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Expenditure and price elasticities of demand for cowpeas in northern Ghana. Implications for public policies.

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Abstract

Dry legumes or pulses are ranked as the second most important crop after cereals such as maize in Sub-Saharan Africa. For instance, 70 percent of the worldwide production of cowpeas are attributed to Africa (AATF, 2009 and IITA, 2016). In West and Central Africa, smallholder farmers are increasing their production of pulses such as cowpeas because of their positive agricultural, economic and nutritional benefits such as drought resistance, multiple source of income, inexpensive source of protein and micronutrients such as iron (Pele, 2015). Despite these benefits the consumption of cowpeas in the West Africa, particularly in Ghana, is still quite low.

Little is known about the demand for cowpeas in Ghana and specifically how on average households respond to a change in price and expenditure considering their demand for cowpeas. This study seeks to address this knowledge gap by estimating expenditure and prices elasticities of demand for cowpeas in northern Ghana. A QUAIDS model were estimated using consumer data collected from approximately 4, 600 randomly selected households. Results indicated that only 15 percent of the respondents are cowpeas consumers. Households allocated the most part of their foods budget share to the consumption of staple foods like cereals, vegetables and also to the group of animal protein rather than to vegetable protein. The QUAIDS specification indicated that except cowpeas, most of the food categories present in household food basket like cereals, root/tuber, animal protein (meats and fish) had a positive expenditure elasticity which indicate that they were normal goods. However, the consumption of cowpeas exhibited a negative expenditure elasticity which indicate it is an inferior good. Same findings were found for both compensated and uncompensated prices elasticities. Except cowpeas, all the foods categories had a clear negative own price elasticity which confirmed their status of normal good. The consumption of cowpeas had a positive own price elasticity. Several reasons were indicated to explain this surprising result: the procedure used in generating the prices, the limited data on cowpeas expenditure and the main focus of the survey which was not on dry pulses. In addition, on average cowpeas were mainly produced for own consumption which could have made it scare on markets and affected its price. Further research should use a household consumption model to capture the role that cowpeas play in a household's food basket.

Key words: Cowpeas Consumption, QUAIDS, Price and Expenditure Elasticities, Ghana.

1. Introduction:

1.1. Overview of Ghana and its Northern region

Ghana is a costal country located in West Africa, with a population estimated to be over 25.9 million in 2013, mostly young and living in urban areas (World Bank Statistics, 2016). Over recent years, Ghana has experienced important economic growth and has been classified as a Lower Middle Income (LMI) country. In 2015, the country's Gross Domestic Product (GDP) reached $37, 864 billion USD with the agricultural sector contributing more than 20 percent of the GDP and employing more than 50 percent of the country workforce (World Bank Statistics, 2016). Even though Ghana is on its way to achieving the first Millennium Development Goal (MDG) and experienced a substantial decline in the national poverty rate, poverty is still a primary concern in northern Ghana. With a wide natural resources endowment, agriculture remains the main economic sector for cash crops such as cocoa, rubber and cotton as well as food crops such as corn, yam, cassava and plantain.

The Ghanaian diet is largely made of starchy roots (cassava and yams), fruits (plantain) and cereals (maize and rice). Starchy roots and cereals provide Ghanaians with almost three quarters of their dietary energy (FAO, 2016). FAO (2016) indicated that this typical diet seems enough for the energy requirements; however; the quantity of protein and lipids contained in these food groups is quite low. The rapid urbanization and development of the country has modified Ghanaian food consumption patterns, with an increased preference for imported food, especially wheat and rice. (Kruk et al., 2010; FAO, 2016) indicated recently that in Ghana the prevalence of undernourishment has decreased considerably even though health indicators for infant and under-five mortality rates had remained fairly constant. Due to some severe unstable food productions, low purchasing power and the lack of good road infrastructure in northern Ghana, food insecurity persists and is one of the major issues. Moreover, the case of undernutrition and malnutrition present in northern Ghana have brought important micronutrient deficiencies. For instance, Quaye (2008) and Kruk (2010) has pointed out the deficiency issue in iodine and vitamin A among young children.

To sum up, northern Ghana represents almost 30 percent of the whole population but still suffers from several issues such as malnutrition and undernourishment, lack of protein and nutrients. Most of these issues or diseases could possibly be compensated or mitigated by the consumption of pulses like cowpeas which offers multiple dietary advantages (FAO, 2016). The research questions for this study are mainly to investigate the role that cowpeas currently play in the foods consumption basket of household in norther Ghana. Through this, we expect to see how household allocate their budget share across the different food categories including to pulses and cowpeas specifically. Results from this study could enlighten Ghanaian public policy maker on the need to increase more awareness on all the benefit deriving from the consumption of cowpeas.

1.2. Overview of cowpeas consumption in West and Central Africa

Cowpeas (*Vigna unguiculata (L.) Walp.*) is a legume predominantly produced in tropical areas such as Africa, Asia, Central and South America for both human and animal consumption. According to Langyintuo et al. (2003), the production and trade of cowpeas is one of the growing business and is considered the most relevant economic legume crop in Africa. Monyo (2015) and IITA (2016) indicated that about 5.4 million tons of dried cowpeas are produced on more than 14 million hectares globally. Specifically, nearly 5.2 million tons of cowpeas are produced on more than 7.8 million hectares in SSA which resulted in more than 70 percent of the world's production. In northern Ghana, though the production of cowpeas is considered the second most important crop after groundnut, its per capita consumption remains quite low, around 10 kg (Mishili, 2009; Coulibaly et al., 2010).

The grain of cowpeas contains 25 percent of protein, multiple vitamins and minerals. Many studies indicated that it pair well with cereals and starchy tuber crops as an inexpensive source of high quality of protein (Langyinto et al., 2004). Beyond the nutritional advantages, the production of cowpeas is also drought resistant and is used to improve nitrogen fixation in the soil (Coulibaly et al., 2010; IITA, 2016). Since cowpeas mature early in the production season, they are also considered to be a strategic crop to bridge the classic hunger gap generally experienced

between June and August in Ghana when the ongoing production is not yet harvested and food crops of the previous harvest are scarce or very expensive (Mishili, 2009). Cowpeas are an additional source of income for smallholder farmers. During the dry season, the cowpeas stems and leaves can also be sold for animal feed which is another source of income for rural households.

Recent studies on consumer preferences for food crops in West Africa have identified a set of observable factors like the size, color or insect damage, and unobservable factors like taste, cooking time, sucrose level or protein content which influence consumer choices and their willingness to pay (Lowenberg-Deboer et al., 2003). Especially, Langyinto et al. (2004) studied consumer preferences for cowpeas in Ghana and Cameron using a hedonic pricing model and found that the two factors that consumers are most willing to pay a premium price for are the grain size and the absence of insect damage. Preferences for these characteristics were confirmed in a study conducted regionally in West and Central Africa by Lowenberg-Deboer et al. (2003) using the per capita consumption levels on the supply and demand of cowpeas.

As a merging research interest, the literature provides a wide range of information on the production and the post-harvest management of cowpeas; however, there are still very limited information on consumers' responsiveness to price change or to an increase in household disposable income. In order to fill in this literature gap, this study aims to further the understanding of the cowpeas consumption patterns by analyzing the household price and income elasticities. The results of this study will help improve the understanding of the cowpeas consumer characteristics and investigate how household allocate their budget share across food groups particularly to pulses like cowpeas.

2. Method and Data

2.1. Theoretical model: AIDS and QUAIDS specifications

The economics literature provides multiple approaches to understand and to evaluate household behavior for the demand for foods consumption and the factors that influence

consumer decisions. In recent studies, common approaches which are the Almost Ideal Demand System (AIDS) proposed by Deaton and Muellbauer (1980) and the Quadratic AIDS (QUAIDS) of Banks, Blundell, and Lewbel (1997). Deaton and Muellbauer (1980), explained the multiple advantages of using the AIDS specification compared to the two others commonly used approaches, the Rotterdam model and the translog specification. The AIDS specification has the capacity to simultaneously estimate several feature of the model which have to be estimated subsequently using the other two approaches. The AIDS expresses the expenditure share (w_i) of a good (*i*) as a function of its own price, the prices of others substitutes or complementary goods, and a function of the real disposable income or the household total food expenditure. The functional form of the AIDS model is based on a rational representative consumer who maximizes its utility function with a Price Independent Generalized Log (PIGLOG) class preferences estimated through cost or expenditure function defines as the minimum expenditure required to reach a specific level of utility given market prices (Muellbauer, 1970). Let $c(u,p)$ be the expenditure function of *u*, the utility derived from consuming a good and of a vector price p and homogenous in *p*.

We estimated the budget share of good *i*, following the equation (6) below.

$$w_i = \frac{p_i q_i}{c(u,p)} = \frac{\partial \log c(u,p)}{\partial \log(p_i)} * \frac{p_i}{c(u,p)} \quad (1)$$

$$\log c(u,p) = \alpha_0 + \sum_i \alpha_i \log p_i + \frac{1}{2} \sum_i \sum_j \gamma_{ij}^* \log p_i \log p_j + u\, \beta_0 \prod_i p_i^{\beta_i} \quad (2)$$

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i\, u\, \beta_0 \prod_k p_k^{\beta_k} \quad with \quad \gamma_{ij} = \frac{1}{2}\left(\gamma_{ij}^* + \gamma_{ji}^*\right) \quad (3)$$

With $\alpha_i, \beta_i \; and \; \gamma_{ij}^*$ are parameters of the estimations.

The representative consumer maximize its utility so, we could set the total expenditure *X* to be equal to the *c(u,p)* which can easily be inverted to give the actual *u* as a function of price *p* and *x*. The budget share of the AIDS specification can then be rewritten as follow:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log (x/P) \;\; with\; P, a\; price\; index\; defined\; below \quad (4)$$

$$log\ P = \alpha_o + \sum_i \alpha_i \log p_i + \frac{1}{2} \sum_i \sum_j \gamma_{ij} \log p_i \log p_j = \sum_i w_i \log p_i \quad (5)$$

In order to get estimations for each household, we included the sub-index *h* in the AIDS (4).

$$w_{ih} = \alpha_i + \sum_j \gamma_{ij}\, log p_j + \beta_i \log (x_x / k_h P) \quad (4')$$

Deaton and Muellbauer (1980) mentioned that in case households have similar characteristics they will have their preferences $k_h = 1$. Deaton and Muellbauer (1980) and Romero-Jordan et al., (2010) provided the following adding up and symmetry restrictions such as:

$$\sum_i \alpha_i = 1;\ \sum_j \beta_j = 0\ and\ \sum_i \gamma_{ij}^* = \sum_j \gamma_{ij}^* \quad (6)$$

Important properties of the demand function are the homogenous of degree 0 in prices and the validation of the Slutsky symmetry.

However, one important limit of the AIDS is first, the difficulties to incorporate household demographics variables like the household size into the specification. Secondly the AIDS require a heavier programming procedure in order to get the price and expenditures elasticities (Poi, 2012). Moreover, Xi et al. (2004) indicated the AIDS model has difficulty to capture the effects of non-linear Engel curves. The QUAIDS is more flexible and enables to fit easily some household demographic variables into its specification. Only one single command is required in STATA (quaids) to estimate the QUAIDS model which also impose automatically the restrictions (6).

Under the same the theoretical assumptions, Banks, Blundell, and Lewbel (1997) specified the QUAIDS model which is just an updated version of the AIDS model, specified above, by including a quadratic feature in the equation (4').

$$w_i = \alpha_i + \sum_j \gamma_{ij}\, log p_j + \beta_i \log \left\{\frac{x}{a(p)}\right\} + \frac{\lambda_i}{b(p)} \left[\ln\left\{\frac{x}{a(p)}\right\}\right]^2 \quad (7)$$

$$\log a\,(p) = \alpha_o + \sum_i \alpha_i \log p_i + \frac{1}{2} \sum_i \sum_j \gamma_{ij}^* \log p_i \log p_j \quad (8)$$

$$\log b\,(p) = \log a(p) + \beta_0 \prod_i p_i^{\beta_i} \quad (9)$$

Poi (2012) indicates the use of a vector of household characteristics in the specification of the QUAIDS model. A scalar representing household size was included in this study in order to

capture how it affects household intensity of consumption. The QUAIDS specification enables the computation of both own and cross price elasticities for both compensated and uncompensated demand functions of the good *i* with respect to change in price of good *j* as follow:

$$\epsilon_{ij} = \left(\mu_{ij}/w_i\right) - \delta_{ij} \text{ with } \mu_{ij} = \partial w_i / \partial ln P_j \quad (10)$$

$$\epsilon_{ij} = \frac{1}{w_i}\left(\gamma_{ij} - \left[\beta_i + \frac{2\lambda_i}{b(\boldsymbol{p})}\, ln\left\{\frac{x}{a(\boldsymbol{p})}\right\}\right] * \left(\alpha_j + \sum_l \gamma_{jl} \ln p_l\right) - \frac{(\beta_i)\lambda_i}{b(\boldsymbol{p})}\left[\ln\left\{\frac{x}{a(\boldsymbol{p})}\right\}\right]^2\right) - \delta_{ij}$$

Similarly, the income or expenditure elasticities is computed using the following:

$$\epsilon_i = \left(\partial w_i / \partial ln x\right)/w_i + 1 = \frac{1}{w_i}\left[\beta_i + + \frac{2\lambda_i}{b(\boldsymbol{p})}\, ln\left\{\frac{x}{a(\boldsymbol{p})}\right\}\right] + 1 \quad (11)$$

2.2 Data and empirical model

The northern Ghana has been the center of many attentions in the recent years as one of the main Zone of Influence (ZOI) of the Feed the Future and the USAID. The region covers 45 administrative districts and is subdivided into four regions as follow: Brong Ahafo; Northern; Upper East; and Upper West. The total population of these districts in 2010 was about 4.93 million which represented about 20 percent of the country population (Ghana Statistical Service, 2012a). While the ZOI covers all of the districts in the other three regions, only seven of the 22 districts of Brong Ahafo Region are included.

The primary objective of the Population Based Survey (PBS) was to conduct a national survey in the ZOI and to estimate several Feed the Future (FtF) measured indicators such as the Economic well-being; Women and Children Anthropometry; Hunger and Diet Diversity; Women's Empowerment etc. The consumption data collection was conducted in 2012 by the Ghanaian Institute of Statistical, Social and Economic Research (ISSER), and the original survey instrument was provided by the Bureau of Food Security. This USAID funded survey was co-managed by the METSS in Kansas State University (KSU). A two-stage probability sampling approach was used in designing the survey sample. The first stage selected the enumeration areas (EAs) in the 2010 Ghana Census using the probability proportional to size (PPS) method. The second stage involved in a systematic sampling approach to select households in each sampled EA. Given the effective

sample size of 4,600 and the custom of drawing a sample of 20 households from each EA, a total of 230 EAs within the ZOI was drawn by the Ghana Statistical Service (GSS).

The ISSER used a systematic sampling approach on this comprehensive list of households and household head names to draw the second stage household sample. At the household level, a total of 4,410 households were interviewed, implying a completion rate of about 95.9 percent. The total number of respondents for the weighted sample was 24,860 including adults and children. The variables of interest include: the quantity consumed and purchased of a set of food crops, the household size, the total expenditure per household.

All surveyed households were administered a food consumption survey that collected data on the respondents' demographics, social and economic data at the household level. Then data were collected on the household food consumption levels including quantity of food consumed, purchased, own produced or received as gift. Data on commodities market prices were not collected nor were the varieties of cowpeas purchased by the household. Despite the limited data, this study was still able to conduct a price and expenditure elasticities effects based on the quantities and expenditures of cowpeas reported by households. Because of the data limitation, only the household size was used as a demographic characteristic in this study in explaining the food consumption decisions.

A brief descriptive summary of variables fitted in the QUAIDS specification is provided in Table 1 along with their anticipated effects on the dependent variable, the cowpeas budget share. STATA 14 is used in the analysis.

Table 1: Description and anticipated effect of fitted variables collected in two weeks period

Role in the model	Variables	Description	Type and value label	Anticipated effects
Dependent variable	Cowpeas budget share	Ratio of cowpeas expenditure / Total food expenditure	Continious (0 - 1)	N/A
Independent variables	Budget share of all food categories[1]	Ratio of the listed food expenditure / Food expenditure	Continious (0 - 1)	Positive or negative
	Prices in (GH¢) of all food categories	Biweekly mean price of food categories	Continious	Positive or negative
	Household size	Number of people in the household	Categorical	Positive
	Biweekly Food Expenditure	Biweekly food expenditures (GH¢)	Continious	Positive or negative

3. Results

Figure 1 illustrates the food budget share allocation across the majorities of food categories present in the household food basket. On average, households in norther Ghana allocate more of their food budget share to the consumption of cereals, animal proteins and vegetables. This allocation is consistent with the previous studies on foods consumption in Ghana. The budget share allocated to the "Others Foods" category is higher than expected. This may be explained by the high number of food categories included in this group. The "Other Foods" category contains the following food categories: Fruits, Milk and dairy Products, Sugar, Oil, Beverages, Spices and Vendor Foods. The focus of this study remains the analysis of the consumption of cowpeas even though from Figure 1 it is obvious that either cowpeas or others pulses were not well represented in household food budget shares allocation. It is possible that this small budget

[1] The food categories the following food groups: Cowpeas, Cereals, Roots/Tubers, Pulses, Vegetables, Meat/Fish and all Others Foods.

share indicates that households in northern Ghana produce cowpeas and others pulses for home consumption purposes and have little to no need for purchasing these foods at local markets. Also, it is worth to mentioning that the budget share is generated based on the quantities of cowpeas purchased by the household. So, wherever there is no actual purchased it is obviously difficult to get the real budget share even though it does not mean that the household did not consume cowpeas. An alternative explanation of this small budget share could be interpreted by the poverty status or a substitution between pulses and the meat/fish category which occupied almost 20 percent of the food budget share.

Figure 1: Budget share allocation across food categories

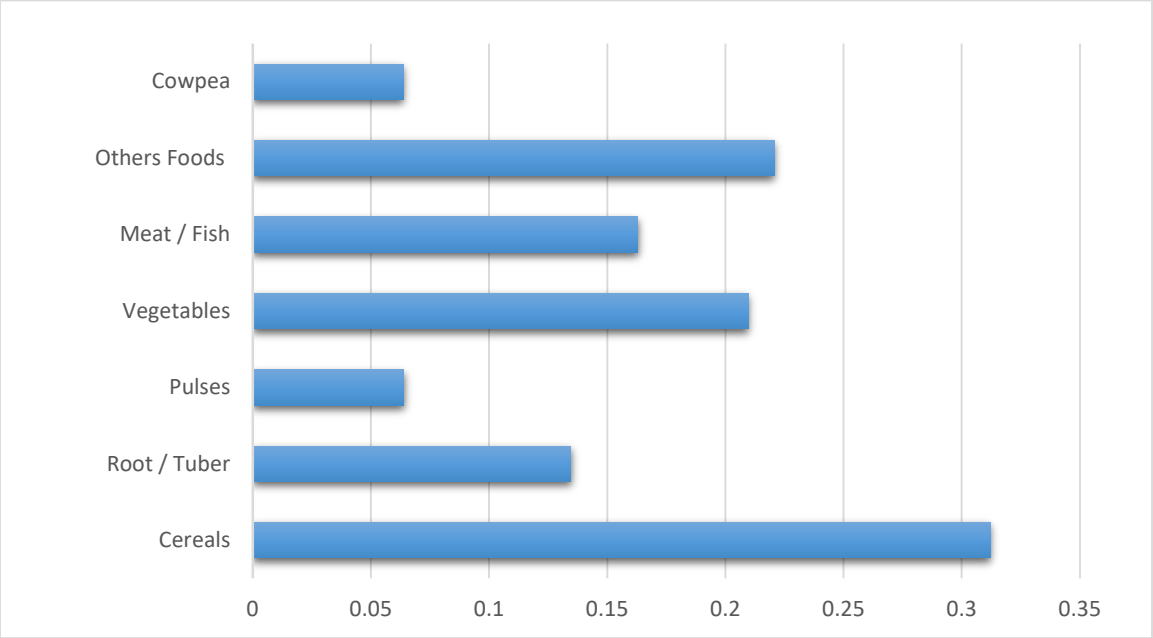

Table 2 presents the statistic descriptive analysis for the fitted variables. There is heterogeneity in number of observations for the fitted variables, which indicates a data limitation issues particularly for the main variable of this study: cowpeas.

Due to the lack of data on the prices of the food categories, we have generated the prices based on the quantities purchased and their corresponding expenditures which we assume to be closed to their approximate market prices. Based on this assumption, the average market price of cowpeas is GH¢[2] 3.8 per Kg. When comparing this cowpeas price to the rest of food categories prices, the cowpea price is higher than the prices of cereals or vegetables. We suspected a presence of outliers in the dataset but it was not a real concern because we only included logarithmic[3] values of each variable in the QUAIDS specification. The average household size in northern Ghana is 5.6 members and household biweekly food expenditure is almost GH¢ 94.

Table 2: Statistics summary of fitted variables

Variables	N	Mean	Std. Dev.	Min	Max
Price of cereals	3, 838	2.556	4.588	0.044	180.500
Price of Root/Tuber	2, 401	1.735	1.554	0.063	40
Price of Pulses	2, 105	3.770	2.578	0.004	22.340
Price of Vegetable	3, 852	1.313	1.731	0.017	68.938
Price of Meat/Fish	3, 473	3.395	4.641	0.014	70
Price of Others Food cat.	3, 925	1.456	3.070	0.013	100
Price of Cowpeas	573	3.902	2.134	0.200	21
Household size	4, 031	5.591	3.3225	1	35
Biweekly total food expenditure	4, 031	93.573	137.355	0	3097.770

One of the major assumption of the QUAIDS specification is the assumption of a weakly separability preference among foods categories. Results of the QUAIDS specification are presented in Table 3. Table 4 summarizes the expenditure and compensated price elasticities and Table 5 presents the uncompensated elasticities of the QUAIDS models.

[2] 1 GH¢ = 0.5248 USD in 2012.

[3] Logarithmic values are used to fix data issues related to seasonality that may have affected the generated price.

Table 3: Summary of the QUAIDS estimations per foods category

	Gamma							Alpha	Beta	Lambda	Eta
	Cereals	**Root/Tuber**	**Pulse**	**Vegetable**	**Meat/Fish**	**Other Food**	**Cowpeas**				
Cereals	0.102***							-0.178	-0.049	0.001	-0.00
	(0.019)							(0.183)	(0.053)	(0.004)	(0.00)
Roots/Tuber	-0.041*	0.078**						0.550***	0.123***	0.01***	-0.00
	(0.023)	(0.033)						(0.151)	(0.042)	(0.003)	(0.00)
Pulses	-0.024	0.047***	0.068***					0.438***	0.095***	0.005*	-0.00
	(0.018)	(0.016)	(0.023)					(0.121)	(0.035)	(0.003)	(0.00)
Vegetable	-0.02	0.039**	0.01	0.113***				0.412***	0.087**	0.009***	0.001
	(0.019)	(0.019)	(0.016)	(0.025)				(0.152)	(0.042)	(0.003)	(0.00)
Meat/Fish	0.004	-0.044*	-0.04**	-0.1***	0.13***			-0.052	-0.13***	-0.02***	-0.01**
	(0.022)	(0.025)	(0.019)	(0.019)	(0.03)			(0.140)	(0.037)	(0.003)	(0.001)
Other Foods	-0.02	-0.068***	-0.047**	-0.05**	0.05***	0.128***		-0.0455	-0.111**	-0.01***	0.001*
	(0.019)	(0.024)	(0.021)	(0.024)	(0.018)	(0.035)		(0.159)	(0.047)	(0.004)	(0.001)
Cowpeas	-0.0003	-0.011	-0.015*	-0.005	-0.006	0.004	0.033***	-0.124*	-0.019	0.001	0.001
	(0.005)	(0.009)	(0.008)	(0.007)	(0.009)	(0.009)	(0.005)	(0.073)	(0.021)	(0.002)	(0.00)

Observations = 436

Standard errors in parentheses *** p<0.01, ** p<0.05, *p<0.1

*The estimated **Rho = 0.169** (0.0716)***

Table 4: Expenditure and compensated price elasticities of cowpeas consumption in Ghana

Food categories	Expenditure Elasticities	Compensated elasticities						
		Cereals	Root/Tuber	Pulses	Vegetable	Meat/Fish	Other Foods	Cowpeas
Cereals	0.582***	-0.227***	-0.434***	0.119***	0.07***	0.194***	-0.121***	-0.191***
	(0.018)	(0.023)	(0.110)	(0.024)	(0.012)	(0.019)	(0.041)	(0.028)
Root/Tuber	1.427***	-0.014**	0.095	0.418***	0.183***	0.183***	-0.140***	-0.013
	(0.059)	(0.006)	(0.170)	(0.053)	(0.009)	(0.017)	(0.032)	(0.015)
Pulses	1.907***	0.067***	0.475***	0.115	-0.059***	0.0187	-0.052***	-0.178***
	(0.092)	(0.004)	(0.081)	(0.111)	(0.01)	(0.012)	(0.019)	(0.016)
Vegetable	0.622***	0.075***	0.374***	-0.174***	0.148**	-0.499***	0.012	0.057***
	(0.027)	(0.005)	(0.051)	(0.032)	(0.06)	(0.057)	(0.023)	(0.012)
Meat/Fish	1.899***	0.143***	0.251***	-0.077**	-0.359***	-0.063	0.207***	-0.135***
	(0.063)	(0.006	(0.041)	(0.039)	(0.034)	(0.063)	(0.016)	(0.023)
Other Foods	1.074***	-0.03**	-0.708***	-0.270***	0.004	0.229***	0.066	0.135***
	(0.011)	(0.012)	(0.148)	(0.061)	(0.015)	(0.022)	(0.102)	(0.014)
Cowpeas	-0.346***	-0.014***	-0.054**	-0.131***	0.013***	-0.063***	0.027***	0.324***
	(0.081)	(0.003)	(0.023)	(0.021)	(0.004)	(0.013)	(0.004)	(0.075)

Observations = 310

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The first part of Table 4 indicates that all the food categories have a positive and significant expenditure elasticity. Specifically, given a 1 percent increase in total household food expenditure, the budget share allocated to pulses increased by 1.91 percent, and the consumption of meats and fish also increased by 1.89 percent while the consumption of cereals only increased by 0.55 percent. Surprisingly, results indicated that the consumption of root and tuber and pulses are as the category of meat and fish, luxuries good. Most of the rest of the food categories are normal goods with also positive and significant expenditure elasticities. However, the consumption of cowpeas has a negative food expenditure elasticity indicating it is an inferior good. These results are interesting and quite difficult to interpret especially for the categories of pulses. However, as the survey data was collected during the Ramadan period and dry season it is possible that these commodities with high demand were scare on market which may have affected their observed expenditures. In fact, the group of pulses combines several crops such as beans, bambara beans, soya and green beans which may have biased our estimations. Though, past studies on foods consumption in Ghana found that green beans consumption was considered as a socially luxurious food. Green beans are pricier than the other regular legumes due to their social apprehension which may explain the fact that with a 1 percent increase in the total food expenditure, household has to almost double their budget allocated to their consumptions. The negative expenditure elasticity of the cowpeas could be explained by the limited data issue experienced for the consumption cowpeas. Except the negative expenditure elasticity obtained for the consumption of cowpeas, the rest of the elasticities are consistent with previous studies findings such as (Coulibaly et al., 2002; Langyinto et al., 2003).

Table 4 also provides the compensated price elasticities for the different food categories by cross and own price elasticities. The main focus is on the own price elasticities since cross prices elasticities depend largely on each household preferences and substitutions patterns. One important result of the compensated elasticities is the own price elasticity of the group of cereals which is negative and significant. This result is consistent with the downward slopping theory of the own price elasticity for normal goods. Given an increase in the price of cereals by 1 percent, the demand for cereals decreased by 0.2 percent. Similar effect is found for the demand of meat and fish. It is worth to mentioning that the consumption of cereals, mainly corns, is considered

as a staple food in Ghana, though results indicated that the demand of cereals had decreased as their prices increased, it was probable that the decrease in demand was smaller than the actual increase in its price. Surprisingly, the compensated own price elasticities of the consumption of vegetables and cowpeas were all positive which are inconsistent with the demand theory. Though cowpeas had a negative expenditure elasticity, the demand for cowpeas increased following an increase in its price by 1 percent. Several plausible reasons could explain this odd result. First, the survey data did not target specifically the case of cowpeas consumption. Furthermore, we used the observed food expenditure and quantity purchased to generate the prices instead of using their actual market prices which were unavailable. This approach led to more limited and missing data as some household did not purchased cowpeas during the survey collection period and then we fail to generate the price for these households. Another important factor which may also explain this result is that the survey was administrated in rural areas where cowpeas were mainly produced for household own consumption. The increase in cowpeas demand following an increase in its price may be explained by the production of cowpeas which was mainly destined to household own consumption regardless to its market price variations.

In addition to the expenditure and compensated price elasticities, this study has also estimated the uncompensated prices elasticities of the different food categories presented in Table 5 below. Similar results to the compensated prices elasticities are also found considering the Marshallian demand functions of the different foods categories. The uncompensated own price elasticities of cereals and meat/fish are both negative and significant which are consistent with the previous finding as well as with demand theory. Given an increase in their respective prices increase, their quantities demanded decreased. However, the uncompensated price elasticity of cowpeas still has a positive and significant elasticity which is consistent with the finding of the compensated price elasticity. None of the others food categories has a significant uncompensated own price elasticity.

Table 5: Uncompensated price elasticities of cowpeas consumption in Ghana

Food categories	Uncompensated Elasticities						
	Cereals	**Roots/Tuber**	**Pulses**	**Vegetable**	**Meat/Fish**	**Other Foods**	**Cowpeas**
Cereals	-0.391***	-0.756***	-0.293***	-0.064***	-0.288***	-0.371***	-0.109***
	(0.027)	(0.114)	(0.035)	(0.005)	(0.023)	(0.04)	(0.011)
Roots/Tuber	-0.069***	-0.027	0.190***	0.113***	-0.021***	-0.253***	0.047***
	(0.004)	(0.171)	(0.033)	(0.009)	(0.007)	(0.031)	(0.009)
Pulses	0.016***	0.323***	-0.012	-0.120***	-0.156***	-0.150***	-0.172***
	(0.002)	(0.078)	(0.113)	(0.007)	(0.011)	(0.019)	(0.013)
Vegetable	-0.01***	0.128**	-0.494***	0.020	-0.819***	-0.155***	0.089***
	(0.003)	(0.05)	(0.044)	(0.064)	(0.064)	(0.021)	(0.013)
Meat/Fish	0.051***	-0.002	-0.427***	-0.457***	-0.3***	0.019	-0.05***
	(0.004)	(0.04)	(0.058)	(0.03)	(0.067)	(0.014)	(0.016)
Other Foods	-0.137***	-0.976***	-0.665***	-0.098***	-0.153***	-0.141	0.233***
	(0.007)	(0.15)	(0.078)	(0.009)	(0.018)	(0.104)	(0.02)
Cowpeas	-0.043***	-0.118***	-0.206***	-0.017***	-0.163***	-0.023***	0.309***
	(0.002)	(0.023)	(0.024)	(0.002)	(0.014)	(0.003)	(0.077)

Observations = 310

Standard errors in parentheses

*** p<0.01, ** p<0.05, *p<0.1

Based on the uncompensated cross price elasticities, we could identify some complementarity and substitution relationships between the food categories. For instance, there is a complementary relationship between cereals and pulses (cross price elasticity of -0.3). This finding is similar to the conclusion made by Mishili et al., (2009) concluding a complementary food consumption habit between cereals (corn) and pulses. Similar relationship is found between cowpeas and roots or between vegetables and pulses. Furthermore, we could also identify some substitution relationship between cowpeas and roots or between pulses and roots.

The main advantage of using the QUAIDS estimation is the flexibility it provides to include some household demographic variables into its specification. Subsequently, we have fitted the household size in the QUAIDS estimated as an important variable which influence the intensity of household consumption. From the results obtained, it is found that the household size affected negatively the food budget share allocated to the consumption of animal proteins like meat or fish. Specifically, as household size increases, their consumption of animal proteins decreased. This result is also consistent with the previous finding on the expenditure elasticity of meat and fish which is greater than 1: luxury good. As a luxury good, the consumption of meat decreased with an increase in size of the household. The effect of household size on the budget share allocated to others foods categories was not found to be significant.

4. Discussion and conclusion

The study aims to deepen the general understanding of the cowpeas consumption patterns in northern Ghana by analyzing the household price and expenditure. As it has been widely shown in the literature that the consumption of pluses such as cowpeas could sufficiently supply the required amount of protein and vitamins necessary to be healthy. Besides, it was interesting to see economically, what role cowpeas actually played in the diet of Ghanaian households.

Results indicated that only 15 percent of the respondents in northern Ghana are cowpeas consumers which provided a need to study household consumption patterns especially because this region suffers from malnutrition and undernourishment. Furthermore, it was found that

household allocated the most part of their food budget share to the consumption of staple foods like cereals and vegetables. The group of animal proteins like meats and fish received a higher proportion of the household budget share compare to the group of vegetable protein such cowpeas or pulses. While these primary results are important in describing household food choices, they do not provide enough information on the substitutions and income effects which took place within household. To fill in this gap, the QUAIDS model was specified to estimate household expenditure and price elasticities across different food categories.

Results of the QUAIDS indicated that expect cowpeas, all of the food categories present in household foods basket like cereals, root/tuber, and animal protein all have a positive expenditure elasticity which indicated that they were normal goods. However, the cowpeas consumption exhibited a negative expenditure elasticity which indicating it is an inferior good. Overall, these findings were consistent for both compensated and uncompensated prices elasticities. While other food categories have a clear negative own price elasticity which confirmed their status of normal good, the consumption of cowpeas had a positive own price elasticity. Several reasons were indicated to explain this surprising result: the procedure of generating prices, the limited data and the focus of the survey which was not on dry legumes.

Even though some of the results of this study were surprising it was important to indicate that consumption of pulses in general is an adequate source of inexpensive high quality protein and vitamin especially for developing countries with limited resources. Increase awareness on the benefit derived from their consumption will be a good public and private policies to mitigate malnutrition and undernourishment issues in northern Ghana. Another important aspect of the cowpeas consumption analysis that is not included in this study is the consumer preferences for observable and non-observable characteristics of cowpeas like: size, color, insect attacks, taste, or aroma which could better explain the substitution and income effect found across cowpeas varieties. Next researches should further this analysis by analyzing and finding these specifics observable and unobservable characteristics of cowpeas that consumers prefer and may be willing to pay premium for in order to close the loop of the analysis of cowpeas consumption pattern in northern Ghana.

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