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RESPONSE OF RICE OUTPUT TO PRICE AND NON-PRICE FACTORS IN GHANA

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ABSTRACT

The objective of this study was to assess the magnitude and effect of various price and non-price factors on output of rough rice in Ghana for the period 1966-2009. Coefficients of the output response model were estimated through the ordinary least squares (OLS) and tested for stability and appropriate standard Gaussian properties. Output of rough rice was found to be positively and significantly driven by increases in harvested area, yield, own price and world price of rice with important indirect effects to producers. It however decreases with unit increases in the price of maize, urea fertilizer and with increasing state involvement in the rice market through nominal rate of assistance. Supply of local rice in Ghana could be improved through vigorous pursuance of intensification and area expansion and appropriate transmission of prices to farmers with least distortion.

***Keywords**: Output response, nominal rate of assistance, rice supply, Ghana*

1.0 INTRODUCTION

In pursuit of enhancing food security and reducing poverty in Ghana, past and present governments have devised (initiated) and implemented policies and projects to develop and ensure a continuous contribution of the agricultural sector to the economic development of the country. A very important commodity that has received much attention in the past and still remains a strategic commodity in the country is rice. Rice has become the second most important staple food in Ghana after maize, with its consumption increasing substantially since the late 1990s. Beside its important role in the diet of the average Ghanaian, rice through production, processing and marketing serves as a source of livelihood for most of the rural and some sub-urban dwellers (majority of which are women).

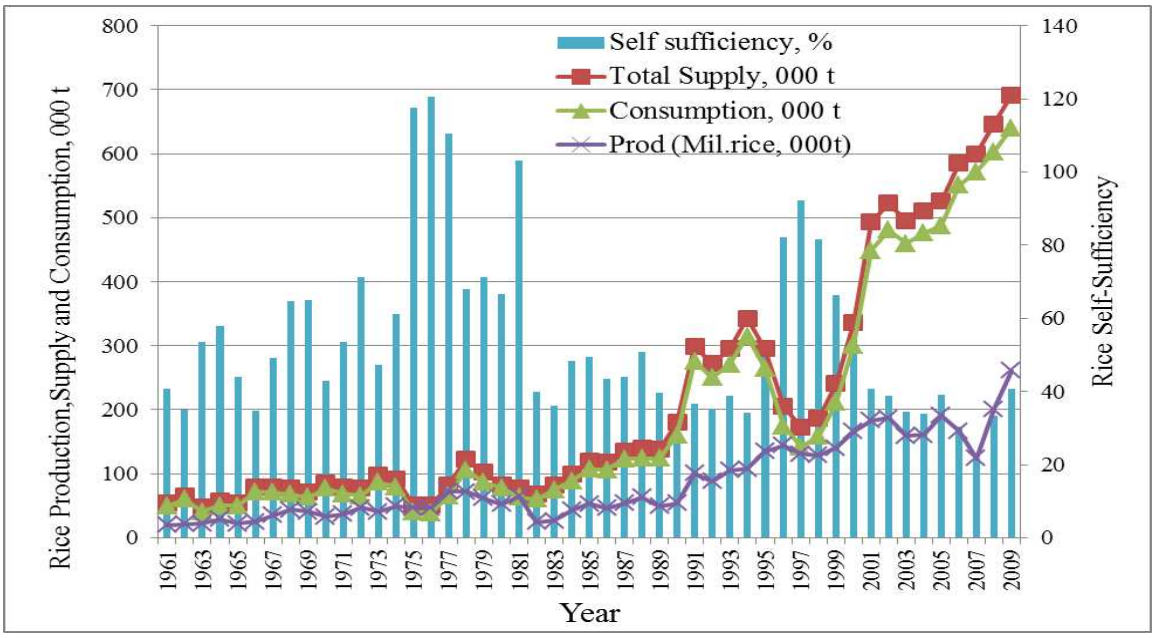
Having been identified expressly as a political crop in Ghana, protection measures and incentives (both price and non-price) have been applied towards revitalizing the local rice industry after its gradual collapse in the early 1980s (on-set of trade liberalization and structural adjustment program). In spite of all efforts put in place so far, the local rice industry has failed to catch up with expectation, as local rice production lags well behind demand. By the present state of the local rice industry, over 60% of domestic consumption is met through imports. The increasing quantities of rice imported into the country (driven by increasing demand and low domestic production) drains not only foreign exchange, but through an unbalanced competition, leads to a decrease in profitability of local rice (Asuming-Brempong and Osei-Asare, 2007) and exposes the country to shocks on the international market by virtue of its high dependence on rice imports.

To help reduce this draining of foreign exchange and mitigate the hardship created on local rice farmers, a 'National Rice Development Strategy' was initiated in 2009 with primary goals of doubling output of local rice and reducing imports by 50% (latest by the year 2018). To contribute towards the achievement of doubling of rough rice output, this study estimates the output response of rice for Ghana using secondary data scoping the years 1966 to 2009.

1.1 RICE CONSUMPTION AND PERFORMANCE IN SUPPLY

Per capita rice consumption of rice (*Oryza spp. L*) in Ghana increased from 17.5kg per annum between the years 1999 and 2001 to 22.6kg per annum between the years 2002 and 2004 (Amanor-Boadu, 2012). By the year 2011, it had reached 38kg per annum and is anticipated to reach 63kg per annum by the year 2015. Like other West African countries, Ghana which was virtually self-sufficient in rice during the mid-1970s now accounts for approximately 40% of its domestic rice supply and consumption needs, with the gap between demand and domestic production widening since the late 1990s

Figure 1.0 Demand and Supply of rice in Ghana



Source: Author's construct with data from IRRI- (World Rice Statistics, FAO data)

Bridging of this gap has been the major focus of rice policy since the year 2001. Asuming-Brempong (1998) suggested that Ghana has comparative advantage of paddy rice production over other countries in the sub-region, yet in spite of the abundant resources at its disposure, rice production as seen from fig.1.0 lags well behind demand (a similar situation is been observed in almost all the coastal West African countries)

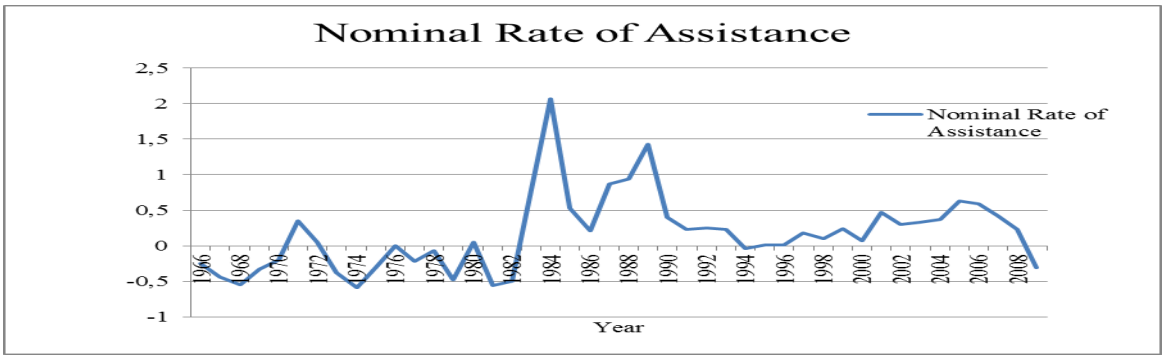
1.2 RICE POLICY AND GOVERNMENT ASSISTANCE

The focus of rice policy pre-SAP (Structural Adjustment Program) period was to help achieve self-sufficiency in rice and to maintain adequate buffer stocks for price stabilization and food security in periods of shortfall. The rice sub-sector during the periods between 1957 and 1982 received much support in the form of subsidies on inputs like tractor and fertilizer. The then government's support in subsidizing the purchase of tractors was directed towards mechanizing rice production in Ghana. These supports were however withdrawn in 1983, by virtue of political developments in the country which resulted in a major change in the economic policy of the country. This period marked the beginning and adoption of the Structural Adjustment Program (SAP). The SAP involved a progressive liberalization of both internal and external trade, a partial abolition of controlled prices, privatization of certain state monopolies and a progressive withdrawal of subsidies (Kranjac-Berisavljevic *et al*, 2003). This consequently led to a drop in profits accrued to commercial farmers and a progressive disengagement on their part. The SAP in addition, led to a collapse of institutional arrangements

responsible for the development and maintenance of seed multiplication and units for variety improvements. Major Rice mills across the country during the aforementioned period also collapsed.

Several policy measures and projects including 'Ghana Agricultural Policy: Action Plan & Strategies', 'Agricultural Services Rehabilitation Project (ASRP)', 'Medium Term Agricultural Development Program (MTADP)' and 'Food and Agricultural Sector Development Policy (FASDEP I and FASDEP II)' have all played parts in helping revitalize the rice-subsector. These policies and projects have been implemented alongside other protection and trade measures in the form of tariffs to importers, tax on consumers and subsidies or tax to producers of rice

Figure 2.0 Nominal Rate of Assistance to the rice sub-sector of Ghana



Source: Author's construct with data from Anderson and Nelgen (2012)

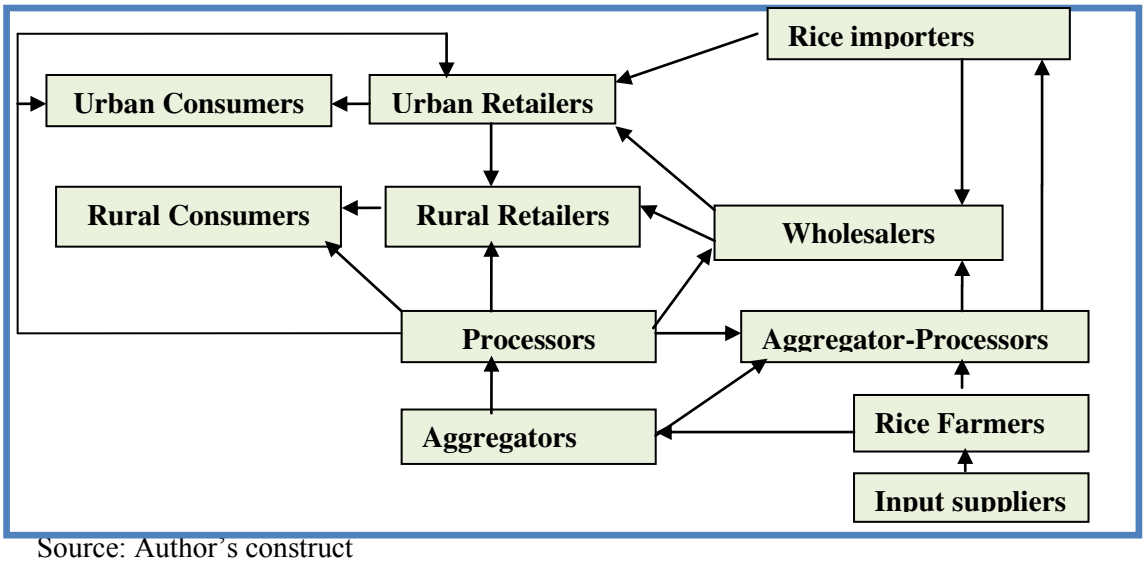
With the current focus of the initiated National Rice Development Strategy (NRDS) on doubling local rice output and reducing the influx of imported rice on the local market, rice imports currently attract the following duties and levies; 20% import duty, 12.5% Value Added Tax (VAT), 2.5% National Health Insurance Levy (NHIL) collected by the VAT secretariat, 0.5% Export Development and Investment Fund Levy (EDIF), 1% Inspection fee, 0.5% Export Development and Investment Fund Levy (EDIF), 1% Inspection fee, 0.5% ECOWAS Levy, and 0.4% Ghana Customs Network (GCNET) (Rondon and Ashitey, 2011). These duties and levies were withdrawn in 2008 due to the commodity crisis observed in that year, but were reinstated in 2010 in pursuit of achievement of the goals of the NRDS.

Plans towards doubling of output of local rice are currently being implement through promotion of productivity enhancing innovations of small and commercial rice producers and enterprises along the value chain, promoting consumption of local rice through quality improvement, value addition and domestic and regional marketing, and promotion of stakeholder innovation capacity for the utilization of rice by-products while ensuring sound environmental management practices (Ramesh and Jamie, 2011)

1.3 RICE MARKET STRUCTURE

The rice market in Ghana is characterized by two major distribution channels; the local rice channel and the imported rice channel (with the latter holding much grounds in urban markets which according to MiDA accounts for 76% of total rice consumption in the country). Taking into account input use, the local rice channel is made up of input suppliers, local rice producers, aggregators, local rice processors, rice wholesalers ('aggregator-processors'), rural/urban retailers and rural/urban consumers. The imported rice channel comprises rice importers, imported rice wholesalers/rice wholesalers (some of which deal also in local rice), urban/rural retailers, and urban/rural consumers.

Figure 3.0 Rice Distribution Network for Ghana



Source: Author's construct

Most of the inputs used in cultivation of rice (including fertilizers and pesticides) are imported into the country and marketed through wholesale and retail input distributers. Movement of output on harvest from the farm gate to the final consumer goes through aggregators, processors (and sometimes aggregator-processors – thus aggregators who are also into processing and usually have formal contracts with rice importers who deal also in the sale of local rice), wholesalers, rural and urban retailers, and then to the final consumers. Most of the distribution and power in the local rice channel is centered on the wholesalers, who mostly influence the degree of profit (price) transmission to the respective actors in the chain based on their expectation about the retail market prices (Amanor-Boadu, 2012). Concentration of power on the wholesalers and at times processors is attributed to poor market information on the part of producers, retailers and other agent in the distribution network. Low bargaining power on the part of producers has been attributed as well to limited storage and processing infrastructure and poor roads leading to and from most rice producing areas (Fintrac Inc., 2012).

On the import side, importers are believed to have power advantage on the wholesalers due to their relative size, capital position and access to relevant and timely information (Amanor-Boadu, 2012). In this channel, rice is distributed either through wholesaler to retailers and then to consumers, or directly from the import hub to retailers and then to consumers. With the highly segmented nature of both distribution channels and the concentration of power on the wholesalers and importers, increments in price of rice have been reported by Amanor-Boadu to benefit importers and wholesalers than they do producers and consumers. This could in a way preclude the achievement of goals for implementing protection measures through tariff imposition.

2.0 MODEL SPECIFICATION AND DATA

In the current study, output response of rice for Ghana is estimated based on the following equation:

$$PROD_t = \beta_0 + \beta_1 HA_t + \beta_2 PPR_{t-1} + \beta_3 PPM_{t-1} + \beta_4 WPU_{t-1} + \beta_5 WPR_t + \beta_6 YLD_{t-1} + \beta_7 NRA_{t-2}$$

$PROD_t$ - rough rice output ('000' tonnes),

HA_t - harvested area of rough rice ('000' hectares),

PPR_{t-1} - lagged nominal producer price of rice (Standard Local Currency Unit),

PPM_{t-1} - lagged nominal producer price of maize (Standard Local Currency Unit),

WPU_{t-1} - lagged price of urea fertilizer, world price as proxy for local price (US$/t fob),

WPR - world price of rice with important indirect effects to producers (US$/t fob)

YLDt-1- lagged yield of rough rice (tonnes/hectare)

NRA_{t-2} - two-period lag of nominal rate of assistance (%)

Data (1966-2009) on all the variables were collected from the IRRI website (World Rice Statistics) and the agricultural production database of the FAO (FAOSTAT). Nominal local rice and maize prices in Local currency Units (LCU) were converted to Standard Local Currency Units (SLC) using the FAO conversion factor of 1GHS=10000 GHC. World price of urea was used as a proxy for local price due to difficulty in accessing time series data on local price of urea fertilizer, and due to the high dependence of Ghana on imported fertilizer and other inputs for production. Prior to estimation of the regression equation (with all variables in the log form except nominal rate of assistance (NRA)), the whole set of data was verified to ascertain the order of integration of the individual series, as this is a vital step in the data generation process and choice of estimator.

3.0 RESULTS

Both the Augmented Dickey-Fuller and Phillips-Perron tests employed for verification of the data showed that all the variables are non-stationary at level, but become stationary at first difference. With no *I*(2) variable(s) found in the data set, the regression equation was estimated using the Ordinary Least Squares (OLS) estimator, followed by series of diagnostic tests to avoid spurious results.

Table 1.0 Unit root test of variables (ADF and PP tests)

	Level		First difference	
Variables	ADF	PP	ADF	PP
PROD	-3.047616	-3.105479	-6.754375***	-8.169903***
HA	-3.453404	-3.416014	-8.517481***	-8.991357***
PPR	-0.772423	-0.713302	-6.237591***	-6.232334***
PPM	-2.589135	-2.623278	-8.462564***	-8.588702***
WPU	-2.520567	-2.630823	-5.314694***	-8.588702***
WPR	-2.399102	-2.346208	-5.227777***	-5.619573***
YLD	-3.447409	-3.309861	-10.35932***	-11.39051***
NRA	-3.403103	-3.389963	-6.746493***	-9.662176***
Critical value	-3.518090	-3.518090		

NB: 95 percent confidence level for critical value, ***1%

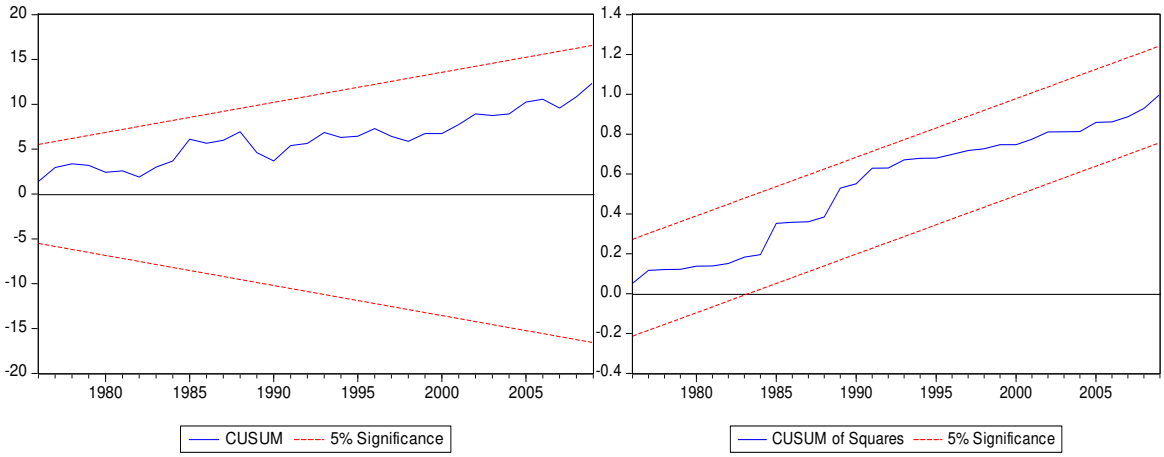
Diagnostic tests for normality, serial correlations, structural stability and misspecification of the functional form through a Reset test were applied, and the results show that the regression equation passed all the diagnostic tests and the insignificant value for the Rest tests reflects correctness of the estimated regression equation. The Jarque-Bera test for ascertaining normality in the distribution of the residuals gave a value below the critical value, thus, implying that the residuals are normally distributed. Both the Breusch-Godfrey serial correlation LM test and the Q-stat values indicated that there is no first or second order serial correlation in the residuals, with the ARCH test signaling a homoscedastic nature of the residuals. To affirm the reliability of the estimates (thus the result is not spurious one), the residual series was tested for stationarity through the Augmented Dickey-Fuller test. The result showed that the residual series is stationary, with the ADF statistic being significant at the 1% level.

Table 2.0 Estimates of output response of rice for Ghana

Variable	Coefficient	t-Statistic	
Intercept	0.697327	1.276678	
Log (HA_t)	0.775182	7.315647***	
Log (PPR_{t-1})	0.304639	3.076503***	
Log (PPM_{t-1})	-0.255163	-2.432065**	
Log (WPU_{t-1})	-0.179042	-2.191515**	
Log (WPR_t)	0.220308	1.969670*	
Log (YLD_{t-1})	0.449187	3.613680***	
NRA_{t-2}	-0.103105	-1.824536*	
Adj. R^2	0.930259	F-statistic	79.12672
Durbin-Watson Stat	2.087081	Prob (F-statistic)	0.000000
Jarque-Bera	3.983157	Log Likelihood	19.94146
B-G LM F-stat (1):	1.2296 (0.2755)	Akaike info criterion	-0.568641
F-stat (2):	1.6264 (0.2125)	Schwarz criterion	-0.237656
Q-Stat (1):	0.6698 (0.413)	Hannan-Quinn criter.	-0.447322
(-2):	2.2194 (0.330)	Mean dependent var	4.770077
ARCH Test: F-stat:	0.0328 (0.8573)	S.D dependent var	0.633434
Reset Test	: 1.7495 (0.1950)	S.E of regression	0.167281
ADF of residual	: -7.322345***	Sum squared resid	0.951419

***1%, **5%, *10%

Figure 4.0 CUSUM and CUSUM of Squares Tests



In analyzing the stability of the estimated coefficients, the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUM) were applied, and the results showed that they remain within the 5% boundary. According to Bahmani-Oskooee (2001), this shows that the regression equation is correctly specified and the estimated coefficients are stable.

In interpreting the result, the individual effects of the variables on output of rice were all found to be significant. A total of about 93% of variations in output of rice in Ghana is explained by dynamics in the variables for the estimated equation. The result indicates that area cultivated was significant at the 1% level, with elasticity of 0.775, implying that a one percent increase in area cultivated of rice will lead to a 0.775% increase in output of rice. An increase in the area cultivated of rice could lead to appropriate and efficient use of the abundant labor available in the country, exploitation of economies of scale and pave room for mechanizing production of local rice as this technology is been precluded by the current small sizes of farms. The small sizes of current holdings are attributed in greater part to

the current land tenure system which limits size of holdings and investment towards land improvement and to lack of access to credit on the part of farmers (with high interest rates on those available).

The own price elasticity of 0.305 was found to be significant at the 1% level, with that for the competitive field crop (maize) -0.255 being significant at the 5% level. An increase in the farm gate price of local rice increases the financial base of farmers and allows them to meet some vital production cost which consequently leads to the positive effect on output. Increases in the farm gate price of maize however, lures farmers to reallocate or withdraw vital inputs from rice production into maize production in pursuit of making better returns as rational beings. This consequently leads to the obvious adverse effect on output. An increase in the price of urea fertilizer, leads to a 0.179% decrease in output of rough rice and this decrease is significant at the 5% level. Fertilizer is a very vital input in rice production and its optimum use ensures sustainable yields and output if complemented with other vital inputs of production like pesticides, water supply (either through rain or irrigation) and labor. With rice farms in Ghana currently been reported to be low in productivity and farmers being generally poor, a further increase in the price of fertilizer will reduce the purchasing power of the farmers on the amount they are able to purchase and the inability of farmers to adequately meet the nutritional needs of the rice plants would result in an adverse impact through excessive competition by the plants for the limited nutrients stalled in the soil.

An increase in the world price of rice leads to a 0.220% increase in the output of local rice and this increase is significant at the 10% level. This resultant effect is attributed to both internal and external influences. With Ghana being highly dependent on rice imports, an increase in the world price of rice would *ceteris paribus* make imported rice more expensive and could result in a decrease in the amount imported into the country. This would to some extent reduce the level of competition on the local market, increase the share of local rice on the market and incite appropriate investment in local rice cultivation. Increases in world price of rice would reflect as well through the imposed *ad valorem* tariffs on imports in the wholesale prices of local rice and a consequent increase in the farm gate price based on the degree of transmission. A unit increase in yield of rice leads to a 0.449% increase in output. Increases in yield (output per unit area) reflects increase in productivity of farmer's fields as a result of increasing fertility of the fields, better control of pests, weeds and diseases and adequate supply of water to the plants. Observation of improvements in these dimensions would under normal circumstances have the obvious positive effect on output.

Governments of major importing and exporting countries have intervened in agricultural and food markets for several decades with the aim of ensuring welfare for both producers and consumers. Such interventions have mostly been in the form of distortion through subsidy and taxes. The effect of such distortions are believed to differ between major and minor importers and exporters and to depend on whether there exist or not intermediate inputs on the production side. As a relatively small importer of rice, distortions in the rice sub-sector of Ghana through nominal rate of assistance is seen to have an adverse effect on rice production, contrary to the positive effects observed in most major importing countries. Distortions through imposition of high tariffs on rice imports as is observed for Ghana was confirmed by Amanor-Boadu (2012) to rather have beneficial effects for rice importers and wholesalers than they do producers and consumers, thereby resulting in failure of the purpose for imposition of such a restriction measure. This adverse effect could as well be due to the highly segmented nature of the market and the corresponding poor transmission of price and profit shares. A 1% increase in the nominal rate of assistance leads to a 0.103% decrease in output of rice, and this decrease was found to be significant at the 10% level. Price support through nominal rate of assistance on the part of government for a small importing country like Ghana is seen therefore to do more harm to the rice sub-sector than good.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Rough rice output in Ghana is found to be driven by changes in area cultivated of rice, own price and price of competitive field crop (maize for the current study), price of urea fertilizer, world price of rice with important indirect effect to producers, productivity of farmer's fields (captured through yield) and

nominal rate of assistance to farmers. As a small importing nation, nominal rate of assistance is observed to have adverse effect on output of rice and increments in prices through such distortions do benefit importers and wholesalers than they do consumers and producers due to poor transmission by virtue of the highly segmented nature of the market, poor assess of farmers to market information, limited processing and storage facilities in the country (which influences the bargaining power of farmers), poor access to markets due to underdeveloped road infrastructure, and likely increases in price of intermediate inputs of production. The poor nature of roads to and from some producing areas have been reported by Fintrac Inc. (2012) in a USAID funded project "Enabling Agriculture Trade" to lead to a 5% to 10% decrease in price paid for paddy rice in such areas . A positive effect in assistance may be observed in major importing countries with better market structure which allows for appropriate transmission of price increments and have direct offsetting measures in place to mitigate any adverse impact of increases in price of intermediate inputs.

Local rice supply could be improved through vigorous pursuance of intensification and area expansion and appropriate transmission of prices to farmers with least distortion. Price support and control which cause distortions in the rice market need to be minimized. The focus of future research could be on how best this could be achieved or on estimating the optimal rate to use in order to mitigate the adverse effect of state assistance. To achieve sustainable output of rough rice, measures should as well be put in place to improve upon the current fertilizer subsidy structure to ensure adequate and efficient use of fertilizer in rice production.

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