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Effect of Price and Non-price Incentives on Production and Marketable Surplus of Food Crops Supply in Ghana

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Aim: This study examined food crop farmers' supply responsiveness to selected price and non-price variables.
Study Design: Cross-sectional design
Place and Duration of Study: The study was carried out in Ejura Sekyeredumasi District in the Ashanti Region of Ghana and data was collected in November 2013.
Methodology: A simple random sampling technique was used to sample 250 farmers for the study. Structured questionnaire was used to solicit information from the sampled farmers on production and marketing of maize and cassava. The study used a modified Nerlovian supply model to analyse the data in order to assess farmers' supply responsiveness to selected price and non-price variables.
Results: The results of the study revealed that food crop farmers respond favourably and promptly to incentive package (price or non-price factors) and this reflected in farmers' output and farm management practices.
Conclusion: The study provides evidence to support price incentives and non-price factors on food crop supply response. It suggests that a strong complementary policy instrument involving price and non-price factors will provide a fillip to agricultural productivity.

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Keywords: Price incentives; non-price factors; supply response; Ghana.

1. INTRODUCTION

The agriculture sector plays a significantly vital role in the development of countries `around the world. It creates opportunities for addressing poverty and providing a safety net when coping with unemployment or under employment situations and economic difficulties globally. In developing economies, and in particular sub-Saharan Africa, the sector is strongly linked to growth, poverty reduction and food security [1]. The sector provides employment and income security and accounts for a large section of the population in agro-based economies. Growth in such agro-based economies requires increased productivity and expansion of the agricultural sector as growth in the sector has multiplier and ramified effects in other sectors of the economy. Accelerated growth requires a drastic increase in the productivity of smallholder farming combined with more effective support to the millions of farmers residing in remote areas. Such increased productivity depends heavily on the kind of public policy support and the attention government gives to the sector in terms of budget and types of policy.

State policies as precursors for growth rely on the extent to which policy makers and planners are informed about the real issues on the ground. Thus the strength of farmers' responsiveness to the various incentives provided by policy makers is critical [2], and requires systematic analyses to inform policy makers about the performance of the sector. This raises questions about the extent to which policy makers, planners and practitioners of agriculture are informed about estimates of the supply response of the sector to the various policy instruments implemented in respective countries. It leads to questions about aspects of agricultural policies that are most important driver of agricultural productivity. The need to provide this information is critical, particularly given that agriculture is the single most important sector of the Ghanaian economy.

A study of farmers' supply response to price and non-price incentives is therefore of paramount significance for designing suitable and workable agricultural policies that are able to trigger agricultural development. This will however depend, as pointed out earlier, on the awareness of government policy makers of supply response estimates. Knowledge of supply response estimates of agriculture to public policy in agro-based economies cannot be overemphasized. The estimates of such elasticities serves as good indicators of the successes or failures of public policy introduced to drive the sector's growth. It informs policy makers and planners about what works and what does not, in terms of policy instruments they have designed and implemented.

The absence of such information could lead to several problems including the implementation of ad hoc policies which may not be based on any theory or reality and this could lead to a bias against the agriculture sector [3]. The implementation of such ad hoc policies may be attributed to inadequate, or lack of, information on agricultural supply for policy makers to make the right decisions, for example, whether to tax or not to tax agriculture. According to [4], in the 1950s, lack of a suitable and effective model to measure agricultural production and productivity contributed to the neglect of agriculture as a growth strategy for economic development.

The response behaviour of smallholder farmers is characterized by use of traditional inputs, rainfall dependent and inadequate capital investments has been much debated, with no consensus established yet. As a way around the challenges, supply response analysis has

in recent years therefore emerged as an important tool for measuring the effectiveness of agricultural policy-productivity linkages [2]. This is evidenced by the use of supply response analysis in many structural adjustment programme (SAP) reports of the World Bank [5].

In Ghana, governments have over the years supported farmers through diverse price and non-price incentives as a way of enhancing production and productivity, and stabilizing farm incomes, particularly among food crop farmers who are often counted as the poorest among the various occupational groups in Ghana [6]. The poor status of these farmers if not enhanced may constrain agricultural productivity thereby leading to stagnation in the growth of the general economy, whose growth has been tied to the agriculture sector. It is in view of this, that a host of policy instruments including substantial investments (in the form of price and non-price incentives) have been made in the sector. While such investments are critical to growth of the sector, the real success of such public investments is much dependent on the farmers' responsiveness towards the incentives provided [2].

This huge public expenditure in a sector, considered by many as risky investment terrain has engineered several debates about the use of, and possible gains from, such public funds in the agriculture sector. Some questions that remain are whether the investments or incentivized packages made available to farmers have really been worthwhile in terms of improving agricultural productivity. Many people are interested in knowing which incentive package is most effective for raising productivity and incomes of farmers as well as generating sufficient food supply and growth. In this study the question is how have Ghanaian farmers responded to the various price and non-price incentive policies in the country? To address these questions we needed information on the elasticities of price and non-price incentives on acreage and yield of individual crops.

According to [7] the estimates of the coefficients of supply response parameters provide policy makers and development planners with information on policy impact on growth and poverty. A positive response, in terms of direction and dimension measures the extent of agriculture growth with respect to the crop under study. It is therefore hypothesised that a better understanding of supply response models would provide leverage in explaining the dimension and direction of agricultural policies on the economy.

Apart from the reality that studies in the subject of supply response behaviour mainly concentrate on time series data and primarily on cash crops such as cocoa, studies relating to supply response of Ghana's agriculture are scarce. This study aims at assessing supply response in the agricultural sector in Ghana through modifying the neo-classical supply response model put forward by [2,8]. The case of food crop farmers' responsiveness to selected price and non-price policy variables was chosen for obvious reasons. Because of data inconsistencies from various data sources; and to eliminate temporal effects using time series data, the author employed cross sectional information to examine farmers' responsiveness to agriculture price and non-price factors or policy instruments. Thus the study employs empirical data from a farm level cross sectional survey to estimate the elasticities of supply response of production and marketed surpluses of smallholder farmers. This is carried out contrary to the views that policies benefiting marketed surplus response are likely to accrue to only large scale farmers.

After the economic decline experienced in the late 1970's and early 1980s Ghana, like other sub Saharan African countries, had consistently designed and implemented policies and programmes aimed at reviving and sustaining the economic glory once enjoyed by the country in the 1950's and 1960's. Although agricultural development policies in the country

have undergone several revolutions, the objectives have mainly remained unchanged [9,10]. Principally, food and agricultural policies in the country have included provision of food security by way of adequate and nutritionally balanced diets at affordable prices for Ghanaians and promoting improvement in small holder productivity. In addition to ensure that that efficient agricultural producers earn incomes that are comparable to those outside the agriculture sector; making agriculture an attractive employment alternative to industry, trade and commerce. Read It is also aimed at ensuring that agriculture contributes effectively to the country's balance of payments through export diversification and import substitution through the establishment of effective linkages between agriculture and industry. Furthermore, the policy intended to promote balanced regional development and growth, based on regional comparative advantages and resource endowment for agricultural activities.

In the second half of the 1990's through to the 2000's, the growth of the agriculture sector and the economy in general gave the impression of renewed hope for the country. However, a nuanced review of agricultural supply response literature shows less than expected results. While some crops and sectors experienced positive growth, others showed mixed results. Yet, despite the numerous reforms, not much in terms of market development and productivity was seen to have been achieved. Government's attempts at achieving acceptable rates of growth and development have woefully failed [11]. The poor and discouraging performance of the sector has been attributed to a number of factors ranging from low and poor infrastructure development; low farm gate prices; high cost of production ;non availability of inputs among others; to wrong perceptions and attitudes towards farming.

It is believed that non-price factors dominate over price or market incentives in farmers' decision making [12], such that poor pricing is cited as anti-increase productivity. Restricted market access may have been cited as retarding growth in the sector; absence of proper road connections; or the distances involved in transporting food crops from farm gate and urban markets is also acknowledged as being critical. Thus, even though price is crucial, the significance of non-price factors in improving agriculture cannot be discounted. Yet, in Ghana, there is no strong evidence to support this assumption. This, however, does not suggest that there has been no research on supply response in Ghana. Like both developed and developing agricultural economies quite a number of empirical studies on supply response and economic rationality of smallholder farmers have been conducted. The challenge however rests with the nature and extent to which these farmers have responded to changing dynamics of prices (inputs and outputs) and other non-price factors.

In Ghana factors usually cited as likely to influence and shape productivity in the agricultural sector (especially food crops) are: the high cost of fertilizer and its application; the high cost of consumer goods high population and high rate of urban-rural drift; unpredicted soaring food prices; lack of rural infrastructure; and the stifled nature of agro-supporting services like credit and storage facilities. An assessment of farmers' response behaviour to policy in terms of the effect that the latter have on farm activities and benefits accrued to farmers is critically significant for improving policy formulation and implementation and thereby the agricultural sector's contribution to overall economic growth.

The present study on supply response of cassava and maize in rural Ghana is an attempt to explore whether the production and marketing decisions of the selected food crops growers in the study area have any relevance to changes in prices and the selected non-price variables. Production and marketed surplus response functions are estimated for each of the selected crops in the study. The objective of the study is to examine the supply response

behaviour of cassava and maize producers towards price and non-price factors in the Ejura area of Ashanti Region, Ghana. Cassava and maize were selected for the study because the statistics indicates that maize production in Ghana stands at 1.5tons per hectare, which is about 3 tons\ha short of the achievable target. Cassava production on the other hand is 11.4 tons\ha as against the achievable rate of 28.0 tons\ha [13]. The productivity gap suggests that there is still more room for improvement, given the current level of technologies introduced to farmers.

The produce from these crops are widely consumed in the country. In addition, the crops are highly suitable for almost all the agro-ecological regions of Ghana. These crops, especially cassava, are easy to cultivate. Current statistics indicates that despite the productivity gaps and the challenges farmers are facing with respect to the cultivation and marketing of the crops, maize and cassava production in the country is growing at the rate of 6.13 and 3.15 respectively [13]. Production of maize stood at 1,872,000Mt as against 13,504000 Mt during the 2010 season.

While studies of these selected crops are critical to food security and the development of agriculture in the country, the literature shows scanty data on supply response of food crops in Ghana. Most studies have focused on cocoa, however those which have provided estimates for the agriculture sector mostly employed time series aggregated data which in most cases conceals variations within the sector. This study uses a cross sectional data collected directly from farmers in the field due to unavailability of panel data.

2. THE STUDY AREA AND METHODOLOGY

2.1 The Study Area

The study was carried out in Ejura-Sekyedumase district. The district is one of the thirty-two district in Ashanti Region of Ghana. It lies between longitudes 1.3ºW and 1.46^{o}W. and latitudes 7.3ºN and 7.8ºN. The district capital is Ejura which is approximately 100km north of Kumasi, the capital of the Ashanti Region. The district is located between the Brong Ahafo and Ashanti Regions agricultural zones with rainfall ranging between 1200mm and 1500mm. The area experiences two rainfalls annually. Topographically, the area is generally gentle and undulating with hills ranging between 150mm and 300mm above sea level. The semi deciduous vegetation coupled with the forest orchrosols soils supports the cultivation of several food crops. Some cops such as maize, cassava, cowpea, okra, yam, cocoyam and plantain were common in the district. Tree crops such as mango, orange oil palm, and cocoa can also be found in the area.

2.2 Methodology

2.2.1 Data collection procedure

The study used both primary and secondary data. The primary data was collected from two hundred and fifty (250) farm households selected from Ejura and its surrounding farming communities. With the use of a structured questionnaire, information on production and marketing of maize, cassava and other food crops in the area was elicited from the farmers. A simple random sampling technique was used in selecting farmers for the study.

As a result of the difficulty in accessing wholesale prices, the study used farm gate (producer) prices in estimating the market prices of the crops. It was assumed that since most farmers sold their crops immediately after harvest it was better to use the farm gate prices to compute the price variable used in the model. To a large extent the farm gate or harvest price influence farmers' decision making processes more than any other price since crops are usually sold at the farm gate and immediately after harvest. Most farmers did not find it difficult recollecting the price of produce sold in the immediate past (previous) season. Rainfall distribution and amount are important factors that affect crop yield. This variable is assumed to be given since policy makers and planners have very little control over it. Although irrigation facilities could serve as proxy for natural rainfall, it was not considered because maize and cassava in Ghana are not often cultivated by irrigation. Non price factors included in the model were those that policy makers could have some control over with respect to its direction and magnitude, and what will accelerate agricultural productivity.

Although it was acknowledged that farmers' income is another critical factor that determines yield and acreage expansion in subsequent years, this was considered as a given. For reasons that are not always clear, farmers often have difficulty remembering the exact amount of money spent on farming operations. While some believe it is a deliberate act, others are of the view that farmers are not interested in such details. Most farmers could not help in estimating the actual amount of money they spent in producing and/or marketing their produce. Profit and income was difficult to compute and hence it was not included in the model.

2.2.2 Analytical framework

In this study the modified Nerlovian model was used to test the hypothesis that infrastructure investment (non price factors) complements price factors (policies) to increase food production and marketed surpluses responses of food crop farmers. The combined Nerlovian model was adjusted to capture marketed surpluses in order to estimate the response behaviour of the farmers. In view of this, the conceptual framework for estimating agricultural supply response to agricultural incentives was first formulated by [8]. The Nerlove postulated model for estimating the supply response of agricultural supply response was based on different behavioural hypotheses.

The Nerlove model of agricultural supply response is one of the most successful and widely used in applied econometrics. This is evident from the hundreds of studies that employed supply response analysis. It was adopted in this study because it employs both cross-sectional and time series data in its estimation analysis. The model can be written in three equations. It is maintained that in agriculture, the desired output is determined by the farmer by taking into consideration risk and other enabling factors. The first equation thus, hypothesizes that desired (expected) output Q^d, in period t being a function of some variable X, in time t.

$$Q_t^d = \alpha_0 + \alpha_1 X_t + \mu_t \quad [1]$$

It has been observed that in developing countries like Ghana where acreage expansion or expected output is hardly realized in a short period due to financial constraints. In addition gestation periods of the crop, and availability of technology may also constrain farmers response in agriculture. This makes it difficult if not impossible for the expected output to be realized in a short period. The situation is corrected by introducing a proportionality variable [2,14].

This brings us to the second behavioural principle postulated by [8]. The second behavioural equation postulates a dynamic relationship of output between time periods. It states that the change or adjustment in acreage between periods occurs in proportion to the difference between the desired acreage for the current period and the actual acreage in the previous period.

$$Q_t = Q_{t-1} + \gamma(Q_t^d - Q_{t-1}) + V_t \ , \ 0 \leq \gamma \geq 1 \qquad [2]$$

From equation two [2] the actual output in a particular time period$t$is a proportion of the expected change and the adjustment variable γ must lie anywhere between 0 and 1for the adjustment to converge over time. Since the convenience is not easy particularly in a developing country like Ghana, this study allows γ to lie in between 0 and 1. Equation two [2] can be restated in terms of price resulting in equation three [3].

Equation three hypothesised those farmers expectations are re-organized between periods in proportion to discrepancy between the actual and expected levels of price of output. That is

$$P_t^e = P^e + \beta(P_{t-1} - P_{t-1}^e) \qquad [3]$$

In order words, in the traditional Nerlovian model, this equation postulates that expected price at period$t$, $P_t^e$is determined by the expected price in time$t-1 P_{t-1}^e$ plus an adjustment proportionate (β) to the difference between actual and expected price for period $t-1$

Where:

P_t^e = expected real producer price in period t
P_t = actual producer price in period t.
Q_t^d = desired output at time t
Q_t = actual output at time t
X_t = other factors affecting supply in period t
β = Coefficient of expectation (0 ≤β≤ 1)
γ = Coefficient of output adjustment (0 ≤γ≤ 1)
μ_t = random disturbance term
$\alpha_0 and \alpha_1$ = unknown coefficients

Substituting equations [1] into equation [2] gives

$$Q_t - Q_{t-1} = \gamma[(\alpha_0 + \alpha_1 X_i + \mu_t) - Q_{t-1}] + V_t \qquad [4]$$

Manipulating equation [4] and rearranging the resulting equation gives:

$$Q_t = \alpha_0\gamma + \alpha_1\gamma X_t + Q_{t-1}(1-\gamma) + (V_t + \gamma\mu_t) \qquad [5]$$

Introducing the price equation [3] into equation [5] and rearranging the result gives a reduced form of supply equation as;

$$Q_t = \delta_0 + \delta_1 P_{t-1} + \delta_2 Q_{t-1} + \delta_3 X_t + V_t \qquad [6]$$

Where:

$\delta_0 = \alpha_0\gamma\beta$
$\delta_1 = \alpha_1\gamma\beta$
$\delta_2 = (1-\beta)+(1+\gamma)$
$\delta_3 = -(1-\beta)+(1+\gamma)$
$V_t = \gamma\mu_t - (1-\beta)\gamma\mu_{t-1}$

Assuming that the expected price, P^e is equal to the last period's price P_{t-1} see equation [2] , then $P_t^e = P_{t-1.}$ When $\beta = 1$ and imposing a restriction on either γ or β gives us the opportunity to derive a unique solution of the equation of supply which can be determined by means of a least square technique. A reduced form equation of the above equations is obtained as;

$$Q_t = \varphi_0 + \varphi_1 P_t + \varphi_2 Q_{t-2} + \varphi_3 Z_t + V_t \quad [7]$$

Where,

$\varphi_0 = \alpha_0\gamma$
$\varphi_1 = \alpha_1\gamma$
$\varphi_2 = 1-\gamma(0 \geq \varphi_1)$
$\varphi_3 = \alpha_2\gamma(0 \leq \varphi_2 \leq 1)$
$V_t = \gamma\mu_t$

Equation [7] represents the typical supply response equation documented in the literature of supply response analysis [15]. Also, φ_1= short run supply elasticity of price.

$\frac{\varphi_1}{1-\varphi_2}$ = long run supply elasticity
$1-\varphi_2$ = area adjustment coefficient (see [16])

2.2.3 Estimated (modified) model

The model selected for the study is represented by the function;

$$Q_t = f(PR_{t-1}, Fc, Rd, S_t, C_t, Co_t)$$

Thus it is assumed that the desired level of output in time *t* is a function of output price, cost of input, road accessibility, credit use, consumer goods availability and suitable storage facility. T the model can be simplified as;

$$Q_i = \partial_0 + \partial_1 PR_{t-1} + \partial_2 Rd + \partial_3 Fc_i + \partial_4 C_i + \partial_5 Co_i + \partial_6 S_i + \partial_7 CS_i + \mu_t \quad [8]$$

Where:

Q_i = Quantity of crop produced or marketed by household *i* (kilograms) divided by the size of each household.
PR_{t-1}= The price ratio which is defined as the actual price of crop at *t - 1,* divided by the actual price of cowpea, the most competitive crop (in Ghana Cedis)
Rd = Road accessibility variable
Fc_i = Cost of fertilizer used by each farmer on per acre of land cultivated
CS_i = cost of cassava sticks on per acre of land cultivated
C_i = Dummy for credit use (1 for those who used credit and 0 for otherwise).

Co_i = Dummy for local availability of consumer goods (1 for availability and 0 for otherwise).
S_i = Dummy for storage suitability (1 for suitability and 0 for otherwise).
μ_t = Error or disturbance term to take care of random shocks

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of Respondents

Table 1 presents socio-economic characteristics of the respondents. Sixty –five percent of the respondents are male while 35% are female. This reflects national statistics, which indicates that there are more male farmers than female farmers in the Ashanti Region [17]. Arguably, the predominance of males to females in the agriculture sector or farming is attributed to the tedious nature of farming, which requires lots of energy which many women cannot compete with their counterpart men.

It was revealed during data collection that in many cases, household chores performed by females seem to occupy them so much that they have little time to work in the farm. Age is another socioeconomic factor of the respondents which was considered. This factor sometimes determines the strength and aspiration of the farmer. The result of the study revealed that about 20% of the farmers interviewed are between the ages of 18 -33 years, 55% are between the ages of 34 and 60 years while about 24% of the farmers are above 60 years. Ghana might continue to experience low production in absence of mechanised farming the youth who are energetic and can do some meaningful farm work seem to be avoiding farming due to absence of mechanisation.

The educational status of the farmer determines the speed with which he is likely to adopt agricultural technologies. Those who can read and write stand a better chance of understanding things faster. Table 1 indicates that about 46.7% of the respondents did not have any formal education, 37.5% had basic education and a little over 15% had either secondary education and above. The number of the respondents who had some level of formal education is encouraging as more than 50% have attended formal school. Informal training by agriculture extension officers seems to be high in the area.

The household size of the respondent is another key factor that affects production. Since most rural people rely on family labour. The number of respondent with children below the age of 18 years is just about half the total number of farmers interviewed. Land is the most important and basic factor of production in agriculture.. The ownership of land and its proper use are therefore very important in agriculture. The statistics above (Table 1) suggests that in many farming communities, including the study area, farmlands are usually owned or inherited by males due to the patricentric nature of inheritance in many communities of Ghana [18].

Table 1. Socio-economic characteristics of respondents

Socio -economic characteristics	Description	Frequency	Percent
Gender	Male	78	65.0
	Female	42	35.0
	Total	120	100.0
Age(years)	18- 33	25	20.8
	33-60	66	55.0
	Above 60	29	24.2
	Total	120	100.0
Education level	Nil	56	46.7
	Basic	45	37.5
	Secondary	12	10.0
	Post- secondary	3	2.5
	Other	4	3.3
	Total	120	100.0
Ownership of land	Leasehold	58	48.4
	Owner operator	30	25.0
	Communal	25	20.8
	Other	7	5.8
	Total	120	100.0
Farm size(acres)	Less than 1.5	38	31.7
	1.5-4.0	24	20.0
	4.0-10.0	51	42.5
	Greater than10.0	7	5.8
	Total	120	100.0

Source: field data, 2013

Table 1 also shows that land ownership in the area of study is mostly leasehold , the farmer (tenant) present a bottle of schnapps (alcoholic drink) and an amount of money to the landlord who in turn gives the farmer the right to work on the land. Depending on the agreement between the two (lessor and lessee), the tenant (lessee) is allowed to work on the land for a period spanning between 3 and 5 years. The contract however can be renewable. The size of farm owned and cultivated by a farmer to a larger extent determines the size of output all else remaining constant. The size of farm is partly determined by the size of household labour or the wealth of the farmer. About two-fifth of the respondent (42.5%) had farm size which ranges between 1.5 to 4.0 acres. About 6 % of the farmers cultivated more than 10 acres of land with the rest, 31.7% of the farmers cultivating less than 1.5 acres of lands.

3.2 Regression Results

The effects of price and non-price factors on quantities of maize and cassava produced and marketed were tested empirically with data from a farm household survey conducted in the study area. The dependent variable refers to the output of maize or cassava cultivated in the area. The regression analysis (Table 2) shows that four variables employed in the model influenced both production and marketed surplus responses.

Table 2. Regression results for maize supply function

Explanatory variables	Quantity produced	Quantity marketed
Constant	5.368 (1.923)	1.368 (2.233)
Log Price Ratio PRm	1.100** (2.9152)	1.020 ** (2.757)
Log Fertilizer cost Fc	-0.580** (2.796)	0.520** (2.894)
Log transport accessibility Rd	0.0271 (0.029)	0.0271 (0.030)
Storage S_1	0.029** (2.719)	0.029** (2.619)
Credit C_i	0.0079 *** (4.678)	0.0079*** (4.018)
Consumer goods C_0	0.015 (0.011)	0.015 (1.011)
R^2	0.558	0.497
N	250	250
F-Statistic	15.197	14.897
F-Prop	0.0002	0.0010
Wald $\chi 2$	23.454	17.87

******** *Significant at 1%,* ****** *Significant at 5%and* ******* *Significant at 10%; t-statistics are in parenthesis.*
Source: Authors' own analysis, 2013

The variables for cost of fertilizer, price factor and storage were significant at 5% significant level while, the credit variable is significant at the 1% level of significance for both models. It was also realised that, apart from cost of fertilizer which showed a negative relationship with production levels, the rest of the variables exhibit positive relations to both production and marketed surplus responses.

The results however showed that the most important of the variables, in terms of magnitude that determines output and marketed surplus of maize, is the price factor. The results generally show that contrary to *a priori* expectation, the cost of fertilizer (technology application) had a significant positive effect on marketed surplus quantity but negative on production levels. This might be due to the difficulties with which farmers have to be able to gain access to existing technologies which hinder farmers from adjusting the production as per their expectation.

This result suggests that increasing the cost of fertilizer is likely to increase market output; however it is likely to negatively influence production levels. In general, the results showed that both economic and technological factors contribute to improving the supply responsive behaviour of farmers.

Consumer goods variables influenced marketed surplus quantities but had no statistically significant effect on the quantity of maize produced. Surprisingly, the result of the survey indicates that transport accessibility does not influence quantities of production and marketed surplus.

The majority of smallholder farmers are not able to gain access to loans from the formal financial institutions. In view of this, they rather rely on informal sources to support their consumption and farming activities. In other words these smallholders do not factor in the difficulties of borrowing from formal financial institutions since they know they will not be provided with such facilities.

Poor rural road networks and lack of vehicles could greatly slow down the production and distribution of food crops in the country. If farmers are unable to market their produce after a

good harvest, they are likely to reduce production in subsequent seasons. This will worsen the already soaring food crisis in Ghana.

The coefficient of determination, R^2 is 55% for the quantity of maize produced equation. This means that all the variables used in the regression model could explain about 55% of the variation in quantity of maize produced in the area during the survey. The R^2 for the marketed surplus model is 49%. This implies that 49% of the variations in the dependent variable- marketed surplus were due to the variations in the explanatory variables used in the model.

The regression result for quantities of cassava produced and marketed as surplus is presented in Table 3.

Table 3. Regression results for cassava supply function

Explanatory variables	Quantity produced	Quantity Marketed
Constant	9.0245 (4.032)	-5.925 (3.858)
Log Price Ratio PRm	0.883*** (5.047)	0.688** (2.869)
Log cost of cassava sticks	0.372 * (1.689)	0.793*** (5.680)
Log transport accessibilityRd	0.314** (2.712)	0.343 (0.128)
Credit C_i	0.119* (1.747)	0.130 (0.396)
Consumer goods C_0	-0.690 (0.70)	0.039 (0.118)
R^2	0.542	0.519
N	65	65
F-Statistic	17.297	18.897
F-Prop	0.0012	0.0020
Wald $\chi 2$	5.93	4.40

******** *Significant at 1%,* ****** *Significant at 5%and* ******* *Significant at 10%; t-statistics are in parenthesis.*
Source: Authors' own analysis, 2013

The result (Table 3) indicated that with the exception of consumer goods, all other explanatory variables employed in the production function influenced farmers' decision on the quantity of cassava to produce. For quantity of cassava produced, cost of sticks and credit were significant at 10% level whereas, transport accessibility and price ratio were significant at 5% and 1% respectively.

The R-square for this regression is 0.542 and this means that 54% of the variation in the quantity of cassava produced is explained by the variation in the explanatory variables. Also from the F-statistics and the probability value it can be concluded that the overall regression is significant at 1% significance level which means that at least one of the explanatory variables significantly affect quantity of cassava produced. Similarly in the case of the marketed surplus, the R-square is 0.519 which means that 51% of the variation in the marketable surplus of cassava is explained by the variation in the explanatory variables. For the explanatory variables the price ratio and the cost of planting material (cassava stick) are significant at 1% and 5% level respectively.

The values of the coefficients are elasticities hence considering the cost of planting materials; the coefficient indicated that if the cost of cassava sticks for planting increased by 1% the quantity of cassava produced and marketable surplus of cassava would also increase by 37% 79% respectively. In the case of price ratio a percentage increase will increase quantity produced by 88% and marketable surplus by 68%.

4. CONCLUSION AND POLICY IMPLICATION

This paper examined the supply response behaviour of two major food crop farmers (cassava and maize) on price and non-price factors in an important food growing districts of Ghana. The study provides evidence to support price incentives and non-price factors (e.g. infrastructural development) on supply response. It suggests that a strong complementary policy instrument involving price and non-price factors will provide fillip to agricultural productivity. Although rural infrastructure development is critical for agriculture development and therefore a priority for government, incentive price reforms must not be ignored if agricultural productivity is to be accelerated and sustained. The Government of Ghana is encouraged to adopt a holistic approach in terms of produce price and provision of stable price would influence and farmers' decisions the most. This is because the price elasticities of acreage/output are larger than that of the non-price factor elasticities.

The paper further revealed that access to credit, especially from the formal sector, is a challenge for most farmers in the study area. This discourages farmers from area and output expansion. As a necessary measure to support farmers, government is to encourage the adoption of the group loan scheme as the best alternative way of getting loans from the banks and other government institutions to farmers. Creditors (formal and informal) should make frantic efforts to look for ready markets for their clients (farmers) as an alternative for purchasing the produce themselves in order to recoup their loans.

The existing road network is in a deplorable state. Farm to village spurs are undeveloped. Farmers therefore carry head loads of goods from the bush to the village (house) before haulage to market centres. Government, through the District Assemblies should make an effort to improve the road networks in order to make the food producing areas accessible. The inadequate storage facilities in the rural communities also pose a serious setback to food production.

The survey revealed that the lack of such facilities compels many farmers to dispose of their produce at low prices during the harvest period or immediately after harvest. This reduces farmers' incomes and also daunts the interest in farming especially among the youth. Government must involve the local Government, Non-governmental organizations and other philanthropic bodies and individuals in the construction of silos, produce buying centres and the provision of transport facilities.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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