

Price and Non-Price Incentives and Food Crops Supply Response in Ghana

Abstract

Aim: This study examined 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 techniques was used to sample 250 farm households for the study. Structured questionnaire was used to solicit information from the sampled farmers on production and marketing of maize, cassava and other food crops. 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 this study indicate that food crop farmers respond favourably and promptly to any incentivized package (price or non-price factors) and this reflected in farmers' output and farm management practices.

Conclusion: It is therefore suggested that price and infrastructure policies should be implemented as complementarities rather than supplementing each other in the production functions.

Key words: price incentives, non-price factors, supply response, Ghana

1.0 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 un(der)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 (WDR, 2008). 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

39 residing in remote areas. Such increased productivity depends heavily on the kind of
40 public policy support and the attention government gives to the sector in terms of
41 budget and types of policy.

42 State policies as precursors for growth rely on the extent to which policy
43 makers and planners are informed about the real issues on the ground. Thus the
44 strength of farmers' responsiveness to the various incentives provided by policy
45 makers is critical (Nerlove, 1979) and requires systematic analyses to inform policy
46 makers about the performance of the sector. This raises questions about the extent to
47 which policy makers, planners and practitioners of agriculture are informed about
48 estimates of the supply response of the sector to the various policy instruments
49 implemented in respective countries. It leads to questions about aspects of agricultural
50 policies that are most important driver of agricultural productivity. The need to
51 provide this information is critical, particularly given that agriculture is the single
52 most important sector of the Ghanaian economy.

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

63 The absence of such information could lead to several problems including the
64 implementation of ad hoc policies which may not be based on any theory or reality
65 and this could lead to a bias against the agriculture sector (Bautista and Valdes, 1993).
66 The implementation of such ad hoc policies may be attributed to inadequate, or lack
67 of, information on agricultural supplies for policy makers to make the right decisions,
68 for example, whether to tax or not to tax agriculture. According to Lewis (1954), lack
69 of a suitable and effective model to measure agricultural production and productivity
70 in the 1950's contributed to the neglect of agriculture as a growth strategy for
71 economic development.

72 The response behaviour of smallholder farmers is characterized by use of
73 traditional inputs, rainfall dependent and inadequate capital investments has been
74 much debated, with no consensus established yet. As a way around the challenges,
75 supply response analysis has in recent years therefore emerged as an important tool
76 for measuring the effectiveness of agricultural policy-productivity linkages (Nerlove,
77 1979). This is evidenced by the use of supply response analysis in many structural
78 adjustment programme (SAP) reports of the World Bank (Krueger *et al.*, 1992).

79 In Ghana, governments have over the years supported farmers through diverse
80 price and non-price incentives as a way of enhancing production and productivity, and
81 stabilizing farm incomes, particularly among food crop farmers who are often counted
82 as the poorest among the various occupational groups in Ghana (PHC, 2000). The
83 poor status of these farmers if not enhanced may constrain agricultural productivity
84 thereby leading to stagnation in the growth of the general economy, whose growth has
85 been tied to the agriculture sector. It is in view of this, that a host of policy
86 instruments including substantial investments (in the form of price and non-price
87 incentives) have been made in the sector. While such investments are critical to
88 growth of the sector, the real success of such public investments is much dependent
89 on the farmers' responsiveness towards the incentives provided (Nerlove, 1979).

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

101 According to Mamingi (1996), the estimates of the coefficients of supply
102 response parameters provide policy makers and development planners with
103 information on policy impact on growth and poverty. A positive response, in terms of
104 direction and dimension measures the extent of agriculture growth with respect to the
105 crop under study. It is therefore hypothesised that a better understanding of supply

106 response models would provide leverage in explaining the dimension and direction of
107 agricultural policies on the economy.

108 Apart from the fact that studies in the subject of supply response behaviour
109 mainly concentrate on time series data and primarily on cash crops such as cocoa,
110 studies relating to supply response of Ghana's agriculture are dated. This study aims
111 at bringing supply response up to date through modifying the neo-classical supply
112 response model put forward by Nerlove (1958; 1979). The case of food crop farmers'
113 responsiveness to selected price and non-price policy variables was chosen for
114 obvious reasons. Because of data inconsistencies from various data sources; and to
115 eliminate temporal effects using time series data, the author employed cross sectional
116 information to examine farmers' responsiveness to agriculture price and non-price
117 factors or policy instruments. Thus the study employs empirical data from a farm
118 level cross sectional survey to estimate the elasticities of supply response of
119 production and marketed surpluses of smallholder farmers. This is carried out
120 contrary to the views that policies benefiting marketed surplus response are likely to
121 accrue to only large scale farmers.

122 After the economic decline experienced in the late 1970's and early 1980's
123 Ghana, like other sub Saharan African countries, had consistently designed and
124 implemented policies and programmes aimed at reviving and sustaining the economic
125 glory once enjoyed by the country in the 1950's and 1960's. Although agricultural
126 development policies in the country have undergone several revolutions, the
127 objectives have mainly remained unchanged (MTADP, 2000; GPRS I & II; FASDEP,
128 I&II; GSGDA, 2010). Principally, food and agricultural policies in the country have
129 included provision of food security by way of adequate and nutritionally balanced
130 diets at affordable prices for Ghanaians and promoting improvement in small holder
131 productivity and ensuring that efficient agricultural producers earn incomes that are
132 comparable to those outside the agriculture sector. Thus, making agriculture an
133 attractive employment alternative to industry, trade and commerce. It also aimed at
134 ensuring that agriculture contributes effectively to the country's balance of payments
135 through export diversification and import substitution through the establishment of
136 effective linkages between agriculture and industry. Furthermore, the policy intended
137 to promote balanced regional development and growth, based on regional
138 comparative advantages and resource endowment for agricultural activities.

139 In the second half of the 1990's through to the 2000's, the growth of the
140 agriculture sector and the economy in general gave the impression of renewed hope
141 for the country. However, a nuanced review of agricultural supply response literature
142 shows less than expected results. While some crops and sectors experienced positive
143 growth, others showed mixed results. Yet, despite the numerous reforms, not much in
144 terms of market development and productivity was seen to have been achieved.
145 Government's attempts at achieving acceptable rates of growth and development have
146 woefully failed (Aryeety *et al.*, 1997). The poor and discouraging performance of the
147 sector has been attributed to a number of factors ranging from low and poor
148 infrastructure development; low farm gate prices; high cost of production; non
149 availability of inputs among others; to wrong perceptions and attitudes towards
150 farming.

151 It is believed that non-price factors dominate over price or market incentives
152 in farmers' decision making (Gulati and Kelly, 1999) such that poor pricing is cited as
153 anti-increase productivity. Restricted market access may have been cited as retarding
154 growth in the sector; absence of proper road connections; or the distances involved in
155 transporting food crops from farm gate and urban markets is also acknowledged as
156 being critical. Thus, even though price is crucial, the significance of non-price factors
157 in improving agriculture cannot be discounted. Yet, in Ghana, there is no strong
158 evidence to support this assumption. This, however, does not suggest that there has
159 been no research on supply response in Ghana. Like both developed and developing
160 agricultural economies quite a number of empirical studies on supply response and
161 economic rationality of smallholder farmers have been conducted. The challenge
162 however rests with the nature and extent to which these farmers have responded to
163 changing dynamics of prices (inputs and outputs) and other non-price factors.

164 In Ghana factors usually cited as likely to influence and shape productivity in
165 the agricultural sector (especially food crops) are: the high cost of fertilizer and its
166 application; the high cost of consumer goods high population and high rate of urban-
167 rural drift; unpredicted soaring food prices; lack of rural infrastructure; and the stifled
168 nature of agro-supporting services like credit and storage facilities. Measurement of
169 reliable and accurate policy response with respect to the actual level of use and gains
170 of agricultural resources, and its impact on the economy is the surest salvage the
171 economy.

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 1.5 tons 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 (MTADP, 2000). 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 (SRID/MoFA, 2011). 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 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.

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2.0 The Study Area and Methodology

2.1 The Study Area

Ejura is approximately 100km north of Kumasi, the capital of the Ashanti Region. The area lies 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.

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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. However, since policy makers and planners have very little control over rainfall is assumed to be given. 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 Nerlove (1958). 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 constrained 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 (Nerlove, 1979; Maddala, 1971),.

This brings us to the second behavioural principle postulated by Nerlove (1958). 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.

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

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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 1-for the adjustment to converge over time. Since the convenience is not easy particularly in developing country like Ghana, this study allows γ 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

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

289

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 $t - 1$ 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 ($0 \leq \beta \leq 1$)

γ = Coefficient of output adjustment ($0 \leq \gamma \leq 1$)

μ_t = random disturbance term

α_0 and α_1 = unknown coefficients

Substituting equations [1] into equation [2] gives

305

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

307

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

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

310

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

313

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

315

316 (Askari and Cummings, 1977)

317 Where:

$$\delta_0 = \alpha_0 \gamma \beta$$

$$\delta_1 = \alpha_1 \gamma \beta$$

$$\delta_2 = (1 - \beta) + (1 + \gamma)$$

$$\delta_3 = -(1 - \beta) + (1 + \gamma)$$

$$V_t = \gamma \mu_t - (1 - \beta) \gamma \mu_{t-1}$$

323

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

329

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

331

332 Where, $\varphi_0 = \alpha_0 \gamma$

$$\varphi_1 = \alpha_1 \gamma$$

$$\varphi_2 = 1 - \gamma \quad (0 \geq \varphi_1)$$

$$\varphi_3 = \alpha_2 \gamma \quad (0 \leq \varphi_2 \leq 1)$$

$$V_t = \gamma \mu_t$$

337

Equation [7] represents the typical supply response equation documented in the literature of supply response analysis (Fosu, 1997). 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 Koustsoyiannis, 1979)

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. 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

3.0 Results and Discussion

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 1) shows that four variables employed in the model influenced both production and marketed surplus responses.

Table 1: Regression Results for Maize Supply Function

Explanatory variables	Quantity produced	Quantity Marketed
Constant	5.368 (1.923)	1.368 (2.233)
Log Price Ratio PR _m	1.100** (2.9152)	1.020 ** (2.757)
Log Fertilizer cost F _c	-0.580** (2.796)	0.520** (2.894)
Log transport accessibility R _d	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 χ^2	23.454	17.87

*** Significant at 1%, * *Significant at 5% and *Significant at 10%; t-statistics are in parenthesis.

Source: Authors' analysis, 2013,

The study shows that while the variables for cost of fertilizer, price factor and storage were significant at 5% significant level, the credit variable is significant at the 1% level of significance for both responses. 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.

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

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

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

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

408 Poor rural road networks and lack of vehicles could greatly slow down the
409 production and distribution of food crops in the country. If farmers are unable to
410 market their produce after a good harvest, they are likely to reduce production in
411 subsequent seasons. This will worsen the already soaring food crisis in Ghana.

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

418 The regression result for quantities of cassava produced and marketed as
419 surplus is presented in Table 2.

420
421

Table 2: Regression Results for Cassava Supply Function

Explanatory variables	Quantity produced	Quantity Marketed
Constant	9.0245 (4.032)	-5.925 (3.858)
Log Price Ratio PR _m	0.883*** (5.047)	0.688** (2.869)
Log cost of cassava sticks	0.372 * (1.689)	0.793*** (5.680)
Log transport accessibility	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 χ^2	5.93	4.40

*** Significant at 1%, ** Significant at 5% and * Significant at 10%; t-statistics are in parenthesis.

Source: Authors' analysis, 2013,

The result (Table 2) indicates 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 are 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

444 and the cost of planting material (cassava stick) are significant at 1% and 5% level
445 respectively.

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

452

453 **4.0 Conclusion and policy implications**

454 This paper engages with the supply response behaviour of two major food
455 crop farmers (cassava and maize) on price and non-price factors in an important food
456 growing districts of Ghana: the Ejura District of the Ashanti Region. The paper
457 provides evidence from a study which suggests apparent complementarity between
458 price incentives and non-price factors (e.g. infrastructural development) on supply
459 response. It suggests that a strong complementary policy instrument involving price
460 and non-price actors provides fillip to agricultural productivity. It was observed that
461 while rural infrastructure development was critical for agriculture development and
462 therefore a priority for government, incentive price reforms must not be ignored if
463 agricultural productivity is to be accelerated and sustained.

464 Government should adopt a holistic approach in terms of produce price and
465 provision of that could probably influence and farmers' decisions the most. This is
466 because the price elasticities of acreage/output are larger than that of the non-price
467 factor elasticities.

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

476 The existing road network is in a deplorable state. Farm to village spurs are
477 undeveloped. Farmers therefore carry head loads of goods from the bush to the village

478 (house) before haulage to market centres. Government, through the District
 479 Assemblies should make an effort to improve the road networks in order to make the
 480 food producing areas accessible. The inadequate storage facilities in the rural
 481 communities also pose a serious setback to food production.

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

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