301 (-5.737)**	5.009 (6.513)**	-	-
Gender (0=Male, 1=Female)	-0.131 (3.330)**	-0.076 (-1.969)*	-0.096 (-2.602)**	0.773	1.294
Age (0=<30yrs, 1=Otherwise)	-0.044 (-1.156)	-0.108 (-2.880)**	0.023 (0.638)	0.811	1.233
Religion (0=Christianity, 1=Otherwise)	0.133 (3.543)**	0.194 (5.327)**	0.235 (6.755)**	0.894	1.118
Tribe (0=Akan, 1=Otherwise)	-0.002 (-0.054)	0.127 (3.237)**	0.089 (2.367)**	0.757	1.322
Proportion of hh income under the control of females	0.078 (1.975)*	0.008 (0.200)	-0.067 (1.567)	0.764	1.309
Ln Years in School	0.199 (5.034)**	0.106 (2.782)**	0.144 (3.938)**	0.808	1.238
Ln Household Size	-0.035 (-0.799)	0.148 (3.610)**	-0.003 (-0.074)	0.634	1.578
Ln Active Females in Household	0.177 (4.455)**	0.069 (1.797)	0.095 (2.555)**	0.721	1.388
Ln Cassava Expenditure	-0.056 (-1.191)	0.274 (6.057)**	0.305 (7.036)**	0.576	1.735
Ln Plantain Expenditure	0.071 (1.578)	0.035 (0.788)	0.182 (4.293)**	0.602	1.662
Ln Fruits & Vegetables Expenditure	-0.075 (-1.503)	0.263 (5.396)**	0.270 (5.782)**	0.499	2.003
Ln Cereals Expenditure	-0.284 (-6.472)**	-0.061 (-1.434)	-0.090 (-2.211)*	0.658	1.521
Ln Meat Expenditure	-0.217 (-4.480)**	0.147 (3.111)**	0.166 (3.669)**	0.884	1.131
Ln Fish Expenditure	-0.064 (-1.425)	-0.138 (-3.157)**	-0.163 (-3.874)**	0.530	1.888
Ln Yam expenditure away from home	0.024 (0.653)	0.034 (0.939)	0.013 (0.365)	0.589	1.697
Ln Per Capita Household expenditure	0.074 (2.242)*	-0.064 (-1.251)	-2.567 (-2.498)*	0.441	2.269
Ln Per Capita Household expenditure squared	-0.145 (1.968)*	0.191 (0.208)	2.312 (2.250)*	0.175	5.714
R^2	*0.570*	*0.595*	*0.637*		
F (Prob.)	*16.387 (0.000)*	*19.912 (0.000)*	*24.881 (0.000)*		
Standard Error of Regression	*0.0183*	*32690.70*	*0.3005*		

*T-values in parenthesis; ** = Significant @1%, * = Significant @ 5%.*

The coefficient of household expenditure on cereals in the budget share equation showed a significant negative relationship with yam budget share at the 1% level. This means that in Accra cereals were used as substitutes for yam and as such the demand for one inversely affected the demand for the other, *ceteris paribus*. The results suggested that a ten percent increase in household expenditure on cereals will cause the household to reduce its yam budget share by almost 3 percent. Though not significant

at the 10% level, yam budget share in Accra was found to be inversely related to household expenditure on fish and fish products. A ten percent increase in household expenditure on fish will cause about 0.6% reduction in household yam budget share. As noticed in the aggregate model, there was also a significant negative relationship between expenditure on meat and yam budget share at the 1% level, implying that an increase in household expenditure on meat resulted in a reduction in household yam budget share. The two commodities are expensive in Accra and as such, given the household budget constraint, one would expect the budget share of one of these products to drop as the budget share of the other increased.

Yam expenditure elasticities from all the budget share models for the consumer locations have been discussed in section 5.8.

5.5 Estimated model for the determinants of yam consumption expenditure in Kumasi

This section provides a discussion on yam regression estimates for Kumasi. Table 5.4 gives the parameter estimates for the three separate models. The F-statistic of the budget share equation was significant at the one percent level, thus the hypothesis that none of the explanatory variables had a significant influence on yam budget share was rejected. The coefficient of determination for the model was 0.639, implying that 64% of the variation in yam budget share in Kumasi was caused by changes in the independent variables combined. The standard error of regression (SER) for the budget share equation was very low, indicating that the model was a better predictor of yam budget shares in Kumasi than the estimated mean budget share whose standard deviation was higher than the SER. The collinearity statistics in the table 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 5.4: Regression model estimates for Kumasi

Explanatory Variable	Dependent Variable			Tolerance Statistic	Variance-Inflation Factor (VIF)
	Yam Budget Share (I)	Yam Expenditure (II)	*Ln* Yam Expenditure (III)		
Constant	0.810 (7.825)**	-910345.73 (9.146)**	1.950 (1.934)*	-	-

Gender (0=Male, 1=Female)	-0.188 (-4.672)**	-0.240 (-6.220)**	-0.226 (-6.065)**	0.741	1.350
Age (0=<30yrs, 1=Otherwise)	0.060 (1.398)	-0.031 (-0.758)	0.036 (0.908)	0.652	1.533
Religion (0=Christianity, 1=Otherwise)	-0.140 (-3.165)**	-0.145 (-3.416)**	-0.152 (-3.720)**	0.613	1.630
Tribe (0=Akan, 1=Otherwise)	-0.070 (-1.774)	-0.028 (-0.735)	0.076 (2.073)*	0.766	1.306
Share of HH income controlled by women	0.22 (0.567)	0.109 (2.967)**	0.146 (4.101)**	0.809	1.236
Ln Years in School	-0.094 (-2.352)**	-0.081 (-2.098)*	-0.147 (-3.961)**	0.745	1.342
Ln Household Size	0.024 (0.385)	0.037 (0.620)	0.053 (1.940)*	0.304	3.293
Ln Active Females in Household	0.073 (1.576)	-0.014 (-0.317)	0.002 (0.038)	0.553	1.807
Ln Cassava Expenditure	0.163 (3.662)**	0.269 (6.315)**	0.319 (7.743)**	0.607	1.649
Ln Plantain Expenditure	0.008 (0.186)	0.113 (2.699)**	0.187 (4.621)**	0.629	1.589
Ln Fruits & Vegetables Expenditure	-0.078 (-1.929)*	-0.070 (-1.814)	-0.106 (-2.826)**	0.731	1.368
Ln Cereals Expenditure	-0.017 (-0.424)	-0.035 (-0.934)	-0.040 (-1.099)	0.781	1.281
Ln Meat Expenditure	-0.526 (-9.307)**	0.130 (2.401)**	0.055 (2.048)*	0.376	2.660
Ln Fish Expenditure	-0.014 (-0.247)	0.250 (4.654)**	0.149 (2.874)**	0.382	2.620
Ln Yam expenditure away from home	0.031 (0.843)	0.103 (2.891)**	0.135 (3.942)**	0.875	1.142
Ln Per Capita Household expenditure	-2.841 (-2.820)**	-1.418 (-2.050)*	-1.361 (-2.019)*	0.404	2.474
Ln Per Capita Exp. Squared	-2.936(2.837)**	1.533 (2.137)*	1.305 (2.021)*	0.168	5.952
R^2	*0.639*	*0.677*	*0.703*		
F (Prob.)	*21.253 (0.000)*	*26.007 (0.000)*	*30.106 (0.000)*		
Standard Error of Regression	*0.07439*	*30592.66*	*0.3100*		

*T-values in parenthesis; ** = Significant @1%, * = Significant @ 5%.*

It may be evident from the table that gender of household head, religion, educational level, household expenditures on cassava and meat as well as per capita expenditure were significant in the budget share equation, at least, at the 5 percent level. Household expenditure on fruits & vegetables was also found to be significant in the budget share at the 5% level. However, household expenditures on cereals, plantain, fish, yam away-from-home, and women's share of household income were not significant in the budget share model at the 5% level. It may be observed from the table that household expenditure on cereals did not significantly influence household yam consumption in Kumasi at the five percent level. This might possibly suggest that in Kumasi, majority of households still held on to the traditional

diets of roots and tubers and that expenditure on cereals did not affect household consumption of the former significantly.

Unlike the model for the pooled data, the results showed that in Kumasi, like Accra, male headed households spent more on yam than female headed households. This was probably due to the fact that male headed households normally had higher incomes and/or larger sizes than female-headed households. Male headed households in the sample had average household size of 6.26 and average per capita monthly expenditure of GH¢ 24.69 as compared to female-headed households which had average household size of 5.76 and GH¢19.04 per capita monthly expenditure. The test of difference between means led to the conclusion that male headed households in Kumasi had high incomes than female headed households at the 5% level.

Contrary to the finding in the Accra model but consistent with results in the aggregate model, educational level of household head was found to have a negative effect on yam budget share in Kumasi; however, the effect was not significant in the aggregate model at the 5% level. The results imply that the less educated in Kumasi spent more on yam products than the highly educated. It could stem from the fact that less educated households in Kumasi had relatively larger household sizes (about seven people) compared to their highly educated counterparts whose average household size was about four people. The coefficient of household size, though insignificant at the 5% level, indicated a positive effect on household yam budget share. The effect of household size was significant at the 5% level in the double-log model. A ten percent increase in household size will cause a 0.5% increase in household yam expenditure in Kumasi.

Household expenditures on cassava, plantain, fish and expenditure on yam away from home were positively related to household yam expenditure. This implies that these commodities were not considered as substitutes for yam in Kumasi. Typically, cassava and yam are used to prepare different meals in Kumasi. Cassava is boiled normally with other starchy staple such as plantain or cocoyam and pounded into *fufu*, and yam is boiled and consumed as *ampesi*. In Kumasi, because plantain is usually used together with cassava to prepare *fufu*, the two commodities are thus complements. The positive relationship between plantain expenditure and yam could partly imply that households in Kumasi buy yams and plantains together to either prepare *ampesi* or use the plantain to prepare *fufu*.

In other words, it appears households in Kumasi used plantain for *fufu* and yam for *ampesi* and thus, expenditure on plantain is not likely to cause a reduction in household yam budget share.

Consistent with the observation in the aggregate model and the Accra model, household expenditure on fruits & vegetables had negative effect on yam budget share in Kumasi. The coefficient, which was significant at the 5% level, implies that a 10% increase in household expenditure on fruits & vegetables will cause household yam budget share to drop by 0.78%. This relationship is partly due to the expensive nature of both yam and fruits & vegetables. The implication of the finding is that when households increase their yam budget shares, *ceteris paribus*, they will do so by cutting down on the consumption of fruits & vegetables which are essential for body maintenance and good health.

Consistent with the Accra and aggregate models, household expenditures on meat and fish were found to be negatively related to yam budget shares in Kumasi. The results imply that increases in household expenditures on meat and fish will result in a reduction in household yam budget share. These commodities (yam, meat and fish) are relatively expensive in Kumasi and as such given the household budget constraint, one would expect the budget share of one of these products to drop as the budget shares of the others increased.

5.6 Estimated model for the determinants of yam consumption expenditure in Techiman

Yam regression estimates for Techiman are discussed in this section. Table 5.5 provides the model estimates for the budget share, yam expenditure and logarithm of yam expenditure models. The Fstatistic of the budget share equation was significant at the one percent level, thus the hypothesis that none of the explanatory variables had a significant influence on yam budget share was rejected. The coefficient of determination for the model was 0.560, implying that 56% of the variation in yam budget share in Techiman was explained by changes in the independent variables combined. The standard error of regression (SER) for the budget share equation was very low, indicating that the model was a better predictor of yam budget shares in Techiman than the estimated mean budget share whose standard deviation was higher than the SER. The collinearity statistics in the table show 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 5.5 Regression model estimates for Techiman

Explanatory Variable	Dependent Variable			Tolerance Statistic	Variance-Inflation Factor (VIF)
	Yam Budget Share (I)	*Yam Expenditure (II)*	*Ln Yam Expenditure (III)*		
Constant	0.620 (4.677)**	-325750.339 (2.738)**	8.399 (12.282)**	-	-
Gender (0=Male, 1=Female)	0.071 (1.599)	0.128 (2.863)**	0.139 (3.079)**	0.690	1.450
Age (0=<30yrs, 1=Otherwise)	0.044 (1.049)	0.023 (-0.908)	-0.047 (-1.110)	0.789	1.267
Religion (0=Christianity, 1=Otherwise)	0.262 (5.960)	0.023 (0.519)	0.098 (2.192)*	0.647	1.546
Tribe (0=Akan, 1=Otherwise)	0.267 (5.978)**	0.084 (1.857)	0.090 (1.980)*	0.624	1.603
Proportion of income controlled by women	0.006 (0.143)	0.133 (3.117)**	0.148 (3.448)**	0.722	1.385
Ln Years in School	-0.038 (-0.900)	0.005 (0.122)	-0.009 (-0.205)	0.730	1.369
Ln Household Size	0.225 (3.822)**	0.182 (4.103)**	0.151 (3.408)**	0.509	1.966
Ln Active Females in Household	0.173 (4.003)**	0.142 (3.232)**	0.120 (2.712)**	0.661	1.514
Ln Cassava Expenditure	0.092 (2.055)*	0.196 (4.286)**	0.154 (3.371)**	0.634	1.578
Ln Plantain Expenditure	-0.209 (-4.520)**	0.071 (1.506)	0.121 (2.550)**	0.588	1.700
Ln Fruits & Vegetables Expenditure	-0.080 (-1.931)*	0.148 (3.156)**	0.189 (4.013)**	0.594	1.683
Ln Cereals Expenditure	0.163 (4.080)**	0.169 (4.212)**	0.156 (3.810)**	0.799	1.252
Ln Meat Expenditure	-0.015 (-0.304)	-0.076 (-1.511)	-0.005 (-0.102)	0.505	1.980
Ln Fish Expenditure	-0.268 (-5.252)**	-0.180 (-3.507)**	-0.137 (-2.655)**	0.479	2.089
Ln Yam expenditure away from home	-0.037 (-1.002)	0.02 (0.529)	-0.083 (-2.240)*	0.934	1.071
Ln Per Capita Household expenditure	-1.442 (3.361)**	0.037 (0.039)	-2.082 (-4.274)**	0.636	1.573
Ln Per Capita Household expenditure squared	-1.510 (-1.954)*	-0.056 (-0.054)	2.221 (4.418)**	0.194	5.155
R^2	*0.560*	*0.531*	*0.528*		
F (Prob.)	*14.094 (0.000)*	*13.672 (0.000)*	*13.398 (0.000)*		
Standard Error of Regression (SER)	*0.03771*	*42297.19*	*0.2482*		

*T-values in parenthesis; ** = Significant @1%, * = Significant @ 5%.*

Household size, active females in household, household expenditures on cassava, plantain, fruits & vegetables, cereals, and fish were significant in the budget share model, at least, at the 5 percent level. Ethnic affiliation of household head and income (per capita expenditure) were also found to be significant in the budget share equation. However, age of household head, educational level and household expenditure on meat were found not to significantly influence household yam budget share in Techiman at the five percent level.

Contrary to the findings in the Accra and Kumasi models, but consistent with the results in the aggregate model, female headed households in Techiman devoted a higher share of their food budget to yam than male headed households. Christian and Akan households in Techiman spend significantly less on yam as compared to their non-Christian and non-Akan counterparts respectively.

Like the previous models, the Techiman budget share equation also found a positive relationship between women's share of household income and household yam budget share. The number of active females in the household had a significant positive effect on yam budget share at the household level. A ten percent increase in the number of active females in the household will cause the household to increase its yam budget share by 1.7%. Household expenditures on cassava and cereals were positively related to household yam consumption. A 10 percent increase in household expenditures on cassava and cereals will result in 0.92% and 1.63% increases in budget shares respectively. Household expenditures on fish and yam away-from-home had significant negative effects on yam budget share in Techiman. A 10 percent increase in household expenditure on fish will cause about 2.7% reduction in household yam budget share. Household expenditures on fruits & vegetables and plantain also had negative effects on yam budget shares.

Yam expenditure elasticities from all the budget share models for the consumer locations have been discussed in section 5.8.

5.7 Estimated model for the determinants of yam consumption expenditure in Tamale

Yam regression estimates for Tamale are discussed in this section. Table 5.6 provides the model estimates for the budget share, yam expenditure, and logarithm of yam expenditure models. The Fstatistic of the budget share equation was significant at the one percent level, thus the hypothesis that none of the explanatory variables had a significant influence on yam budget share was rejected. The coefficient of determination for the model was 0.383, implying that 38% of the variation in yam budget share in Tamale was explained by changes in the independent variables combined. The standard error of regression (SER) for the budget share equation was very low, indicating that the model was a better predictor of yam budget shares in Tamale than the estimated mean budget share whose standard deviation was higher than the SER. The collinearity statistics in the table show 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 5.6 Regression model estimates for Tamale

Explanatory Variable	Dependent Variable			Tolerance Statistic	Variance-Inflation Factor (VIF)
	Yam Budget Share (I)	*Yam Expenditure (II)*	*Ln Yam Expenditure (III)*		
Constant	0.258 (2.220)*	-969112.54 (10.100)**	-1.402 (-2.478)*	-	-
Gender (0=Male, 1=Female)	0.052 (1.247)	0.119 (3.220)**	0.107 (3.422)**	0.878	1.139
Age (0=<30yrs, 1=Otherwise)	-0.052 (-1.250)	0.079 (2.171)*	0.069 (2.242)*	0.896	1.116
Religion (0=Christianity, 1=Otherwise)	-0.005 (-0.115)	0.044 (1.123)	0.089 (2.658)**	0.775	1.290
Tribe (0=Akan, 1=Otherwise)	0.138 (3.065)**	-0.076 (-1.514)	0.034 (1.015)	0.760	1.316
Proportion of income controlled by women	-0.011 (-0.274)	0.066 (1.796)	-0.022 (-0.702)	0.889	1.125
Ln Years in School	0.074 (1.715)	-0.146 (-3.843)**	-0.168 (-5.230)**	0.833	1.200
Ln Household Size	0.305 (4.875)**	-0.020 (-0.368)	0.087 (1.854)	0.392	2.551
Ln Active Females in Household	0.133 (2.335)*	0.002 (0.031)	0.047 (1.098)	0.471	2.122
Ln Cassava Expenditure	-0.001 (-0.032)	0.210 (0.250)	0.291 (1.607)	0.752	1.330
Ln Plantain Expenditure	-0.010 (-0.218)	0.054 (1.364)	0.017 (0.492)	0.759	1.317
Ln Fruits & Vegetables Expenditure	-0.289 (-5.276)**	0.075 (1.556)	0.060 (1.464)	0.512	1.953
Ln Cereals Expenditure	0.005 (0.109)	0.187 (4.892)**	0.146 (4.532)**	0.824	1.213
Ln Meat Expenditure	0.057 (0.927)	0.186 (3.394)**	0.213 (4.599)**	0.401	2.494
Ln Fish Expenditure	0.032 (0.532)	0.061 (1.137)	0.216 (4.745)**	0.414	2.418
Ln Yam expenditure away from home	-0.085 (-2.059)*	0.143 (3.923)**	0.086 (2.793)**	0.908	1.101
Ln Per Capita Household expenditure	-3.767(1.955)*	-0.353 (0.576)	-3.668 (-4.763)**	0.705	1.419
Ln per capita Expenditure Squared	-3.881 (2.929)**	0.378 (0.455)	3.750 (4.870)**	0.243	4.115
R^2	*0.383*	*0.578*	*0.723*		
F (Prob.)	*5.975 (0.000)*	*17.442 (0.000)*	*38.012 (0.000)*		
Standard Error of Regression (SER)	*0.85744*	*30123.09*	*0.2643*		

*T-values in parenthesis; ** = Significant @1%, * = Significant @ 5%.*

From Table 5.6, tribal affiliation, household size, active females in household and household expenditures on fruits & vegetables and yam away-from-home as well as per capita expenditure were significant in the budget share equation, at least, at the 5% level. Consistent with the Techiman model but in sharp contrast to the results in the Accra and Kumasi models, Akan households had significantly lower yam budget shares than non-Akans in Tamale. In Tamale and Techiman, most of the consumers,

who were also yam producers, happened to be non-Akans, hence the high budget share for the non-Akans.

Women's share of household income was found to have no significant effect on household yam expenditure in Tamale though the sign was positive and consistent with *a priori* expectation. Consistent with the Aggregate, Kumasi and Techiman models, household size had a positive relationship with household yam budget share in Tamale. The significant coefficient implies that the larger the household size, the higher the household food budget allocated to yam. Just as was found in the previous models, the number of active females in the household had a significant positive effect on household yam budget share in Tamale.

Household expenditure on fruits & vegetables was found to be negatively related to household yam budget share. Fruits and vegetables were expensive in Tamale and as such, given the household budget constraint, an increase in household expenditure on this food group is likely to result in a reduction in the amount spent on yam at home. Household expenditures on cereals, meat and fish had positive but insignificant effects on yam budget share in Tamale. With respect to expenditure on yam away-from-home, a negative relationship was observed in the budget share model. This implies that the household yam budget share decreases in response to increases in household expenditure on yam away-from-home.

5.8 Yam expenditure elasticities

Table 5.7 provides the yam expenditure elasticities for the four consumer locations considered in the study. These elasticities were calculated from the budget share equations by using the coefficients of the per capita expenditure and the quadratic expenditure term. It may be observed from the table that the expenditure elasticities have the expected positive sign. This implies that an increase in household income will cause household yam budget share to increase.

Table 5.7: Yam expenditure elasticities

Consumer location	Yam budget share (w)	Per capita expenditure	Quadratic expenditure term

		Coefficient (β_1)	*Exp. elasticity ($1 + (\beta_1/w)$)*	*Coefficient (β_2)*	*Exp. elasticity ($1 + (\beta_2/w)$)*
Accra	7.86	0.074	1.0094	-0.145	0.9816
Kumasi	14.45	-2.840	0.8035	-2.936	0.7968
Techiman	14.92	-1.442	0.9034	-1.51	0.8988
Tamale	10.35	-3.767	0.636	-3.881	0.6250
All Areas	**11.65**	**-2.833**	**0.7568**	**-2.926**	**0.7488**

Source: Estimated from the budget share equations

In all areas, except Accra, the expenditure elasticity was less than unity ($0 < \eta_i < 1$), suggesting that yam is a normal food commodity. In Accra, however, yam expenditure elasticity was greater than unity implying that yam is a luxury commodity; even with the expenditure elasticity calculated from the quadratic expenditure term the estimate was still close to unity (0.982), an indication that yam is a luxury or almost a luxury food commodity in Accra. The results here compare quite favourably with expenditure elasticities for other carbohydrate sources in other empirical studies. The expenditure elasticities for potato, bread, and flour were also found to be positive and elastic; and that for rice and pasta were positive but inelastic in Russia (Rimma *et al*, 2003). In their analysis of the food consumption of Japanese households, Chern *et al* (2003) found the expenditure elasticity of non-glutinous rice to be positive and elastic (1.065) and that for bread, a major staple and carbohydrate source, to be positive and inelastic (0.503). Agbola (2003) found the expenditure elasticity of grains to be positive and elastic (1.25) in South Africa. However, Elliot and van Zyl (1991) found the expenditure elasticity for maize meal, rice and bread to be positive but inelastic - ranging between 0.157 and 0.231 for rural areas and 0.061 and 0.157 for urban areas in South Africa respectively.

For the pooled data, household yam budget share increases at a declining rate of 7.6% for every 10% increase in household income, *ceteris paribus*. The estimated yam expenditure elasticity (0.76) is very close to the reported expenditure elasticity obtained for starches (0.78) as a group in a study by Ord (1965) which was noted to be consistent with the estimates obtained in an earlier study in urban Ghana by Kaneda and Johnson (1961). In his estimation of yam expenditure elasticity for Ghana, Haessel (1976) relied on the estimate from Ord (1965) and obtained elasticities of 0.651 and 0.908 depending on the operational definition of yam. In Haessel's study, yam was defined firstly as yam plus cocoyam with expenditure elasticity of 0.651, and the second definition was yam, cocoyam and cassava put together which had expenditure elasticity of 0.908. This implies that when cocoyam and cassava are

taken out of the data, the actual expenditure elasticity for yam could be similar but different in magnitude to the estimated figure in this study.

A 10% increase in household income (expenditure) will warrant 6.3%, 8.0% and 9.0% increase in household yam budget share in Tamale, Kumasi, and Techiman respectively. Even though the income response is inelastic for all these urban centers, households in Techiman respond more to income changes than households in Kumasi and Tamale with respect to household yam budget shares. In Accra, household response to income changes with respect to yam budget share was found to be elastic. This implies that households will more than double their yam budget shares when household income is doubled. This finding is consistent with *a priori* expectation in view of the high price yam commands on Ghanaian urban markets especially in Accra. This result supports and agrees with the results from the study of Hoddinott and Yohannes (2002) which established that as household expenditures increase and household foods are diversified, they tend to increase their consumption of high-value staples and non-staples rather than low cost staple foods. The finding is also consistent with Bennett's law which posits that households switch from less to more expensive calorie consumption as their incomes rise.

Table 5.8 shows the yam expenditure elasticities for low, middle and high income groups in the four urban communities considered in this study. It could be seen from the table that yam expenditure elasticity for each of the urban centers decreases with income level. Low income households are more responsive to changes in household income as opposed to high income households as far as yam budget shares are concerned. This finding is consistent with the findings of many other studies (e.g. Bopape, 2006; Dawoud Seham, 2005; Chern *et al*, 2003) which converge on the point that for reasons of survival, low income households tend to increase their food budget shares than high income households following increases in household income. This is particularly so for relatively more expensive food commodities like yam, meat, and fruits & vegetables. It could be inferred from the Table that for low income households, yam expenditure elasticity ranges from a low figure of 0.89 in Kumasi to a high figure of 1.26 in Accra. For the middle income households, yam expenditure elasticity ranges between a low figure of 0.28 in Tamale and a high figure of 1.02 in Accra. For the high income group, however, expenditure elasticity was found to be high (1.01) in Accra and lowest (0.21) in Tamale.

Table 5.8: Estimated yam expenditure elasticities by consumer location and income group

Consumer location	Income Group*	Yam budget share (w)	Coefficient of per capita expenditure (β)	Exp. Elasticity (1 + (β/w))
	low	7.86	2.075	1.2640
	middle	8.19	0.15	1.0183
	high	6.74	0.061	1.0090
Accra	***All***	***7.86***	***0.074***	***1.0094***
	low	14.19	-1.58	0.8887
	middle	15.87	-1.683	0.8940
	high	3.72	-1.71	0.5403
Kumasi	***All***	***14.45***	***-2.84***	***0.8035***
	low	17.9	-1.261	0.9296
	middle	14.17	-2.574	0.8183
	high	9.12	-2.635	0.7111
Techiman	***All***	***14.92***	***-1.442***	***0.9034***
	low	13.03	-0.616	0.9527
	middle	8.78	-6.357	0.2760
	high	5.54	-4.374	0.2105
Tamale	***All***	***10.35***	***-3.767***	***0.6360***
	low	13.83	-1.464	0.8941
	middle	11.37	-3.552	0.6876
	high	6.83	-3.861	0.4347
Pooled Sample	***All***	***11.65***	***-2.833***	***0.7568***

Low income group has monthly income below GHC100.00; Middle Income: GHC101 - 500.00; High Income: >GHC500.00 per month* *(Author's construct)***

Source: Estimated from budget share regression models for the various locations and groups

The negative relationship found between yam expenditure elasticity and income level in Table 5.8 is fairly common in empirical literature (Strauss, 1986; Behrman and Wolfe, 1984; Wolfe and Behrman, 1983; Ward and Sanders, 1980) and consistent with Engel's law which posits that food budget shares of consumers increase at a declining rate with increasing income, all other things being constant at reasonable levels.

In his study on food consumption patterns in Egypt, Dawoud (2005) found cereals, beans & vegetables, oils & facts, sugar, fish and eggs to be necessary goods with inelastic expenditure elasticities ranging

between 0.541 and 0.871. On the other hand, fruits, meats and milk & milk products were found to be luxury food commodities with expenditure elasticities ranging from 1.209 to 1.327. Even though yam was not considered in her study, yam is a basic staple in Ghana as cereals are in Egypt. Bopape (2006) also found grains, oils, butter & fats, and sugars to be expenditure/income inelastic with elasticities ranging between 0.487 and 0.648. However, meat &fish, fruits & vegetables, and dairy products were found to be expenditure/income elastic.

In their analysis of food consumption patterns of Japanese households, Chern *et al* (2003) found the expenditure elasticity of common staples like bread, fresh fish, fresh meat and fresh vegetables to decline with income level. For instance, the study revealed that expenditure elasticity for bread ranged between 0.502 for low income households and 0.445 for high income households. In the case of fresh meat, expenditure elasticity was found to range between 0.797 for low income households and 0.666 for high income households. Njoku and Nweke (1994) found income (expenditure) elasticity of demand for rice in Nigeria to be greater than unity (elastic) and decreased from low to high income groups. The cited empirical studies, together with this study, confirm the theoretical and empirical consistency of the negative relationship between income level and food expenditure elasticity as established by Engel's law.

5.9 Price elasticities

Table 5.9 gives the Marshallian (uncompensated) and Hicksian (compensated) price elasticities with respect to yam budget share for the pooled data. It could be inferred from the table that household yam budget share was elastic with respect to own price. The estimated elasticity suggests that household yam budget share will more than double if the price of yam on Ghanaian urban markets was doubled, all other things held constant. In other words, given that the quantity of yam consumed by the household remains unchanged, yam budget share will increase at an increasing rate when the price of the commodity is increased. This may not be surprising since yam is relatively expensive compared to other staples. In a study on household expenditure patterns for carbohydrate sources in Russia, Rimma *et al* (2003) found own-price elasticities for all the carbohydrate sources to be positive and significant, indicating that an increase (decrease) in product price increases (decreases) the product's budget share in total household carbohydrate expenditures. The carbohydrate sources in their study included potatoes, bread, flour, rice and pasta which are less expensive compared to yam.

The cross-price elasticities for yam budget share with respect to cassava, plantain, maize and rice were found to be positive and elastic, suggesting that these commodities were used as substitutes for yam in Ghanaian urban communities. Increases in the prices of any of these substitute commodities will cause urban households to increase their yam budget shares, *ceteris paribus*. Among the substitute products considered, household yam budget share was more responsive to changes in the price of rice than the others. Perhaps, it is an indication of the fact that rice is the most important food substitute for yam in urban centers. This finding is consistent with *a priori* expectation since rice is among the so called 'convenience' foods whose preparation is less time-consuming. As such, urban households whose opportunity cost of time is very high would prefer rice when yam is not available or too expensive on the market. The basic carbohydrate sources in Russia (bread, potato, flour, rice, and pasta) were found to be complements, not substitutes, with cross price elasticities being negative and inelastic (Rimma *et al*, 2003).

Table 5.9: Uncompensated and compensated own and cross-price elasticities

Food commodity	Budget Share (%)	Per Capita Expenditure Coefficient*	Price Coefficient	Uncompensated Price Elasticity	Compensated Price Elasticity
Yam	11.65	-2.833	-0.020	1.831	1.919
Cocoyam	1.08	-2.833	0.072	0.261	0.269
Cassava	5.34	-2.833	0.016	1.297	1.337
Plantain	5.73	-2.833	0.009	1.392	1.435
Maize	6.67	-2.833	0.087	1.620	1.671
Rice	14.36	-2.833	0.113	3.490	3.599

The coefficient of the per capita expenditure in the aggregate model was used for price elasticity computation; hence the same figure (-2.833)

Source: Estimated from the budget share model for the pooled sample.

5.10 Effects of women's share of household income and household size

Table 5.10 provides the budget share elasticity with respect to women's share of household income and household size. Except in Tamale, household yam budget share in the other consumer locations was elastic with respect to women's share of household income. The estimated elasticities imply that when women's share of household income is doubled, household yam budget share will more than double in Accra, Kumasi and Techiman. In the case of Tamale, a 10% increase in women's share of household income is likely to cause household yam budget share to increase by about 9.9%. The elasticity is almost unity, suggesting that doubling of females' share of household income will cause household yam budget share to also double in Tamale.

Yam is relatively expensive on urban food markets compared to other staples. As such, when women have enough cash income to supplement that of their husbands, the purchasing power of households increases and their ability to buy more of expensive food commodities like yam is enhanced.

Table 5.10: Elasticities with respect to women's share of household income and household size

Consumer Location	Yam budget share (w)	Coefficient for women's income share (B_1)	Women's Income share Elasticity ($1 + (B_1/w)$)	Coefficient for Household size (B_2)	Household size Elasticity ($1 + (B_2/w)$)
Accra	7.86	0.078	1.0199	-0.035	0.9955
Kumasi	14.45	0.22	1.0152	-0.024	0.9983
Techiman	14.92	0.006	1.0004	0.225	1.0151
Tamale	10.35	-0.011	0.9989	0.305	1.0295
All	***11.65***	***0.035***	***1.0030***	***0.011***	***1.0009***

Source: ***Estimated from budget share models for the various consumer locations***

This positive relationship between food budget share and women's share of household income is consistent with *a priori* expectation and findings from other studies. Hopkins *et al* (1994) found that in Niger changes in female annual income, while controlling for male income, impacted positively on household food expenditures. Hoddinott and Haddad (1995) also found a positive marginal effect of women's income share on household food budget share in Ivory Coast. They showed that a doubling of the proportion of household cash income received by wives would lead to a 1.9% rise in budget share of food eaten within the household. However, other studies have found a negative relationship between women's share of household income and food budget share. Thomas (1997), using Brazilian data, found out that the marginal effect of increasing women's income on food expenditure share was negative. Using data from south-western Nigeria, Adebayo (2004) also found that increases in women's share of household income were likely to result in marginal declines in per capita food intake, implying that income redistribution from men to women would not increase per capita food energy intake in south-western Nigeria. The findings of this study support the positive relationship between women income share and food budget share found in some of the studies noted above. However, it is important to point out that this study looked at yam budget shares, not food budget shares; it is possible for yam budget share to increase (or decrease) and yet household food budget share may decrease (or

increase) or even remain unchanged, *ceteris paribus*. Unlike the study in Nigeria, which suggested that redistribution of income from husbands/males to wives/women may not be an effective strategy for motivating increased intake of food calories at the household level, this study suggests that such a strategy would be very effective in improving household food calorie intake in Ghanaian urban centers.

It may also be seen from Table 5.10 that there is a positive relationship between household yam budget share and household size. In Techiman and Tamale, household yam budget share is elastic with respect to household size. However, in Accra and Kumasi yam budget share elasticity with respect to household size is almost unity. This means that in Techiman and Tamale, household yam budget share will more than double when household membership doubles. For Accra and Kumasi, yam budget share will nearly double when household size is doubled. Burger *et al* (2004) also found a positive but inelastic relationship between food expenditure and household size. The finding in this study suggests that there are no economies of household size as far as the proportion of household budget allocated to yam is concerned. This finding could be explained by the fact that many households do not buy yam in bulk due to its limited shelf life and as such households do not benefit from advantages of bulk purchases such as price incentives.

Rimma *et al* (2003) found a positive and inelastic relationship between household size and the consumption of food products such as bread and pasta. However, a negative inelastic relationship was found between household size and potato, flour, and rice consumption at the household level, which suggested economies of household size with respect to the consumption of these carbohydrate sources. In his empirical study of food demand in Vietnam, Canh (2006) stated that household size does not have a clear effect on food expenditure share. Whereas he estimated a positive relationship between household size and rice consumption, a negative relationship was found between household size and meat/fish products consumption. Houthakker (1957), who found a negative relationship between household size and household food expenditure, explained that the impact of household size on expenditure could be decomposed into two effects. First, there is the 'specific' effect which indicates the need for more commodities (increased quantities) for household consumption as household size increases. Second, the increase in commodity quantities may not be proportional to food expenditure as there may be economies of scale in consumption as household size increases. He further explained that since the coefficient of household size represents the effect of household size when total household

expenditure is held constant, an income effect may emerge. Thus, depending on which effect is dominant, the coefficient may be either positive or 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.

5.11 Determinants of yam expenditure across seasons

An important challenge in the quest for food security among households is sustaining food consumption during the lean season. This is especially true for countries and regions that rely on rain-fed agriculture, and have poor post-harvest storage capacity or limited market opportunities to sell harvest surpluses. This section focuses on the factors that influence household yam budget share during the four survey periods across one complete year cycle. Table 5.11 provides the model estimates for the pooled data (all urban centers combined) for all four quarters considered in the study. The seasonal models for each of the four urban centers have been provided in appendix III.

As already pointed out in the yam budget share analysis (refer to section 4.4.3.3), yam expenditure varied across seasons during the survey period. From the regression analysis, consumer location was found to have significant influence on yam budget share during the lean season. Between the periods February-March and May-June when yam was relatively scarce, consumers in non-yam producing urban centers (Accra and Kumasi) had significantly higher food budget shares allocated to yam than consumers in yam producing urban centers (Techiman and Tamale). Even though Techiman and Tamale are producing centers, yam prices were high during the lean season and since incomes were low in these urban communities, consumers switched from yam consumption to substitutes like maize and rice. Farmers in these communities were likely to sell their yam produce and use the income realized to buy food products that were relatively cheaper.

Table 5.11 Budget share regression estimates across yam seasons^ – all urban centers

Explanatory Variable	**Dependent variable = Household yam budget share**			
	Aug-Sept.	***Nov. – Dec.***	***Feb. - March***	***May-June***
Constant	2.139 (3.802)**	1.603(3.607)**	-0.102 (-0.489)	0.101 (0.453)
Consumer Location (0=Accra & Kumasi; 1=Techiman & Tamale)	-0.071 (-1.475)	-0.080 (-1.681)	-0.097(-2.011)*	-0.092(-1.987)*

Gender (0=Male, 1=Female)	0.008 (0.169)	0.007 (0.150)	0.001(-0.007)	0.002(0.051)
Age (0=<30yrs, 1=Otherwise)	0.031 (0.708)	0.035 (0.824)	0.056(1.291)	0.056(1.302)
Religion (0=Christianity, 1=Otherwise)	0.065 (1.414)	0.052 (1.139)	-0.084(-1.821)	-0.085(-1.859)
Tribe (0=Akan, 1=Otherwise)	0.016 (0.357)	0.015 (0.340)	0.006(0.129)	0.011(0.252)
Proportion of income controlled by women	0.015 (0.331)	0.014 (0.305)	0.012(0.269)	0.013(0.291)
Ln Years in School	0.025 (0.570)	0.016(0.358)	-0.076(-1.697)	-0.067(-1.487)
Ln Household Size	-0.187 (-3.205)**	-0.183(-3.144)**	-0.051(-0.872)	-0.075(-1.274)
Ln Active Females in Household	-0.013 (-0.237)	-0.011(-0.201)	-0.010(-0.196)	-0.005(-0.085)
Ln Cassava Expenditure	-0.030 (-0.663)	-0.027(-0.598)	-0.039(-0.859)	-0.042(-0.941)
Ln Plantain Expenditure	0.026 (0.591)	0.031(0.705)	0.018(0.386)	0.011(0.253)
Ln Fruits & Vegetables Expenditure	0.111 (2.013)*	0.118(2.136)*	-0.038(-1.990)*	-0.051(-2.158)*
Ln Maize Expenditure	-0.058 (-1.216)	-0.063(-1.324)	-0.109(-1.838)	-0.102(-1.951)*
Ln Rice Expenditure	-0.083 (-1.836)	-0.089(-1.966)*	-0.074(-1.958)*	-0.072(-1.505)
Ln Meat Expenditure	-0.091 (-1.527)	-0.073(-1.230)	0.091(1.994)*	0.094(2.053)*
Ln Fish Expenditure	0.158 (2.685)**	0.163(2.782)**	0.117(1.945)*	0.105(1.954)*
Ln Yam expenditure away from home	0.044 (0.993)	0.053(1.220)	-0.128(-2.151)*	-0.114(-1.929)*
Ln Per Capita Household expenditure	-5.638 (-7.853)**	-3.454(-8.172)**	0.109(2.459)**	1.305(2.370)*
R^2	*0.415*	*0.425*	*0.401*	*0.404*
F (Prob.)	*4.634 (0.000)*	*4.901 (0.000)*	*4.259 (0.000)*	*4.340 (0.000)*
SER	*0.368*	*0.291*	*0.137*	*0.146*
*T-values in parenthesis; ** = Significant @1%, * = Significant @ 5%.*				

^ *Harvest season (August-Sept); Not-so abundant period (Nov-Dec.); Lean Season (February – June)*

Household size had a significant effect on yam budget share during the 'abundant' (harvest) season. Households enjoyed economies of size in respect of yam consumption during August-September and November-December periods. Due to the relative abundance of the commodity during this period and its attendant low prices, households were able to buy in bulk and possibly obtained price discounts. For larger households, yam purchased in bulk could be consumed within a reasonably short period to prevent spoilage due to relative short shelf-life of yam.

The effect of household expenditure on fruits and vegetables was mixed. Whereas a positive relationship was observed during the harvest season, a negative relationship was observed during the

lean season. The results suggest that during the period of August through December when yam was relatively abundant, households used fruits and vegetables as complementary products for yam. However, during the lean season fruits and vegetables were used as substitutes for yam. During this period, any increase in fruit and vegetable expenditure reduced the budget for yam and probably went to increase household expenditure on other yam substitutes like rice and maize which are also eaten together with vegetables. Household expenditure on maize was found to be significant during the May-June period when yam was very scarce. This is the period when new yams begin to emerge and prices are really high. During this period maize is also in abundance and thus households use it as a substitute for yam. The negative relationship between maize and yam budget share during this period therefore comes as no surprise.

In the case of rice, a negative relationship was observed throughout the year. However, the relationship was significant only during the 'not-so-scarce and not-so-abundant' period spanning from November to March. During this period, households reduced their yam budget share in favour of rice. The high demand for rice during the Christmas festivities could also account for this substitution relationship between yam (a typical root and tuber crop) and rice (a typical cereal). In spite of yam being a tuber crop and rice being cereal, they are expected to substitute for one another in urban centers. It should be noted that the price of rice (mostly imported) is relatively stable throughout the year compared to yam. As a result, rice becomes relatively cheaper than yam during the lean season of yam.

The inverse relationship between root crops and cereals is consistent with the findings of Handa and Mlay (2006), who noted that, the budget share for tubers declines when that for cereals increases and vice versa. They found an almost perfect substitution between cereals and tubers during the lean season. This strong substitution appears to be an important mechanism employed by urban households to reduce the risk of food insecurity over the production cycle especially during the lean season when food is relatively scarce.

A complementary relationship was observed between meat and fish on one hand and yam budget share on the other hand. Whereas household expenditure on fish was significant throughout the whole year, meat expenditure was found to be significant during the lean season. The positive relationship is not strange since meat and/or fish are taken with yam or any of its close substitutes. This means that even

when households substitute yam with other food commodities like rice, maize, cassava, etc., household expenditure on fish and/or meat will not necessarily reduce.

Table 5.12 shows the seasonal yam expenditure elasticities by consumer location. The seasonal regression estimates for the four urban centers have been provided in appendix III. From Table 5.12, yam was found to be expenditure elastic during the lean season and expenditure inelastic during the harvest season. Yam expenditure elasticity for the pooled data ranged from 0.69 in August – September to a high of 1.15 in May-June when yam was scarce. The implication is that yam is a necessary food commodity during yam abundant periods of the year and becomes a luxury food commodity during the lean season. The explanation for this finding is not far-fetched; yam is relatively expensive during the lean season. In general, yam is a staple food crop expected to have inelastic demand when available. When yam is unavailable or scarce, its price increases and other commodities (e.g. rice) become important substitutes during the lean season and thus the elastic demand. Yam expenditure elasticity was found to be less than unity (a basic necessity) during the harvest season (August-September) in each of the four urban centers. Apart from Accra, yam expenditure elasticity for the November-December period still remained within the inelastic zone. During the February-March and May-June periods, yam became expenditure elastic in Techiman and remained a basic necessity in Kumasi and Tamale. These findings suggest that consumers in Accra and Techiman were more responsive to changes in household expenditure (income) with respect to household food budget allocated to yam particularly during the lean season. Poor or lowincome consumers are likely to be worse off as far as yam consumption is concerned. However, as a coping strategy/mechanism consumers resort to substitution along the production cycle to even out household food consumption, especially during the lean season.

Table 5.12: Seasonal yam expenditure elasticities by consumer location

Consumer Location	Aug-Sept, 2006			Nov-Dec, 2006			Feb-March, 2007			May-June, 2007		
	Budget sharew (%)	*Coeff. Of per cap exp (B)*	*Exp Elasticity (1 + (B/w))*	*Budget share (%)*	*Coeff. Of per cap exp (B)*	*Exp Elasticity (1 + (B/w))*	*Budget share (%)*	*Coeff. Of per cap exp (B)*	*Exp Elasticity (1 + (B/w))*	*Budget share (%)*	*Coeff. Of per cap exp (B)*	*Exp Elasticity (1 + (B/w))*
Accra	12.83	-1.204	0.9062	9.18	0.102	1.011	5.98	0.237	1.040	6.43	1.152	1.179
Kumasi	21.73	-6.139	0.7175	18.76	-2.047	0.891	8.03	-0.197	0.975	10.24	-0.185	0.982
Techiman	21.4	-3.579	0.8328	18.07	-1.563	0.914	10.02	0.069	1.007	11.03	0.699	1.063
Tamale	16.63	-7.077	0.5744	11.75	-4.018	0.658	6.08	-0.714	0.883	7.32	-0.644	0.912
All Areas	**18.07**	**-5.638**	**0.6880**	**13.44**	**-3.454**	**0.743**	**7.23**	**0.109**	**1.015**	**8.67**	**1.305**	**1.151**

Source: Estimated from Seasonal yam expenditure Model.

5.12 Implications for Theory and other Empirical Studies

This section provides the findings of the study in the light of the specific hypotheses and how they compare with findings from other empirical studies.

The first hypothesis tested in the study was that household yam budget share differs across different income groups. Due to its high price, relative to other roots and tubers, yam constitutes a greater share of the food budgets of low-income households compared to their high-income counterparts.

The study supported the null hypothesis that yam budget shares differed significantly across income groups at the one percent level. High income households were found to devote relatively smaller share of their food budget (<10%) to yam compared to their low-income counterparts who devoted more than 12% of their food budget to yam. This finding is consistent with the findings of Asumugha *et al* (2008). It is also in consonance with economic theory which posits that the higher the income level of a consumer, the smaller the proportion of household budget spent on food (Agbola, 2003; Chern *et al*. 2003; and Rimmar *et al*, 2003).

The second hypothesis tested in the study was that yam is a luxury food commodity for low income households in Ghanaian urban centers; low income households are therefore expected to be more responsive to changes in household income level in respect of food budget share allocated to yam.

The study provided empirical evidence to affirm the above hypothesis. Low income households were more income/expenditure-elastic than high income households with respect to yam consumption. Yam expenditure elasticity ranged from a low of 0.43 for high-income households to a high of 0.89 for low income households in a typical urban center, suggesting that low income households are more responsive to changes in income level as far as yam consumption is concerned. Asumugha *et al* (2008) also estimated yam expenditure elasticity of 0.48 for high income consumers, 0.90 for middle income consumers and 0.62 for low income consumers in Nigeria. The inverse relationship found between yam expenditure elasticity and income level is fairly common in empirical literature (e.g. Tsegai and Kormawa, 2002; Strauss, 1986; Behrman and Wolfe, 1984; Wolfe and Behrman, 1983; Ward and Sanders, 1980) and also consistent with

Engel's law which posits that food budget shares of consumers increase at a declining rate with increasing income, all other things being equal at reasonable levels.

Since availability of yam, its price and close substitutes vary across yam seasons, the study hypothesized that yam expenditure elasticity is likely to vary across seasons. At the outset of the study, yam was expected to be more expenditure-elastic during the lean season and less elastic during the harvest season.

Consistent with the null hypothesis above, the study found yam to be expenditure-elastic during the lean season and expenditure-inelastic during the major season in Ghana. Since estimation of yam elasticity across seasons was unique to the current study and beyond the scope of related studies, there was no basis for comparison. However, the availability of many yam substitutes (e.g. rice, maize, cassava) during the lean season and the expensive nature of yam during this period explain why yam is expenditure-elastic during the lean season.

The study tested a fourth hypothesis that yam consumption will be price elastic in urban communities due to availability of many substitutes in these communities. Results of the study supported the null hypothesis. Own price elasticity of yam was estimated to be more than unity (1.92) and the cross-price elasticities with respect to cassava, plantain, maize and rice were all greater than unity, affirming the positions of these related food commodities as strong substitutes for yam in urban Ghana. Contrary to the findings of this study, Asumugha *et al* (2008) and Tsegai and Kormawa (2002) found yam to be own-price inelastic in Nigeria. However, quite importantly, the current study and those cited from Nigeria converge on the point that own-price elasticity of yam is positive, mainly due to its expensive nature.

The study hypothesized that increases in women's income as a proportion of total household income would increase household yam budget share in urban communities. Evidence from the study supported the null hypothesis and found a significant positive relationship between women's income share and household yam consumption. This finding is consistent with results from other empirical studies. Hopkins *et al* (1994) and Hoddinott & Haddad (1995) found a positive relationship between women's income and food consumption in separate studies

conducted in Niger and Ivory Coast respectively. However, Thomas (1997) and Adebayor (2004) found a negative relationship between women's income and food consumption in Brazil and Nigeria respectively.

The final hypothesis tested in the study was that households enjoyed economies of size in respect of yam budget share. Larger households were, therefore, expected to allocate a relatively smaller proportion of their food budget to yam as compared to smaller households.

Using the whole sample, the study did not support the hypothesis of economies of household size with respect to household yam budget share. A positive and elastic or near-elastic relationship was observed between household size and household yam budget share in a typical Ghanaian urban center. However, the seasonal data analysis showed that households enjoyed economies of size in respect of yam budget share during the major season (August – December).

The positive effect of household size on yam consumption is consistent with other studies which considered food as a composite commodity (Sadrali, 2006; Burger *et al*, 2004; Rimma *et al*, 2003). On the other hand, Rimma *et al* (2003) and Houthakker (1957) found a negative relationship between household size and food consumption when specific commodities such as potato, flour and rice were considered. The mixed effect of household size on food consumption is supported by Canh (2006) who noted that, household size does not have a clear effect or direction of influence on food expenditure share after his analysis of food demand in Vietnam.

CHAPTER SIX

6.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary and Conclusions

This study analysed yam expenditure patterns in Ghanaian urban communities taking into account differences in preferences across income groups, household demographic factors and seasons. The

study was motivated by the need to provide an accurate analysis of yam demand in Ghanaian urban centers to provide demand behavioural parameters that will inform urban food policy formulation especially as it relates to yam and other starchy staples.

Yam is an important staple in the Ghanaian urban food system. It is essential to gain thorough knowledge of the determinants of yam expenditure patterns in order to design comprehensive agricultural, food, and social policy options that improve access to yam and for that matter food at the household level. Predictions of changes in consumer expenditure as a result of changes in income, prices and household socio-demographic characteristics were key information for this purpose, and econometric analyses were used to estimate them empirically. Therefore, the study estimated complete yam demand systems as a basis for future decisions on Ghana's urban food policies.

The descriptive analysis examined the structure of food expenditure patterns for specific food and non-food items in Ghanaian urban communities, with special emphasis on the differences in yam budget shares across income groups and other personal characteristics of household heads. This analysis identified disparities in food budget shares of different food commodities across consumer locations, income groups, age, gender and educational levels, among other factors. However, this budget share analysis did not answer the question of whether the disparities arose from varying economic conditions faced by the households or whether they were the consequence of systematic differences in their economic behaviour due to different preferences. Yam demand elasticities for the selected urban centers and households in the various income groups which reflect this economic behaviour were also investigated in this study.

Consumer behaviour 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. In order to choose a suitable model for this study, a detailed review of the body of literature on theoretical and applied demand systems for consumer behaviour analysis was provided. Comparative assessment led to the selection of the Almost Ideal Demand System (AIDS) and Quadratic Almost Ideal Demand System (QUAIDS) because of their flexibility, theoretical consistency and ability to depict non-

linear Engel curves. However, effort was made to estimate the semi-log and double-log functional forms of the model to allow for comparison of parameter estimates.

Among others, the following specific findings were made from the study.

6.1.1 Yam variety, substitute and processed product preference

- Majority (>80%) of yam consumers in Ghanaian urban communities prefer white yam to yellow yam and water yam. The most important reason for consumers' preference for yam varieties was taste. Varietal preference was found to be statistically independent of household income.

- The most preferred yam product in Ghanaian urban centers was found to be boiled yam (*ampesi*) followed by pounded yam (*fufu*). The null hypothesis of independence between yam product preference and income level was rejected statistically at the 1% level. A high proportion of low income households prefer yam in pounded form (*fufu*) while high income households prefer yam in the boiled form (*ampesi*).

- Rice was identified as the most important substitute for yam in urban communities. Relatively more (41%) urban households purchase and consume rice when yam is unavailable or too expensive on the market. Preference of particular commodities as yam substitutes was found to be statistically independent of income level at the 5% level.

6.1.2 Food and yam budget share across urban centers, income groups and seasons

- The study showed that average monthly household recurrent and food expenditures are lowest in Kumasi and highest in Accra. For the pooled sample, 51% of total household budget was spent on food in a typical urban community. Apart from households in Accra whose food budget share forms 42% of total household budget, households in the other urban centers spend between 51 and 59% of their total household budget on food.

- On the average, 12% of the food budget of a typical urban household is spent on yam products. Yam budget shares are highest in Kumasi and Techiman (14 – 15%) and lowest in Accra where 8% of food budget is spent on yam. A typical urban household spends at least 10% of its food budget on meat, cereals, fish, and fruits & vegetables as individual commodities.

- Low income households spend a larger proportion of their food budgets on yam. High income households spend less than 10% of their food budgets on yam compared with low income households who spend between 12 and 16% of their food budgets on yam. The study found out that there are statistically significant differences among households in different income groups as far as yam budget share is concerned.

- Yam constitutes about 13% of average household away-from-home food expenditure budget which was estimated at GH¢ 6.80/month. Yam budget share of away-from-home food expenditure was highest in Techiman (19%), the least urbanized with lowest incomes, and lowest in Accra (6%), the most urbanized with highest incomes.

- Food budget shares that households allocated to yam generally increased during the peak harvest season and dropped during the lean season across all urban centers in Ghana. This could imply that during the lean season when yam is relatively scarce, households rather increase their budget shares for other substitutes like cereals and 'low cost' roots and tubers like cassava and cocoyam.

6.1.3 Determinants of household yam consumption patterns

- The principal determinants of yam expenditure in all the consumer locations combined (pooled data) were identified to include consumer location, gender, number of active females in household, own price of yam and prices of substitutes (rice, maize, and cocoyam), household expenditures on fruits & vegetables, meat, fish, and yam awayfrom-home, and per capita household expenditure.

- Gender, religion, and educational level of household head were among the significant determinants of household food budget share spent on yam in purely yam consuming urban centers (Accra and Kumasi) but not in the yam producing urban centers (Techiman and Tamale). Tribe of household head and household size were, however, significant determinants of yam budget shares in Techiman and Tamale but not in Accra and Kumasi. The magnitudes and directions of influence of these variables were mixed depending on the location of the household.

- The number of active females (15 – 65 year olds) in the household was found to have a significant positive effect on yam budget shares in Ghanaian urban communities.

- Household expenditures on yam substitutes (such as cassava, plantain, and cereals) and complements (e.g. fruits & vegetables, fish, and meat) were found to significantly influence the proportion of household food budget allocated to yam in all the urban centers. Household expenditure on the substitutes had a negative effect on yam budget shares; and due to their high prices, expenditures on the 'supposed' complements also had negative effects on yam budget share.

6.1.4 Yam expenditure elasticities

- Yam expenditure elasticity was found to be positive, implying that yam is not an inferior food commodity in Ghanaian urban communities. Yam expenditure elasticity for the pooled sample was found to be inelastic (0.76), suggesting that yam is a normal food commodity in a typical Ghanaian urban center. However, yam expenditure elasticities for

households of all income groups in Accra were estimated to be greater than unity (elastic), implying that yam is a luxury food commodity in Accra.

- Yam expenditure elasticity was lowest for Tamale (0.64) and highest for Accra (1.01). This implies that Tamale households are least responsive and Accra households are most responsive to changes in household expenditure/income as far as yam budget share is concerned.

- Generally, yam expenditure elasticity was found to be higher for low income households as compared to high income households in all urban centers. This implies that low income households are more responsive to changes in income levels as far as yam budget shares are concerned, *ceteris paribus*.

- Yam expenditure elasticity was found to vary across seasons; yam was expenditure elastic during the lean season and expenditure inelastic during the harvest season. Yam expenditure elasticity for the pooled data ranged from 0.69 in August-September to 1.15 in the May-June period when yam was scarce. The implication is that yam is a necessary food commodity during yam abundant periods of the year and becomes a luxury food commodity during the lean season when yam prices are high.

6.1.5 Price elasticities:

- Own price elasticity (both compensated and uncompensated) for yam budget share was found to be positive and elastic in a typical urban center; implying that increases in yam price will cause household yam budget share to increase more than proportionately, all other things being constant at reasonable levels.

- According to the magnitudes of cross-price elasticities for the selected related food commodities (cassava, plantain, cocoyam, maize, and rice), only substitution relationships were observed in a typical Ghanaian urban community. Except cocoyam, the relationships

between yam budget share and the prices of these commodities were found to be elastic. However, household yam budget share was more responsive to changes in the price of rice, indicating its position as the most important substitute for yam in urban Ghana.

- The own-price elasticity of yam budget share for the pooled sample (which was greater than unity) was higher than the expenditure elasticity (which was less than unity), implying that households react elastically to changes in own price of yam and inelastically to changes in household expenditure/income. So as far as yam budget share is concerned, households in a typical Ghanaian urban center are more responsive to changes in yam prices than household income.

6.1.6 Effect of women's income share and household size on household yam consumption

- Women's share of household income was found to be positively related to household yam budget share; in Accra, a 10% increase in women's share of household income would warrant an 8% increase in the proportion of household food budget spent on yam, all other things being constant at reasonable levels.

- Using the whole sample (pooled data), the study did not support the hypothesis of economies of household size with respect to household yam budget share. A positive and elastic or near-elastic relationship was observed between household size and household yam budget share in a typical Ghanaian urban center. However, in the seasonal analysis, household size had a significant effect on yam budget share during the yam 'abundant' (harvest) season. Households enjoyed economies of size in respect of yam consumption expenditure during the August - December period.

6.2 Recommendations

From the findings of the study, the following recommendations are made to improve the performance of the yam sector and food consumption at the household level in urban centers.

6.2.1 Yam production and distribution

High yam expenditure elasticity implies that with increasing income the consumption of yam will increase in urban centers. Policy should, therefore, focus on measures to improve the production of yam at the producing areas and its distribution to the consuming centers to forestall the possibility of any escalation in yam prices as consumers' incomes improve. Such possible price escalation could have negative nutritional effects especially on poorer households. The yam distribution system in Ghana could be improved through improved road network leading to the hinterlands where yams are produced. This would partly reduce and/or even out prices of yam and make them affordable in urban centers. This will not only increase household consumption of yam but will also reduce the seasonal glut and spoilage that are experienced in major yam producing regions in Ghana during the harvest season.

6.2.2 Improvement in household income

Household income levels in urban centers should be improved through job creation to empower households to meet not only their yam needs but their total household food requirements. Women in Ghanaian urban communities should engage in income generating activities/businesses and/or take up paid work so they can augment household income and thus ensure that household food requirements are met. This will reduce the incidence of malnutrition and its associated ailments at the household level.

6.2.3 Yam processing or value addition

The possibility of processing yam, especially less preferred yam varieties like water and yellow yams, into other forms like chips, flour, *wasawasa* and industrial starch should be explored by the central government through the Ministry of Food and Agriculture, research institutions, private

business initiatives and non-governmental organisations that are interested in food security at the household level. Yam processing will not only reduce the quantum of yam spoiled every year during the harvest season, but it will also even-out the supply of yam products throughout the year to reduce the price differential between harvest and lean seasons and, therefore, make yam more accessible to low-income households, especially during the lean season.

6.2.4 Domestic food policy

Food policy (especially, rice import and yam export policies) should take account of the seasonal variations in the behaviour of consumers in order not to cause potential nutritional difficulties for consumers and/or income of producers. In this regard, the government should reduce export tariffs during yam abundant periods to increase yam exports, and increase export tariffs during lean season to reduce yam export. The government should also increase the production of yam substitutes (especially rice and maize) and embark upon buffer stock programmes to store excess supply of these substitutes for use during yam-scarce periods of the year. Part of the huge rice import bill could be channeled into the production of local rice to make substitute food products available during the lean season of yam. Alternatively, import duties on rice could be reduced during the lean season of yam to encourage more supply of rice on the domestic market to ensure food availability and security at the household level.

6.2.5 Further research

- The potential demand for processed products from yam in urban areas as well as the income earning potential (profitability) of yam processing businesses should be the focus of future research in Ghana. This is important for any policy that aims at adding value to the crop.

- Future research on the effect of seasonality on household demand for other staple food commodities should be considered. This will help in fashioning out a comprehensive food security strategy for Ghanaian urban households.

- Future food consumption studies should address the rural-urban dichotomy to establish whether there are differences in the factors that affect food consumption patterns in urban and rural areas.

When the above recommendations are carefully considered and implemented, among other strategies, Ghana's yam sector will improve and yam (as well as general food) requirements at the household level in Ghanaian urban centers would improve.

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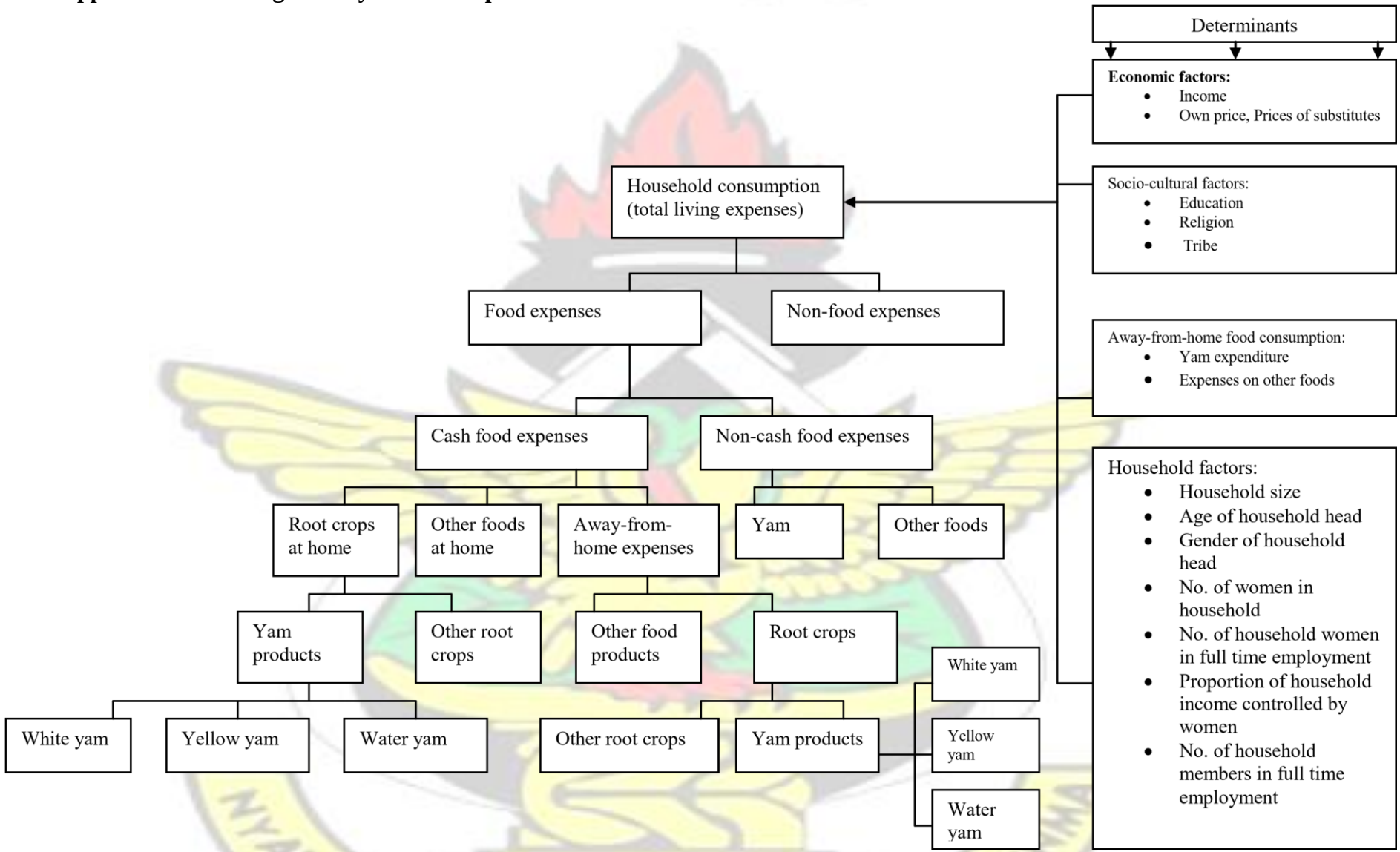
Appendix I: Modeling urban yam consumption in Ghana



APPENDIX II: Supplementary Tables from Income group Regression Analyses

Table a: Budget share Regression Results for low, middle and high income consumers-pooled sample

Explanatory Variable	**Dependent Variable = Household Yam Budget share**		
	Low Income	**Middle Income group**	**High Income Group**
Constant	-3.47 (-0.783)	-9.192 (-2.145)*	-0.779 (-0.186)
Consumer location (0=Techiman &Tamale, 1=otherwise)	0.104 (1.06)	0.144 (2.096)*	0.261 (0.962)
Gender (0=Male, 1=Female)	-0.030 (-0.304)	0.007(0.121)	-0.073(-0.475)
Age (0=<30yrs, 1=Otherwise)	0.070 (0.904)	-0.057(-1.035)	-0.477(2.939)**
Religion (0=Christianity, 1=Otherwise)	-0.090(-1.103)	-0.020(-0.351)	0.479(2.957)**
Tribe (0=Akan, 1=Otherwise)	0.058(0.722)	-0.148(-2.621)**	0.071(0.518)
Proportion of income controlled by women	-0.074(-0.925)	0.107(1.864)	0.343(2.426)**
Ln Years in School	-0.050(-0.585)	-0.039(-0.674)	-0.022(-0.161)
Ln Household Size	-0.030(-0.253)	0.100(1.297)	-0.850(-0.445)
Ln Active Females in Household	0.080(0.813)	0.121(1.869)	0.009(0.058)
Ln Females in full time employment	-0.040(-0.522)	0.050(0.923)	0.148(1.085)
Ln Yam Price	0.018(0.204)	-0.016(-0.296)	0.099(0.609)
Ln Cocoyam Price	0.050(0.675)	0.012(0.211)	0.013(0.260)
Ln Cassava Price	-0.070(-0.824)	0.091(1.470)	-0.026(-0.198)
Ln Plantain Price	0.051(0.660)	0.003(0.056)	0.352(1.594)
Ln Rice Price	0.131(1.563)	0.134(2.326)*	-0.206(-0.955)
Ln Maize Price	-0.197(-2.198)*	0.297(5.003)**	0.214(1.135)
Ln Fruits & Vegetables Expenditure	-0.052(-0.534)	-0.209(-2.960)**	0.399(1.769)
Ln Meat Expenditure	-0.042(-0.430)	-0.133(-1.908)	0.010(0.001)
Ln Fish Expenditure	-0.107(-1.051)	-0.121(-1.755)	-0.518(-2.714)**
Ln Yam expenditure away from home	0.160(2.040)*	0.149(2.538)**	-0.118(-0.700)
Ln Per Capita Household expenditure	-1.464(-2.257)*	-3.552(-2.059)*	-3.861(-2.110)*
Ln Per Capita Household expenditure squared	2.001(2.060)*	2.172(2.123)*	3.063(2.211)*
R^2	*0.180*	*0.395*	*0.590*
F (Prob.)	*1.957 (0.050)*	*6.869 (0.000)*	*2.055 (0.035)*

*T-values in parenthesis; ** = Significant @1%, * = Significant @ 5%.*

Table b: Budget share Regression Results for low, middle and high income consumers in Accra

Explanatory Variable	**Dependent Variable = Household Yam Budget share**		
	Low Income	**Middle Income**	**High Income**
Constant	-38.990 (-1.420)	3.850(0.605)	1.586(0.349)
Gender (0=Male, 1=Female)	-0.357(-0.838)	0.034(0.253)	-0.174(-0.568)
Age (0=<30yrs, 1=Otherwise)	0.382(1.184)	-0.024(-0.203)	-0.130(-0.428)
Religion (0=Christianity, 1=Otherwise)	0.491(1.373)	0.311(2.771)**	0.374(2.148)**
Tribe (0=Akan, 1=Otherwise)	-0.002(-0.003)	0.086(0.768)	0.130(0.625)
Proportion of hh income under the control of females	-0.738(-1.015)	0.078(0.657)	-0.024(-0.108)
Ln Years in School	-0.088(-0.223)	0.145(1.172)	0.090(0.509)
Ln Household Size	-0.649(-1.488)	0.161(1.101)	-0.124(-0.476)
Ln Active Females in Household	0.603(0.846)	0.122(1.020)	0.048(0.193)
Ln Females in full employment	0.217(0.775)	0.176(1.573)	0.102(0.576)
Ln Cassava Expenditure	-0.252(-0.395)	0.120(0.938)	0.173(0.753)
Ln Plantain Expenditure	1.272(1.627)	0.100(0.782)	-0.106(-0.291)
Ln Fruits & Vegetables Expenditure	0.124(0.274)	-0.181(-1.383)	0.589(1.975)*
Ln Cereals Expenditure	-0.901(-1.406)	-0.169(-1.372)	-0.317(-1.137)
Ln Meat Expenditure	-0.518(-1.099)	0.003(0.022)	-0.208(-0.666)
Ln Fish Expenditure	-0.088(--0.189)	-0.085(-0.695)	-0.516(-1.663)
Ln Yam expenditure away from home	0.251(0.770)	0.032(0.278)	0.223(0.754)
Ln Per Capita Household expenditure	2.075(1.990)*	0.150(1.998)*	0.061(1.300)
Ln Per Capita Household expenditure squared	2.609 (2.992)**	-1.736(-0.551)	-3.335 (2.657)**
R^2	*0.883*	*0.623*	*0.597*
F (Prob.)	*1.972 (0.031)*	*2.259 (0.009)*	*1.867 (0.070)*

*T-values in parenthesis; ** = Significant @1%, * = Significant @ 5%.*

Table c: Budget share Regression Results for low, middle and high income consumers in Kumasi

Explanatory Variable	**Dependent Variable = Household Yam Budget share**		
	Low Income	**Middle Income**	**High Income**
Constant	-4.320 (-0.315)	-8.099(-0.324)	-2.677(-0.401)
Gender (0=Male, 1=Female)	-0.451(-2.528)**	-0.102(-0.708)	-0.070(-1.971)*
Age (0=<30yrs, 1=Otherwise)	-0.155 (-0.761)	0.033(0.202)	0.098(0.281)
Religion (0=Christianity, 1=Otherwise)	-0.204(-1.147)	-0.267(-1.343)	-0.253(-0.372)
Tribe (0=Akan, 1=Otherwise)	-0.285(-1.457)	0.081(0.579)	-0.276(-0.598)
Proportion of hh income under the control of females	-0.208(-1.063)	0.123(0.935)	-0.017(-0.028)
Ln Years in School	-0.089(-0.460)	-0.216(-1.337)	-0.044(-0.068)
Ln Household Size	-0.060(-0.180)	0.158(0.727)	0.189(0.532)
Ln Active Females in Household	0.151(0.775)	-0.176(-0.945)	-0.151(-0.534)
Ln Females in full employment	-0.069(-0.411)	0.001(0.010)	0.141(0.592)
Ln Cassava Expenditure	0.331(1.541)	0.173(1.119)	-0.019(-0.032)
Ln Plantain Expenditure	-0.008(-0.035)	0.061(0.383)	0.030(0.034)
Ln Fruits & Vegetables Expenditure	-0.110(-0.585)	-0.242(-1.519)	-0.107(-0.321)
Ln Cereals Expenditure	0.017(0.095)	0.031(0.196)	-0.198(-0.356)
Ln Meat Expenditure	0.269(0.887)	-0.069(-0.322)	0.481(1.007)
Ln Fish Expenditure	-0.503(-1.604)	-0.145(-0.711)	-0.338(-0.710)
Ln Yam expenditure away from home	-0.002(-0.012)	0.420(2.719)**	0.653(2.429)*
Ln Per Capita Household expenditure	-1.580 (-2.356)*	-1.683(-2.287)*	-1.710(2.026)*
Ln Per Capita Household expenditure squared	1.549(2.357)*	1.795(2.306)*	1.831(2.150)*
R^2	*0.348*	*0.535*	*0.792*
F (Prob.)	*1.978 (0.053)*	*2.300 (0.026)*	*2.343 (0.018)*
*T-values in parenthesis; ** = Significant @1%, * = Significant @ 5%.*			

Table d: Budget share regression results for low, middle and high income consumers in Techiman

Explanatory Variable	**Dependent Variable = Household Yam Budget share**		
	Low Income	**Middle Income**	**High Income**
Constant	8.439(0.546)	-8.389(-0.902)	0.554(0.031)
Gender (0=Male, 1=Female)	0.368(2.543)**	0.265(1.882)*	-0.224(-0.487)
Age (0=<30yrs, 1=Otherwise)	-0.308(-2.028)*	0.051(0.377)	-0.023(-2.039)*
Religion (0=Christianity, 1=Otherwise)	-0.140(-0.804)	0.084(0.525)	0.288(0.489)
Tribe (0=Akan, 1=Otherwise)	-0.076(-0.483)	-0.135(-0.899)	-0.412(-0.979)
Proportion of hh income under the control of females	-0.203(-1.226)	-0.038(-0.248)	0.240(0.595)
Ln Years in School	0.011(0.059)	-0.096(-0.756)	0.236(0.624)
Ln Household Size	-0.159(-0.707)	0.306(1.729)	-0.296(-0.729)
Ln Active Females in Household	0.257(1.354)	0.219(1.540)	0.371(1.212)
Ln Females in full employment	-0.238(-1.524)	0.057(0.375)	0.175(0.644)
Ln Cassava Expenditure	0.040(0.204)	0.128(0.854)	0.012(0.027)
Ln Plantain Expenditure	-0.115(-0.721)	-0.070(-0.406)	0.070(0.183)
Ln Fruits & Vegetables Expenditure	0.132(0.640)	-0.182(-1.275)	0.235(0.578)
Ln Cereals Expenditure	0.059(0.351)	-0.009(-0.074)	-0.083(-0.267)
Ln Meat Expenditure	-0.329(-1.973)*	-0.192(-1.151)	0.358(2.489)*
Ln Fish Expenditure	-0.093(-0.467)	-0.344(-1.984)*	-1.011(-1.864)*
Ln Yam expenditure away from home	0.065(0.466)	-0.068(-0.549)	-0.011(-0.025)
Ln Per Capita Household expenditure	-1.261(0.299)	-2.574(-1.985)*	-2.635 (-1.126)
Ln Per Capita Household expenditure squared	-1.762(-0.418)	2.848 (1.989)*	2.914(1.327)
R^2	*0.609*	*0.449*	*0.518*
F (Prob.)	*2.337 (0.022)*	*2.214 (0.014)*	*1.131 (0.452)*
*T-values in parenthesis; ** = Significant @1%, * = Significant @ 5%.*			

Table e: Budget share Regression Results for low, middle and high income consumers in Tamale

Explanatory Variable	**Dependent Variable = Household Yam Budget share**		
	Low Income	**Middle Income**	**High Income**
Constant	-1.473(-0.146)	-17.655(-0.794)	33.365(4.160)**
Gender (0=Male, 1=Female)	0.115(0.740)	0.212(1.158)	0.598(4.199)**
Age (0=<30yrs, 1=Otherwise)	0.132(0.909)	-0.227(-1.821)*	0.380(2.328)*
Religion (0=Christianity, 1=Otherwise)	-0.086(-0.547)	0.197(1.037)	-0.024(-0.179)
Tribe (0=Akan, 1=Otherwise)	0.083(0.504)	-0.109(-0.764)	0.616(5.155)**
Proportion of hh income under the control of females	-0.223(-1.559)	-0.126(-0.795)	-0.095(-0.808)
Ln Years in School	-0.022(-0.147)	-0.200(-1.257)	0.254(2.197)*
Ln Household Size	0.067(0.272)	-0.424(-1.352)	0.555(3.000)**
Ln Active Females in Household	-0.006(-0.026)	0.121(0.609)	-0.458(-2.712)**
Ln Females in full employment	-0.186(-1.100)	0.094(0.503)	-0.091(-0.870)
Ln Cassava Expenditure	0.289(1.464)	0.095(0.588)	0.172(1.249)
Ln Plantain Expenditure	-0.124(-0.819)	0.099(0.517)	-0.393(-2.903)**
Ln Fruits & Vegetables Expenditure	-0.115(-0.553)	-0.097(-0.400)	0.082(0.475)
Ln Cereals Expenditure	-0.139(-0.817)	0.123(0.675)	-0.320(-2.283)*
Ln Meat Expenditure	0.040(2.136)*	-0.044(-0.220)	-0.308(-2.165)*
Ln Fish Expenditure	-0.149(-0.650)	-0.181(-0.785)	0.071(0.332)
Ln Yam expenditure away from home	0.125(0.875)	-6.357(-0.896)	0.096(0.687)
Ln Per Capita Household expenditure	-0.616 (-1.953)*	-6.357(-1.996)*	-4.374(-4.100)**
Ln Per Capita Household expenditure squared	0.685(0.165)	5.906(1.912)*	4.158(4.090)**
R^2	*0.219*	*0.501*	*0.812*
F (Prob.)	*1.785 (0. 092)*	*1.821 (0.080)*	*8.453 (0.000)*

*T-values in parenthesis; ** = Significant @1%, * = Significant @ 5%.*

APPENDIX III: Supplementary Tables from Seasonal Regression Analyses

Table a : Budget share regression estimates for Accra across seasons

Explanatory Variable	**Dependent Variable = Household Yam Budget share**			
	Aug-Sept.	***Nov. – Dec.***	***Feb. - March***	***May-June***
Constant	7.690 (4.658)**	4.970 (5.073)**	-1.749 (-2.510)**	-1.540 (-2.612)**
Gender (0=Male, 1=Female)	0.033(0.733)	0.046(0.571)	-0.112 (-1.376)	-0.098(-1.241)
Age (0=<30yrs, 1=Otherwise)	-0.132(-1.629)	-0.127(-1.633)	0.050(0.648)	0.126(1.683)
Religion (0=Christianity, 1=Otherwise)	-0.177(-2.800)**	-0.183(-2.407)*	0.224(2.954)**	0.213(2.904)**
Tribe (0=Akan, 1=Otherwise)	-0.017(-0.144)	-0.011(-0.134)	0.082(0.990)	0.042(0.526)
Proportion of hh income under the control of females	0.065(0.693)	0.055(0.653)	0.002(0.026)	-0.005(-0.060)
Ln Years in School	-0.154(-2.071)*	-0.164(-2.041)*	0.086(1.072)	0.142(1.835)
Ln Household Size	0.207(2.211)*	0.203(2.214)*	-0.027(-0.293)	-0.119(-1.350)
Ln Active Females in Household	-0.145(-1.664)	-0.150(-1.761)	0.056(0.663)	0.072(0.884)
Ln Cassava Expenditure	-0.169(-2.015)*	-0.189(-2.002)*	0.289(3.097)**	0.253(2.810)**
Ln Plantain Expenditure	-0.263(-3.917)**	-0.270(-2.937)**	0.177(1.960)**	0.262(2.957)**
Ln Fruits & Vegetables Expenditure	-0.129(-1.447)	-0.149(-1.487)	0.242(2.530)**	0.297(3.083)**
Ln Maize Expenditure	-0.057(-0.709)	-0.139(-1.646)	-0.057(-2.481)*	-0.074(-2.908)**
Ln Rice Expenditure	-0.139(-1.646)	-0.057(-0.709)	-0.034(-3.421)**	-0.014(-1.905)*
Ln Meat Expenditure	-0.197(-1.804)	-0.186(-2.113)*	0.106(1.437)	0.128(3.801)**
Ln Fish Expenditure	0.256(2.823)**	0.252(2.553)**	-0.134(-1.349)	-0.222(-2.309)*
Ln Yam expenditure away from home	-0.001(-0.003)	-0.011(-0.003)	-0.041(-0.535)	0.012(0.158)
Ln Per Capita Household expenditure	-1.204(-0.935)	0.102(0.992)	0.237(2.265)*	1.152(2.461)*
R^2	*0.360*	*0.350*	*0.352*	*0.398*

F (Prob.)	*3.989 (0.000)*	*3.989 (0.000)*	*4.034(0.000)*	*4.894 (0.000)*
*T-values in parenthesis; ** = Significant @1%, * = Significant @ 5%.*				

Table b: Budget share regression estimates for Kumasi across seasons

Explanatory Variable	**Dependent Variable = Household Yam Budget share**			
	Aug-Sept.	***Nov. – Dec.***	***Feb. - March***	***May-June***
Constant	4.015 (3.607)**	2.789 (4.223)**	-2.482 (-6.605)**	-1.241 (-2.878)**
Gender (0=Male, 1=Female)	0.174 (3.510)**	0.184 (4.417)**	-0.095 (-2.462)**	0.005(0.119)
Age (0=<30yrs, 1=Otherwise)	-0.086(-1.991)*	-0.088(-1.981)*	0.117(2.873)**	0.147(3.244)**
Religion (0=Christianity, 1=Otherwise)	0.157(4.022)**	0.137(3.429)**	-0.054(-1.297)	-0.088(-1.952)*
Tribe (0=Akan, 1=Otherwise)	-0.006(-1.447)	-0.063(-1.533)	0.086(2.309)**	0.120(2.884)**
Proportion of hh income under the control of females	0.191(4.851)**	0.131(2.851)**	-0.055(-1.520)	0.033(0.825)
Ln Years in School	0.129 (5.311)**	0.138 (3.367)**	-0.218(-5.791)**	-0.254(-6.074)**
Ln Household Size	-0.048 (-0.864)	0.056 (0.818)	-0.100(-1.690)	-0.330(-5.010)**
Ln Active Females in Household	-0.045(-0.838)	-0.055 (-0.925)	-0.022(-0.484)	-0.127(-2.566)**
Ln Cassava Expenditure	-0.321(-6.009)**	-0.217(-7.859)**	-0.190 (-4.534)**	-0.074(-1.978)*
Ln Plantain Expenditure	-0.227(-5.010)**	-0.231(-5.040)**	0.128(3.086)**	0.039 (0.847)
Ln Fruits & Vegetables Expenditure	0.134(4.140)**	0.129(3.403)**	-0.013 (-0.319)	-0.051(-1.157)
Ln Maize Expenditure	0.005 (0.480)	0.007 (0.170)	-0.101(-2.620)**	-0.050 (-1.171)
Ln Rice Expenditure	0.210(3.888)**	0.163 (3.911)**	-0.065(-1.694)	-0.149 (-3.503)**
Ln Meat Expenditure	0.171(2.884)**	0.168(2.791)**	-0.040(-0.711)	-0.145 (-2.333)*
Ln Fish Expenditure	0.072(1.456)	0 075(1.260)	0.318(5.962)**	-0..255 (-4.308)**
Ln Yam expenditure away from home	-0.173(-1.983)*	-0.076(-1.974)*	-0.079 (-2.228)*	-0.062 (-1.583)
Ln Per Capita Household expenditure	-6.139(-1.952)*	-2.047(-1.670)	-0.197(-3.843)**	-0.185 (-5.033)**
R^2	*0.387*	*0.389*	*0.480*	*0.357*
F (Prob.)	*18.261 (0.000)*	*18.751 (0.000)*	*26.632(0.000)*	*16.010 (0.000)*
*T-values in parenthesis; ** = Significant @1%, * = Significant @ 5%.*				

Table c : Budget share regression estimates for Techiman across seasons

Explanatory Variable	**Dependent Variable = Household Yam Budget share**			
	Aug-Sept.	***Nov. – Dec.***	***Feb. - March***	***May-June***
Constant	2.756 (2.701)**	2.508 (2.788)**	1.543 (1.950)*	1.783 (2.143)*
Gender (0=Male, 1=Female)	-0.055(-0.550)	0.047(0.464)	-0.003(-0.026)	0.016(0.152)
Age (0=<30yrs, 1=Otherwise)	0.065(0.698)	-0.073(-0.783)	-0.114(-1.190)	-0.102(-1.076)
Religion (0=Christianity, 1=Otherwise)	-0.141(-1.368)	-0.139(-1.339)	-0.124(-1.163)	-0.129(-1.217)
Tribe (0=Akan, 1=Otherwise)	0.040(0.391)	0.039(0.380)	0.033(0.310)	0.035(0.332)
Proportion of hh income under the control of females	0.066(0.676)	0.070(0.712)	0.087(1.869)	0.083(2.829)**
Ln Years in School	-0.003(0.028)	-0.005(-0.051)	-0.016(-0.161)	-0.013(-0.130)
Ln Household Size	-0.113(-0.979)	-0.097(-1.963)*	-0.010(-0.081)	-0.036(-0.306)
Ln Active Females in Household	-0.008(-0.074)	-0.007(-0.067)	-0.004(-0.036)	-0.004(-0.041)
Ln Cassava Expenditure	-0.126(-1.910)*	-0.120(-1.147)	-0.086(-0.800)	0.096(0.905)
Ln Plantain Expenditure	0.098(0.913)	0.097(0.901)	0.089(0.808)	0.093(0.843)
Ln Fruits & Vegetables Expenditure	0.212(1.985)*	0.215(1.998)*	0.222(2.015)*	-0.221(-2.016)*
Ln Maize Expenditure	-0.011(-0.109)	-0.013(-0.136)	-0.028(-2.276)*	-0.023(-2.235)*
Ln Rice Expenditure	-0.052(-0.551)	0.047(0.498)	-0.022(-1.924)*	-0.029(-2.303)*
Ln Meat Expenditure	0.069(1.613)	0.068(0.599)	-0.059(-0.509)	-0.062(-2.441)*
Ln Fish Expenditure	0.027(0.231)	0.034(0.280)	0.064(2.724)**	-0.055(-1.954)*
Ln Yam expenditure away from home	-0.065(-0.760)	-0.068(-0.790)	0.082(0.920)	-0.078(-0.886)
Ln Per Capita Household expenditure	-3.579(-5.465)**	-1.563(-5.296)**	0.069(4.295)**	0.699(4.608)**
R^2	*0.311*	*0.305*	*0.267*	*0.278*
F (Prob.)	*2.713 (0.001)*	*2.628 (0.001)*	*2.191(0.008)*	*2.315 (0.005)*
*T-values in parenthesis; ** = Significant @1%, * = Significant @ 5%.*				

Table d: Budget share regression estimates for Tamale across seasons

Explanatory Variable	**Dependent Variable = Household Yam Budget share**			
	Aug-Sept.	***Nov. – Dec.***	***Feb. - March***	***May-June***
Constant	9.446 (6.220)**	5.802 (6.941)**	-2.636 (-3.544)**	-3.119 (-5.041)**
Gender (0=Male, 1=Female)	-0.100(-1.228)	-0.140(-1.835)	0.155(1.844)	0.127(1.678)
Age (0=<30yrs, 1=Otherwise)	-0.031(-0.408)	-0.052(-0.720)	0.110(1.397)	0.073(1.028)
Religion (0=Christianity, 1=Otherwise)	0.174(2.050)*	0.210(2.507)**	0.194(2.104)*	0.172(2.062)*
Tribe (0=Akan, 1=Otherwise)	-0.063(-0.748)	-0.025(-0.313)	-0.073(-0.848)	-0.005(-0.070)
Proportion of hh income under the control of females	0.137(1.734)	0.149(2.043)*	-0.025(-0.306)	-0.123(-1.697)
Ln Years in School	0.132(1.652)	0.173(2.315)*	0.216(2.628)**	-0.163(-2.198)*
Ln Household Size	0.047(0.405)	-0.005(-0.047)	0.069(0.573)	-0.157(-2.452)*
Ln Active Females in Household	-0.130(-1.179)	-0.139(-1.350)	-0.036(-0.315)	-0.031(-0.308)
Ln Cassava Expenditure	-0.029(-0.323)	-0.216(-1.697)	0.179(1.040)	0.288(1.239)
Ln Plantain Expenditure	-0.032(-0.384)	0.015(0.189)	-0.054(-0.626)	0.013(0.167)
Ln Fruits & Vegetables Expenditure	-0.213(-2.341)*	-0.014(-0.148)	0.107 (1.017)	0.118(1.244)
Ln Maize Expenditure	0.207(2.788)**	0.293(-1.148)	-0.213(-2.082)*	-0.162(1.953)*
Ln Rice Expenditure	-0.277(-3.255)**	0.026(0.304)	-0.093(-1.007)	-0.029(2.341)*
Ln Meat Expenditure	0.155 (1.645)	-0.158(-1.449)	-0.229(-1.807)*	-0.195(-1.982)*
Ln Fish Expenditure	0379 (1.180)	0.319(1.523)	-0.100(-0.852)	-0.136(-2.282)*
Ln Yam expenditure away from home	-0.056(-0.718)	-0.052(-0.732)	0.054(0.688)	0.136(1.924)
Ln Per Capita Household expenditure	-7.077(-1.986)*	-4.018(-1.210)	-0.714(-1.365)	-0.644(-2.481)**
R^2	*0.527*	*0.502*	*0.428*	*0.536*
F (Prob.)	*6.621 (0.000)*	*6.294 (0.000)*	*4.454(0.000)*	*6.851 (0.000)*
*T-values in parenthesis; ** = Significant @1%, * = Significant @ 5%.*				