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Food Expenditures and Income in Rural Households in the Northern Region of Ghana

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Abstracts:

The objective of this paper is to identify which household factors and farm features determine the farm income in the rural households in the Northern Region of Ghana, and further to examine how farm income, nonfarm income and other socio-demographic factors affect the household fresh vegetable expenditure. The simultaneous equation model is applied to explore the interacting relationship between farm income and the fresh vegetable expenditure. The results indicate that the farm features such as cultivation of staple crops, total number of acres under groundnut cultivation, and the number of bullocks are the major determinants of the farm income, while the socio-demographic factors such as the nonfarm income, education, household composition, age, and gender of the household head significantly affect the fresh vegetable expenditure in the rural households.

Key words: *Fresh vegetable expenditure, farm income, farm features, socio-demographic characteristics*

1 Introduction

The household food expenditures in developing countries have received considerable attention in recent years because of the fast economic growth and increasing concern about food consumption. For example, Campbell et al. (2010) investigate the household rice expenditure in Bangladesh; Gale and Huang (2007) and Yu and Abler (2009) explore the demand for food quantity and quality in China; Nguyen (2010) analyzes food expenditure patterns of the households in Vietnam. Moreover, the strong link between food expenditures and income is well illustrated in consumer demand theory, and food expenditure share is commonly used as an important index of the household welfare and economic well being (McDowell et al., 1997). Hopper (2011) demonstrates the close relationship between household income and the purchased quantities of milk, cream, cheese, eggs, meat, fish, fresh fruits, and fresh vegetables. Income is also found to be one of the most prominent measures of food consumption behavior (Muhammad et al., 2011). Within the scope of food expenditures, vegetable expenditure has gained considerable interest, and numerous research papers have illustrated the importance of vegetable intake on health. Low vegetable consumption is a major factor causing micronutrient deficiencies, and several widespread nutritional disorders including birth defects, weakened immune systems, mental and physical retardation, blindness, and even death are caused by diets lacking such micronutrients (FAO, 2003). Uusiku et al. (2010) reviews the African leafy vegetable consumption in sub-Saharan Africa, and emphasizes the role of dietary fiber and other important components found in leafy vegetables in the prevention of chronic and lifestyle diseases. Although vegetable intake plays a key role in public health, Kobe (2004) points out that vegetable consumption is still very low in sub-Saharan Africa (27–114 kg/capita per year), far below the WHO/FAO recommendation (146 kg/capita per year).

However, most previous studies have focused more on urban households in high-income regions of the lesser-developed countries and bypassed rural households in relatively low-income areas. While currently some countries are experiencing fast urbanization, most developing countries are still inhabited by huge rural populations. According to the World Bank, in 2010,

rural population represented 70% of the total population in India, 55% in China, 87% in Uganda, 49% in Ghana, and 71% in Vietnam,¹ respectively. Therefore, capturing the vegetable expenditure and income patterns in rural households is of great relevance and importance. Based on the crucial role of the vegetable consumption and the relative low vegetable consumption in sub-Saharan Africa, this present study fills the gap of previous studies by focusing on the vegetable expenditure, the household income, and their relationship in rural households using a dataset from a survey conducted in the vicinity of Tamale, the capital city of the Northern Region of Ghana. Ghana, a sub-Saharan developing country, has recorded a high economic growth in the recent years. However, the Northern Region of Ghana, with more than 71% agricultural population², is still one of the least developed areas of Ghana compared with the Central and Southern Region. The study has two objectives. First, this study identifies which household factors and farm features affect the farm income in rural households. Second, we further examine how farm income, nonfarm income, and other socio-demographic factors determine fresh vegetable expenditure in rural households in the Northern Region of Ghana.

A large number of previous studies have explored the determinants of vegetable consumption. Kobe (2004) finds that the vegetable expenditure is affected by the gender of the household head, household income, education, and employment status. Bertail and Caillavet (2008) state that vegetable consumption patterns are influenced by education level, household income, and household size. Han and Wahl (1998) suggest a rapid growth in income will increase demand for vegetables. Vlismas et al. (2009) demonstrate that vegetable consumption is associated with socio-economic status such as occupation, as well as education and income. This study expands the list of explanatory factors in previous studies by including both farm income and nonfarm income, and makes a further contribution by identifying the determinants of household farm income. The results of this study state the vegetable expenditure and farm income determining factors in rural households in the Northern Region of Ghana, and provide valuable information for food marketers, food manufacturers, and the organizations concerned about public health.

2 Conceptual Framework

This study consists of two objectives. It examines factors that determine farm income as well as finds out how income and other socio-demographic factors affect vegetable expenditure in rural households.

2.1 The Farm Income

Farm income in a developed economy can be categorized into gross cash income, gross farm income, net cash income, and net cash income.³ In this paper, farm income refers to the sum of all receipts from the sales of crops, livestock and other farm related goods and services. This definition is similar to gross cash income in the United States agricultural policy formulation, but does not include direct government payments. Since farm income is from the sale of farm goods and services, farm income $FarmI$ depends on the price P_C and the quantity Y_C of these farm goods and services (equation 1).

$$FarmI = \eta (P_C, Y_C) \quad (1)$$

Equation 2 shows how the quantity of farm goods and services Y_C is further affected by farm features k (e.g., farm size and crop types), and household factors δ (e.g., education, household composition), which can affect farm productivity. When cross-sectional data are used, it is reasonable to assume that the prices of farm goods and services are stable during the given period. Thus, given constant prices, only the production quantity Y_C can affect the farm income and farm income $FarmI$ can be expressed as a function of farm features and household factors (equation 3):

$$Y_C = \phi (k, \delta) \quad (2)$$

$$FarmI = \eta (\phi (k, \delta) | P_C) \quad (3)$$

2.2 The Vegetables Expenditure

A household purchasing decision is based on maximizing household utility within the budget constraint. As shown in equation 4, a household maximizes its utility within the income

constraint:

$$U = f(V, M, \theta) \quad s.t. \quad I = P_V V + M \quad (4)$$

where V is the demand of vegetables, M is the demand of all other goods, θ is the parameter defining the utility functional form and capturing household taste, P_V is the price of vegetables, and the price of M is equal to 1 without losing generality. The first order condition of the constrained Lagrange equation suggests the ratio of marginal utility with respect to vegetable demand and all other goods equals their price ratio:

$$MU_V/MU_M = P_V \quad (5)$$

After substituting the first order condition into the budget constraint, the optimal consumption of vegetable V^* is a function of the household income I , price of vegetables P_V , and the taste parameter θ shown in equation 6:

$$V^* = g(I, P_V, \theta) \quad (6)$$

Since the price is assumed to be stable, the optimal consumption of vegetables depends only on the household income I , and the household taste θ (equation 7).

$$V^* = g(I, \theta | P_V) \quad (7)$$

The vegetable expenditure, which is the product of the price and quantity of vegetables, is also a function of two factors, namely, household income and household taste under the stable price assumption (equation 8)

$$Exp_V = P_V V^* = P_V g(I, \theta | P_V) = \phi(I, \theta | P_V) \quad (8)$$

3 Data

Tamale, the capital city of the Northern Region of Ghana, is most populated by Dagomba people who speak Dagbani, a local language. The vicinity of Tamale is dominated by agriculture with crops that include: groundnuts, cotton, and tobacco. The present study uses the dataset from a survey conducted between July 27th and August 2nd, 2010. The survey covered three districts (i.e., Tamale metropolis, Savelugu-Nanton, Tolon-Kumbungu) and 18 towns in the vicinity of Tamale. With the aid of trained enumerators from Ghana's National Statistical Service, multiple

households were selected to geographically and demographically represent the rural households in the region. During the survey, the participating households were asked to report weekly spending on fresh vegetables, share socio-demographic information (e.g., farm income, nonfarm income, age, gender, marital status, education), and provide details about farm features such as types of the planted staple and cash crops, and the total number of acres under groundnut cultivation. After deleting the incomplete records with missing data, a total 204 observations were used in the estimation. The descriptive statistics summary of selected variables is showed in table 1. Within the dataset, 50.5% of the participating households are from Tolon-Kumbungu district, 38.7% from Savelugu-Nanton district, and the remaining 10.8% from Tamale metropolis district. The age range of participants is from 18 year old to 75 year old, with the mean of 38.2 year old. Among the surveyed households, 95.6% are Muslim, 43.1% have male household heads, 8% are single person households, and 15.2% of respondents have not received any formal education. The average household size is 15, including 2.5 children (below 3 years of age) and 0.3 elders (above 61 years of age).

Besides the basic socio-demographic characteristics described above, the collected data also provide information about farm features of these rural households. A typical farm household was reported to plant four types of staple crops (e.g., rice, maize, yam, cassava, sorghum, millet) and two types of cash crops (e.g., pepper, garden eggs, okra, tomato, cotton, tobacco), and have 3.93 acres field under groundnut cultivation. Furthermore, the data also reaffirmed that most rural households in the Northern Region are still poor and have relatively low vegetable expenditure. A typical household has 948.63 Ghanaian cedi of annual farm income and 141.95 Ghanaian cedi of the nonfarm income (1 USD = 1.4432 Ghanaian cedi⁴), but spend only 3.19 Ghanaian cedi on weekly fresh vegetables purchase, that is about 14% of the total household income. Among these rural households, 40.2% households were found to spend less than 5 cedi on fresh vegetables weekly, and 39.2% even report no vegetable purchase. The data also indicated only 5.4% of the households owned bullocks to help their agricultural production, while 62.3% of the farm households do not report any nonfarm income.

4 Empirical Models

The farm income in rural households is determined by both household factors and farm features. Because the farm features such as the farm size and the crop types directly determine the household production level, while the selected household factors such as education level and household composition affect the farm productivity, thus both household factors and farm features can further determine the farm income in rural households. For example, Möllers et al. (2008) find the number of household members, education level, and farm size having significant influence on the farm income of rural households in Slovenia. In this study, the natural logarithm of yearly farm income is the dependent variable, and the household factors and farm features are selected as explanatory variables (equation 9),

$$\log(\text{farmI}) = \alpha_0 + X_{\text{household}}\alpha_1 + X_{\text{farm}}\alpha_2 + \varepsilon_1 \quad (9)$$

where *farmI* is the yearly farm income, α 's are coefficients, $X_{\text{household}}$ is the household factors vector including the household head gender, age, marital status, education, the number of female and male household members 13 years old or older, respectively; X_{farm} is the farm features vector including the indicator variables of staple crop and cash crop, respectively, the total number of acres under groundnuts cultivation, and the number of bullocks, where ε_1 is the error term.

The food expenditure especially for the fresh vegetables in rural household is affected by household income and other socio-demographic characteristics. The relationship has been well illustrated by consumer theory and documented in previous studies. Kobe (2004) finds that the household-level demand for vegetables rises with increasing income. Babatunde et al. (2010) state that both farm and off-farm income can contribute to greater food consumption and better food security and nutrition. Ricciuto et al. (2006) find that household size, composition, and education are significant factors in determining food purchasing among Canadian households. Bittencourt et al. (2007) states that family size, number of children, lifestyle, and health concern are the key factors affecting food consumption pattern in Japan. By focusing on a certain consumer group, Frazao (1992) finds that in the U.S. the lower food expenditure in female-headed households is partly determined by race, education level and income; García and Grande

(2010) suggest that household type, education level, and consumer age have a real effect on the food expenditure levels of elderly consumers in Spain. Kobe (2004) finds that the household-level demand for vegetables is also influenced by the gender of household head, women's employment status, and education level. In the present study, the weekly expenditure on fresh vegetables is chosen as the dependent variable, and the farm income, non-farm income and other socio-demographic factors are selected as explanatory variables in equation 10:

$$VegExp = \beta_0 + \beta_1 FarmI + \beta_2 InonfarmI + X_{socio-demo} \beta_3 + \varepsilon_2 \quad (10)$$

where *VegExp* is weekly household expenditure on the fresh vegetables, β 's are the coefficients, *FarmI* is yearly household farm income, *InonfarmI* is a dummy variable indicating whether a household has a non-farm income, $X_{socio-deomo}$ is a socio-demographic factors vector representing other socioeconomics and demographic factors such as education, gender, age, household composition, and ε_2 is error term.

Because this study focuses on farm income, vegetables expenditures, and their interacting relationship, simultaneous equation method (SEM) is selected as the estimation approach applied to our empirical model. This model includes two equations: the farm income equation and the vegetable expenditure equation (equation 10 and 11). In our empirical model, only the farm income determines the vegetable expenditure rather than the income and vegetable expenditure determining each other; thus, the SEM is actually a cursive simultaneous equation model, which can be estimated by the OLS equation by equation. Gujarati (2003) points out that OLS can be applied appropriately in the recursive simultaneous equations model. Moreover, according to the Breusch-Pagan test results, the two equations have heteroskedasticity problems, therefore OLS with robust standard errors is used in our cursive SEM model.

5 Results

The robust OLS estimation results are shown in table 2. Most of the findings are consistent with expectations and previous studies. The dummy variable indicating whether a farm household cultivates staple crops is found to positively influence farm income in rural

households. In other words, households planting staple crops have farm income twice as high as households not reporting staple crop production. Staple crops play an irreplaceable role in farm production in rural households, and in our dataset, 93.6% of households report planting staple crops. Staple crops are called ‘staple’ because they are grown primarily for household use and not commonly sold. However, a portion of the harvest staple crops might be sold for cash, which could result in increases to the household’s farm income.

The total number of acres under groundnuts cultivation also positively affects farm income. An additional acre planted with groundnuts brings a 10.2% increase to farm income in rural households. Groundnut is a major crop in the Northern Region of Ghana for both self-consumption and sales. Hence households with a larger groundnut planted area usually yield larger harvests which leads to a higher farm income.

Another variable, the number of bullocks owned by a household, also positively influences farm income. The addition of one more bullock is expected to bring a 32.8% farm income increase. Fewer than six percent of farm households own bullocks according to the data. Bullocks not only improve farm productivity, but can also help the owner earn additional income from selling services of bullocks such as field task performance or transportation services. Thus, the households with bullocks have higher farm income.

In the vegetable expenditure equation, six out of the nine socio-demographic characteristics are statistically significant in affecting the household weekly fresh vegetable expenditure. Among the socioeconomic factors, the dummy variable indicating whether a household has a nonfarm income, as well as the education level of the respondent are both positive in influencing the weekly expenditure on fresh vegetables. The households having nonfarm income are found to spend 1.16 new cedi more on weekly fresh vegetable purchasing than their counterparts. In our sample, only 37% of rural households report having nonfarm incomes. Because nonfarm incomes are a supplementary part of household total income, such households can afford to consume more fresh vegetables. The education level also significantly affects the weekly vegetable expenditure in rural households. The households where the respondent received any

formal education are found to spend 2.17 new cedi more on weekly fresh vegetable expenditure than households of respondents not having any formal education. We conclude that households with higher education levels appear to know more about the advantage of eating more fresh vegetables, and therefore usually spend more on fresh vegetable purchases.

The demographic factors that include gender, age, number of children, and number of elders, also significantly determine the weekly fresh vegetable expenditure (table 3). A household with a male head is found to spend 1.19 new cedi less per week on fresh vegetables than a household with a female household head. The result is consistent with Kobe's (2004) findings. Age also has a positive influence on weekly fresh vegetable spending, with a one-year increase in age increasing weekly fresh vegetable expenditure by 0.06 new cedi, or 0.60 for an increase of ten years. While, the relationship between age and fresh vegetable expenditure in developed economies is interpreted as the increasing consumer awareness about the health benefits of vegetable consumption, it is not clear what specific motive drives the confirmed relationship in rural households of northern Ghana. However, from the food distribution standpoint, it is worth remembering that such a relationship has been confirmed.

A household having an additional child three years old or younger can be expected to increase the weekly fresh vegetable expenditure by 0.77 new cedi. Small children require proper nutrition during their early growth and dishes prepared from fresh vegetables may play a role in their diet. In contrast, an additional family member above 61 years of age causes the household weekly spending on fresh vegetables to decrease by 1.21 new cedi. Perhaps, because the elder household members need less food intake than other age groups, the expenditure tends to decline.

6 Implications

Food expenditures, specially the fresh vegetable expenditure, in developing countries have gained wide attention in recent years. However, few studies have focused on the rural households in less-developed regions in developing countries. Although the crucial role of vegetable consumption has been well illustrated by a large number of previous research studies, the fresh vegetable intake is still far below the recommendation level of WHO in Africa. This study

applies a simultaneous equation method to examine farm income, fresh vegetables expenditure, and their relationship in rural households in the Northern Region of Ghana using the survey data collected during the summer in the vicinity of Tamale in 2010.

The estimation results show that compared with other household factors, farm features are relatively more important in determining farm income in rural households. The farm income equation model includes both household factors and farm features; however, only three farm features (i.e., the crops type, the farm size, and the number of bullocks) are found to significantly determine farm income. A household reporting having staple crops under cultivation has a relatively higher farm income than households not cultivating any staple crops. These finding suggests that in comparison to cash crops, staple crops are still a major crop type influential in increasing the farm income in the Northern Region of Ghana. In addition, households cultivating larger groundnut acreage report a higher annual farm income. Groundnut importance is expected since part of the groundnut crop is for self-consumption and the remaining is usually sold for cash. Encouraging the rural household to cultivate more groundnuts might be an efficient way to increase their farm incomes as well as provide an important role in the rural household farm production.

Multiple studies have demonstrated the close relationship between vegetable expenditure and some selected socio-demographic characteristics. The results of this study also find that demographic characteristics such as age, gender, and household composition are significant determinants of fresh vegetable expenditure. These findings can be used to give food distributors and retailers valuable advice in targeting the sales and promotion of fresh vegetables to rural households. This target demographic would consist of households with a female head and a large number of small children since these consumers spend more on fresh vegetable purchases. Consideration of the special needs of small children's growth as well as the taste preferences of female head of household on fresh vegetables will be an efficient promotion strategy for the food marketers. Because a household with a large number of elders 61 years old or older report a relatively lower fresh vegetable expenditure, promoters of public health should consider this

household behavior.

Furthermore, the socioeconomic factors such as education level and nonfarm income also have significant influence on the weekly fresh vegetable expenditure. A household with formal education spends more on the household vegetable expenditure than a household that has not received any formal education. Higher education levels lead to greater understanding about the benefits of fresh vegetable intake, which results in higher fresh vegetable expenditure. Moreover, households having nonfarm income also prove to have higher fresh vegetable expenditure, and increasing this income increases vegetable purchases.

Policy implications can be derived from the results of this present study. Guaranteeing staple crops cultivation, encouraging groundnuts planting, as well as increasing farm assets such as providing bullocks (there are NGOs that engage in such form of development assistance) can enhance the rural households' ability to increase their farm income in less developed regions in developing countries. Moreover, our results show that a household with a female household head, a large number of children, and a small number of elders have relatively higher weekly fresh vegetable expenditures. This information can be used to capture and forecast vegetables expenditure trends in the future for households matching this profile. Encouraging off-farm work and providing more education and training are some of the interventions that contribute to increase consumption of fresh vegetables.

Future work will be needed to collect additional relevant information such as the detailed information about staple and cash crops and prices of farm products. Having such data would enable the examination of the effects of staple and cash crops sales on the farm income, and compute the price elasticity in order to assess how farm income and the vegetable expenditure change with respect to the farm price. Additionally, if a panel data set can be collected, the identification of the fresh vegetable expenditure trends could be more precisely examined and provide additional insights applicable in the formulation of distribution decisions, marketing strategies and the development of local supply network for retailers moving into the region.

Notes:

¹ The World Bank. 2012. Rural population (% of total population). Available online <http://data.worldbank.org/indicator/SP.RUR.TOTL.ZS> [Accessed May 18th, 2012]

² Modern Ghana. 2012. Physical features of the Northern. Available online http://www.modernghana.com/GhanaHome/regions/northern.asp?menu_id=6&menu_id2=14&sub_menu_id=135&gender= [Accessed May 18th, 2012]

³ Investopedia. Definition of 'Farm Income'. Available online <http://www.investopedia.com/terms/f/farm-income.asp#axzz1vp05xh1k> [Accessed May 23th, 2012]

⁴ Government of Ghana (2012) Ghana Association of Bankers Announces New Exchange Rates. Available online <http://www.ghana.gov.gh/index.php/news/general-news/2957> [Accessed April 22nd, 2012].

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Table 1. Descriptive statistics of variables

Variable name	Variable description /Units of measurement	Mean	Std. dev.
VegExp	Weekly fresh vegetables spending in New cedi	3.19	3.98
Income factors			
FarmI	Yearly household income from farming in New cedi	948.63	2208.10
InonfarmI	Have yearly household income from non-farming activities=1	0.38	0.49
Socio-demographic factors			
Malehead	Have male household head=1	0.43	0.50
Age	Actual age of participants, in years	38.24	11.60
Marital status	Married=1	0.92	0.27
Age3	Number of household members 3 years old or younger	2.48	1.99
Age12	Number of household members 4-12 years old	2.90	2.74
Age61	Number of household members 61 years old or older	0.32	0.78
Male_13	Number of male household members 13 years old or older	4.17	2.77
Female_13	Number of female household members 13 years old or older	4.42	3.00
Education	Any formal education = 1	0.85	0.36
Farm characteristics			
Staplec	Cultivate staple crops (including rice, maize, yam, cassava, sorghum, millet) =1	0.94	0.24
Cashc	Cultivate cash crops (including pepper, garden eggs, okra, tomato, cotton, tobacco) =1	0.73	0.45
Groundnut	Total number of acres under groundnut cultivation, in acres	3.92	2.99
Bullocks	Number of bullocks a household owns	0.08	0.36

Table 2. Estimation Results of Farm Income Equation

OLS		
Variable name	Estimated coefficient	Robust std. error
Intercept	4.7378	.4448
Household factors		
Malehead	.2859	.1772
Age	-.0106	.0068
Married	.1994	.2814
Education	.0684	.1899
Male_13	.0384	.0298
Female_13	-.0254	.0313
Farm features		
Staplec	1.1594***	.2387
Cashc	-.1115	.1437
Gnutacre	.1018***	.0306
Bullocks	.3284*	.1767
Number of observations		204
R-square		0.2464

Note: *, ** and *** denote significant at 10%, 5%, and 1% levels, respectively

Table 3. Estimation Results of Vegetable Expenditure Equation

OLS		
Variable name	Estimated coefficient	Robust std. error
Intercept	-5.3604	-5.3604
Demographic factors		
Malehead	-1.1940*	.6665
Age	.06256**	.0259
Married	-1.3338	.9991
Age3	.7695***	.2956
Age12	.1334	.1365
Age61	-1.2104***	.1488
Socioeconomic factors		
Education	2.1706***	.4246
Ln(farmI)	.6018	.4999
INonfarmI	1.1649**	.5527
Number of observations		204
R-square		0.3625

Note: *, ** and *** denote significant at 10%, 5%, and 1% levels, respectively.