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PRICE AND NON-PRICE DETERMINANTS AND ACREAGE RESPONSE OF RICE IN CAMEROON

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ABSTRACT

Rice is now a commodity of strategic significance in Cameroon, driven by changing food preferences in the urban and rural areas and compounded by increased urbanisation. This study estimates supply response coefficients for rice in Cameroon. It is observed that the rice area grown may increase 1.35% for a ten percent increase in relative world price to producer price. A ten percent increase in relative price of substitute maize crop accounts for 1.17% decline in rice area exploited. Stepwise examination of the effects of price, weather and governmental expenditure reveal that in the short-run a ten percent increase in current governmental expenditure for agriculture will increase area grown by 1.35% and 1.15%, respectively. Irrigation could enhance area by 0.74% for ten percent increase in irrigation effort. The area supply response coefficients provide important implications for both expansions of local market and land resource availability. Increased competition could provide additional incentive for enhancing supply pursuant to changes in policies and institutions.

Keywords: Cameroon, rice, cultivated area, producer price, world price.

1. INTRODUCTION

Significant amount of government budget is allocated annually by government agencies, in providing price and non-price incentives. The success of such effort hinges, inter alia, on how strongly the agricultural sector responds to the various incentives provided (Salassi, 1995). The knowledge on the extent to which the agricultural sector responds is not only important in understanding the dynamics of production, but also for planning public programmes mindful of the producer behaviour and response to prices (McKay *et al.*, 1999). Rice is now a commodity of strategic significance in Cameroon, driven by changing food preferences in the urban and rural areas and compounded by increased urbanisation. As shown in Figure-1, the value of production for rice, in comparison to maize, cassava and potato commodities at constant (1999-2001) prices, increased from the 1960s to the end of the 1980s. In 1970 the value of rice output was about 1.6 billion FCFA, which more than doubled to 5.4 billion in 1980. In 1990 it was estimated at 6.6 billion and 7.3 billion in 2000. However, since the mid 1990s, growth in rice production has been slower than that of other food crops.

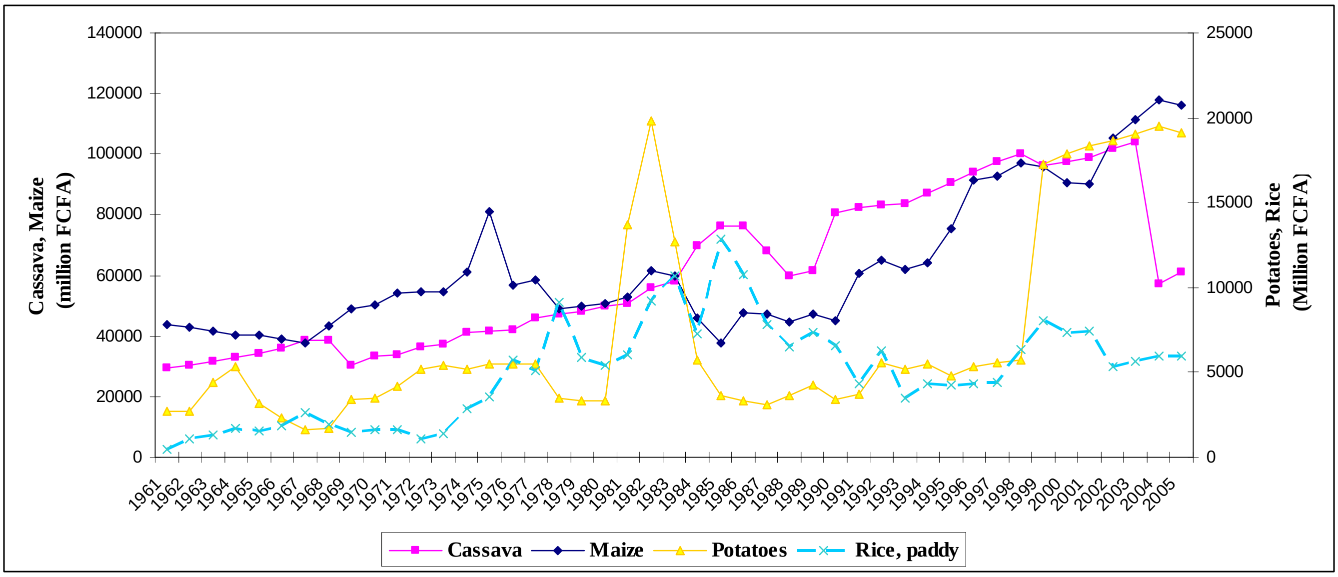

Figure-1: Agricultural production value for rice and other crops (1999-2001 constant prices) (Source: Authors' construction using FAOSTAT, 2008).

While the central African sub-region consumes an annual total of 340,760 tons of rice, Cameroon consumes the highest quantity; 170,900 tons per year, followed by the Democratic Republic of Congo 65,500

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tons, the Central African Republic consumes the least-6500 tons. Constrained by a doubling population, the per capita production has not kept pace with local and regional export demand. Rice producers and other stakeholders are concerned on the inadequate response of the sector (Goufo, 2008). Nowhere is the struggle for increased output more desperate than in the Ndop plains in the Northwest region, and the rice fields in the North-western and Northern regions, home to about 60% of Cameroon's rice growers (Ngwa, 1987). In 1994 about 16,847 ha was under cultivation across the country. In 2004, about 15,193 ha of rice was cultivated, as shown in Figure-2, indicating a decrease of 9.8% (FAO, 2008). Less than 25% of the agricultural surface area is used for the production of rice. In the Ndop plains and in the Northwest region in general, almost 25,000 ha of land is available for production. In 2007, only 3000 ha of the available area were cultivated, which is about 9% of available land.[1] Against this backdrop, the average supply in the country is 273,000 tons, i.e. 61,279 tons of local production and 211,720 tons of imported rice (ACDIC, 2006). The insufficiency in production partly arises because of the simplicity of production systems. Rice is grown principally on small family farms with average size typically less than two ha mostly to meet family needs; hence the marketed surplus is small.

[1]The production cost shows that for irrigated rice, SEMRY observed average yields of 5 tons per ha, a farm unit cost of $765 per ha and annual production cost of $53 per ton. SODERIM another major rice producer observed yields of 4.3 tons per ha, farm costs of $953 per ha and annual production of $222 per ton. These contrasts with UNVDA's yield of 3.9 tons per ha, farm unit cost of $529 per ha and annual production cost of $137 per ton (FAO, 2007).

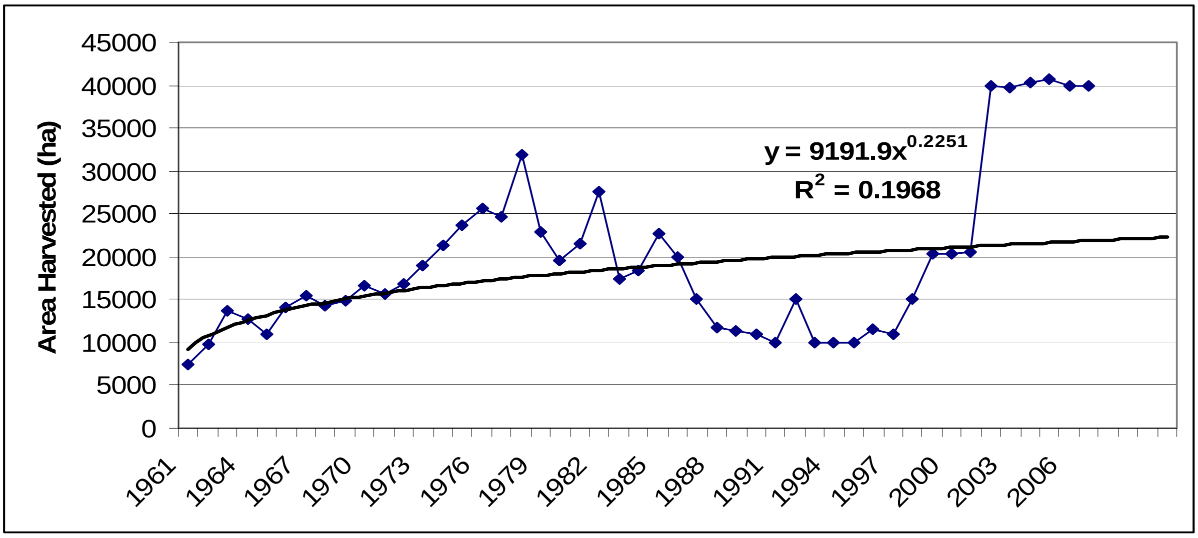

Figure-2: Rice Area Harvested in Cameroon, 1961 - 2008
(Source: Authors' computation using FAOSTAT, 2008)

To meet production shortfall and consumption need, the country relies on importation which steadily increased over the years to reach 360,000 metric tons in 2006, as internal production could only cover 17% of the country's needs in rice (Figure-3). At the same time per capita consumption increased from 13.6 in 1996 to 22.4 in 2006 (FAO, 2007). About 70% of domestic rice production is in the Northern region of the country and 30% in the Northwest and West region with 90% of the crop under irrigated lowlands, 8% in rainfed lowland and 2% in uplands. Upland rice is grown as a mono-crop or intercropped with other food crops following the slash-and-burn shifting cultivation. Rainfed rice production is practiced mainly by women on small plots (Fonjong and Mbah-Fongkimeh, 2007). The irrigated rice production is most structured and was supported with mechanisation and input supply. The support to irrigated rice production has been declining in recent years (FAO, 2006).[2]

[2]A number of improved rice varieties has been released by national and international research centres for cultivation in the country. Some of the irrigated varieties include: B 21616-MR-57-1-3-1, BKN 7033-3-3-323, CICA 8, CISADANE, I KONG PAO, IR 20, IR 24, IR 28, ITA 212, ITA 222, ITA 300, ITA 306, AYA, TAINAN 5 and TOX 3344 (FAO, 2007). Other rainfed lowland varieties include: IR 46, IR 7167-33-2-3, TS X 176 (FAO, 2007). NERICA varieties released in Cameroon include WAB450-I-B-P-135-HB; WAB450-I-B-P-153-HB; WAB450-I-B-P-163-HB; WAB450-I-B-P-33-HB and IDSA10. Non-NERICA WARDA breed upland rice varieties in Cameroon include WAB96-1-1 and WAB384-B-B-3-1-2 which are characterised by weed competitiveness and high yield (Defoer *et al.*, 2004; WARDA, 2007).

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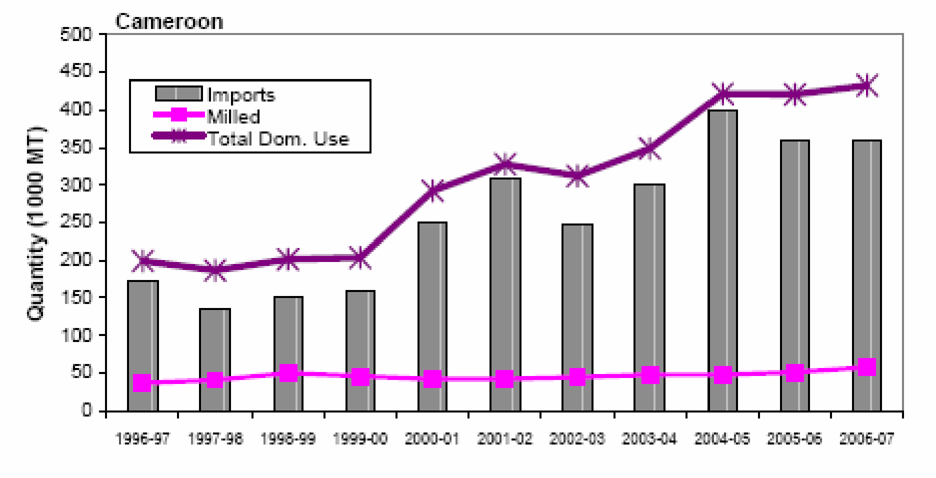

Figure-3: Evolution of rice production, import and domestic use in Cameroon, 1996-2007 (Source: FAO, 2007).

As of 2000, the farming population in Cameroon was estimated at about 8 million (FAO, 2003). Currently, about 25% of food-crop farmers operate about 0.2 million hectares of rainfed upland rice in humid and dryland zones of the country. Some 80% of the upland cultivation is slash-and-burn agriculture. The majority of upland rice farmers in the country are women. Studies of the determinants of agricultural supply and marketed surplus generally indicate important roles for price and non-price, or structural factors. For example, Kanwar (2004), Barten and Vanloot (1996), Tarp (1990), Binswanger *et al.* (1989), Chibber (1988) and Abou-Talb and El Begawy (2008) emphasise the importance of price and non-price variables for the response of agriculture. Chowdhury and Herndon Jr (2000), for instance, shows from an acreage response model for rice-growing states in the USA, a significant inverse relationship between the rice acreage planted and policy-inducing prices (market price, target price and loan rate) in all of the rice-growing states in the USA, with the exception of Louisiana. For Cameroon, an important food supplier for the Central African Economic Zone, establishing the nature of supply response is important. The goal of this study is therefore to estimate supply response coefficients for rice, and establish impact levels for other determinants of supply response. Reliable estimates of the determinants of rice production in a scenario of rising demand and deregulated trade are essential for policy decision to foster agricultural development.

2. METHODS

Supply response could be assumed to be equivalent to response of acreage under cultivation to changes in economic and non-economic factors (Cummings, 1975; Holt, 1999). An implicit supply response function is expressed as:

$$A_t = f(P_t^d, P_t^w, Y_t, R_t, W_t, G_t^x, u_t)$$

Where A_t is the acreage, P_t^d is the producer price for local rice, P_t^w is the global price of rice with important indirect effects to local producers, Y_t is the yield, R_t is the exchange rate of Cameroon currency to foreign currency, W_t weather condition (e.g. rainfall), G_t^x is government expenditure on agriculture, μ_t is the stochastic error term assumed to be independently and normally distributed with zero mean and constant variance. A *priori* it is expected that area cultivated varies positively with producer price of local rice, but it could fall with the strengthening of the local currency against major currencies. Area is expected to vary positively with expected yield but it could either rise or fall with changes in rainfall depending upon whether or not there is a normal rainfall or flood or drought. Relative rather than absolute prices and irrigation could be better account for acreage response (Kumar and Roy, 1985; Ahmed, 1986; Mahmood *et al*., 2007).

The data used in this study covers the period 1961-2006. Data on rice output (paddy equivalent) and irrigation are obtained from the FAO online statistical database, FAOSTAT. Information on producer prices for local rice and maize are obtained from Ministry of Trade and Industrial Development (MINDIC, 2006). Information on government expenditure on agriculture used to capture incentives to farmers is obtained from the Annual Statistical year book from the Ministry of Economy and Planning. Time series information on rainfall is obtained from the FAO's Africa Rainfall and Temperature Evaluation System (ARTES). This data is generated for countries by the National Oceanic and Atmospheric Association's Climate Prediction Centre based on ground station measurements of precipitation and temperature. In this study the coefficient of variation of wet season (May - October) rainfall measured in millimetres is used. The importance of irrigation is tested, with information on irrigated area obtained from FAO (2008).

3. RESULTS AND DISCUSSIONS

On assessing the acreage response, previous years' land size and yield, as well as price and weather effects do have significant influence on area cultivated.[3] As shown in Table-1, the significant positive coefficient of lagged acreage indicates that last year acreage affected the current year acreage. The lagged yield has positive relationship with acreage. Weather in terms of rainfall has a strong positive effect, so also is the public investment variable. The positive coefficient of lagged rice price ratio in the acreage equation bears direct relationship with rice acreage, and indicates that price do influence area under cultivation. The elasticities of world price to domestic price ratio on rice area cultivated are 0.158, 0.168, 0.149, 0.126 and 0.113. The significant positive relationships suggest that world market price for rice has complementary direct relationship with rice holdings in Cameroon. Regarding cross price effects, the coefficient of lagged substitute crop price to world price has expected negative sign and is significant at 10 percent level suggesting a competitive inverse relationship with rice acreage in Cameroon. A ten percent increase in the relative international price of maize leads to a reduction of 1.37%, 0.347%, 0.26%, 0.314%, 0.33% or 0.41% respectively, of the area allotted for rice.

The elasticities of government expenditure in agriculture are 0.113 and 0.108, respectively, thus indicating that the role of government's broad effort in agriculture significantly affects the rice sub-sector with the signals are felt in area increases. Comparing the results across Table-1, the acreage response for rice is generally observed to be positive and small. This connotes that there is a trend to bring more area under cultivation as factors of price and weather, for instance, are perceived to be favourable. However, whether this translates to significant improvements in output will depend on the employment of complementary factors of production of fertiliser, high yielding rice varieties, farm chemicals, improved cropping techniques and better farm management methods.

[3]To obtain reliable estimates for the experiment, a test is first test carried out if there is an equilibrium relationship of the variables Hallam *et al*., 1994). The null hypothesis for the existence of unit root cannot be rejected for the series in their level form as the ADF statistics are above the critical value of -3.27. They are observed to be stationary when differenced. These observations are robust as they compare favourably with the Phillips-Perron (PP) nonparametric test.

Table-1: Area response of rice in Cameroon.

Regressors	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
$\Delta \ln A_{t-1}$	0.302 (3.306)***			0.185 (2.693)**	0.172 (2.624)**	0.161 (2.591)**	0.135 (2.489)**
$\Delta \ln P^{w}_{t-1}/P^{d}_{t-1}$		0.158 (2.647)**		0.168 (2.553)**	0.149 (2.458)**	0.126 (2.363)**	0.113 (2.351)**
$\Delta \ln P^{s}_{t-1}/P^{d}_{t-1}$			-0.0347 (-1.852)*	-0.026 (-1.726)*	-0.0314 (-1.716)*	-0.033 (-1.615)*	-0.041 (-1.396)*
$\Delta \ln W_{t-2}$					0.234 (2.527)**	0.182 (2.425)**	0.170 (2.280)**
$\Delta \ln G^{x}_{t-3}$						0.135 (1.987)*	0.115 (1.920)*
$\Delta \ln I_{t-2}$							0.074 (1.467)*
Intercept	0.1524 (3.242)***	0.1335 (3.225)***	0.1294 (2.934)***	0.1513 (3.364)***	0.2624 (3.258)***	2.0719 (3.472)***	2.0738 (3.625)***
μ_{t-1}	- 0.098 (-2.196)**	- 0.137 (-2.371)**	- 0.128 (-2.356)**	- 0.191 (-2.486)**	- 0.199 (-2.096)**	- 0.235 (-1.978)**	- 0.274 (-2.186)**
R^2 adj.	0.408	0.451	0.426	0.508	0.576	0.592	0.674
DW	1.907	1.920	1.843	1.861	1.853	1.877	1.858
Log likelihood	-11.051	-11.130	-11.043	-12.176	-13.068	-15.137	-17.420
Akaike AIC	1.079	1.460	1.731	2.148	2.483	3.429	3.536
Schwarze criterion	3.822	3.653	3.682	3.999	4.168	4.653	4.724
Box-Pierce χ^2	2.871	2.987	2.991	3.127	3.328	3.389	3.678
J-B χ^2	4.396	4.649	4.736	5.265	5.297	5.324	5.568

Note: Dependent Variable: Land Area (ΔA_t). *** = significant at 1%; ** = significant at 5%; * = significant at 10%. *DW is* the Durbin-Watson statistic. J-B is the Jarque and Bera statistic with a critical value of 5.89. The critical value for the Box-Pierce statistic is 13.52.

The current study for Cameroon could be put into context of previous studies on tropical agriculture and rice production. Mythili (2001) in line with Bhalla and Singh (1996) found low short run elasticity estimates for rice ranging from 0.06 to 0.12 and long run estimates of very high variation ranging between 0.15 to 0.93. While Surekha (2005) found a long run elasticity ranging between 0.538 and 1.91, the acreage response elasticity for rice estimates turned out to be very low ranging between 0.019 in the short run and 0.12 in the long run in Kanwar (2004). Though Gulati *et al*. (1999) observed that the price factor is not a significant variable explaining area changes, Mahmood *et al* (2007) observed positive response coefficients of 0.683 for lagged area, 0.351 for lagged yield and 0.704 for lagged real price. According to Mahmood *et al* (2007), the significant positive coefficient of lagged acreage indicates that last year acreage affected the current year acreage. The positive coefficient of lagged rice price bears direct relationship with rice acreage. The lagged yield has positive relationship with rice acreage but found to be insignificant. The significant coefficient of + 0.158 for the relative world price of rice in model III in Table-3 indicates that producers take into account world price in allocating area for rice, with the possibility of price convergence between producer and imported price.

In sum, area response estimates in previous studies do support the argument that farmers respond to increasing prices to some degree by intensive application of other inputs besides extending the area. The tested variables therefore account for the positive acreage response shown in Figure-2. This growth contributes to two possible paths that enhance the position of agriculture in the economy. First, the resultant increases in agricultural output stimulates the demand for industrial inputs such as fertiliser and farm equipment, and second, more output expands the supply of agricultural goods used as inputs to non-agricultural production process. Increased agricultural growth raises the real income of farm households and hence their demand for other agricultural products, likely more so, for industrial goods and services. This linkage is critical to the influence of agricultural growth on the overall growth performance of the rural and national economy, through significant spill-over effects that go to the heart of improving social welfare as part of the development process (Page, 2006).

6. CONCLUSIONS

Rice is now playing an important role in economic, politic and social aspects in production and consumption decisions in Cameroon. As the economy grows, there is a shift to a diversified market-oriented production system. The process of diversification out of staple food production could be assisted through efforts that promote technological change in agricultural production, improved rural infrastructure, and diversification in food demand patterns. The need to provision the rapidly growing population could act as a trigger for the transformation of rice production systems. Increased competition will provide additional incentive for enhancing supply pursuant to changes in policies and institutions. More important, expanding cultivated area is a viable option for increasing rice production. However, given constraints in arable land availability, current supply could be doubled by using the best varieties available together with appropriate crop management techniques.

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