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Intensification of Rice Production Systems in Southeastern Nigeria: A Policy Analysis Matrix Approach

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Abstract

The Nigerian rice sector has made remarkable improvement in the last decade as production has increased significantly thereby reducing the gap between domestic supply and demand. In the last three decades, rice imports make up greater proportion of Nigerian imports as rice forms a structural component of the Nigerian diet. Past government inconsistent policies were not successful in securing good market share for domestic rice producers, hence producers suffered great losses. The recent resurgence of interest by the present administration to intensify domestic rice production has yielded positive results. The objective of this study is to analyze and assess the costs and benefits of intensification of rice production systems in southeastern Nigeria using a policy analysis matrix approach. Multi Stage sampling technique was employed in selecting 75 upland and 75 lowland rice farmers who were interviewed with structured and validated questionnaire. Data were analyzed using Policy Analysis Matrix (PAM). The result shows that upland; lowland and double rice cropping systems in southeastern Nigeria are profitable based on the policy analysis matrix (PAM) model, and rice production under various systems and technologies is socially profitable and financially competitive. While there exist comparative advantage in the various production systems, with lowland and double cropping being highest, substantial tax was imposed on rice imports in Nigeria and government investment in intensifying rice production had a positive impact on the output of local rice production. The study concludes with strategies for the development of rice sub sector in Nigeria.

Keywords:
Policy Analysis matrix, financial competitiveness, production systems, social profits, and technologies.

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INTRODUCTION

Rice has traditionally been important basic food commodity in Sub-Saharan Africa. Of the total landmass of 98.3 million hectares in Nigeria, only 1.5 million hectares of the cultivable 71.2 million hectares are under rice production. Sorghum and cassava had 3.3 and 4.0 million hectares respectively. Statistics show that agricultural food production in Nigeria increases at about 2.9% per annum while food demand is growing at a rate of 8.3% annually (FOS 1999). This excess demand portrays the problem of food scarcity, which is a consequence of low productivity of staple foods like rice. The widening gap between regional rice supply and demand has been met by imports, which increase at a rate of 20% annually (FAO, 1996).

Revolutionary changes in dietary pressures of West African countries have created a wide and growing imbalance between regional rice supplies and demand. Since 1973, regional demand has grown at an annual rate of 6.0%, driven by a combination of population growth (2.9%) and substitution away from traditional coarse grains (WARDA, 2000). The consumption of traditional cereals, mainly sorghum and millet, has fallen by 12kg per capita, and their share in cereals used as food decreased from 61% in the early 1970s to 49% in the early 1980s (Akpokodje, 2001). In contrast, the share of rice in cereals consumed has grown from 15% to 26% over the same period. Hence, growth in regional rice consumption, however, remains high. The most important factors contributing to the shift in consumer preferences away from traditional staples and towards rice are rapid urbanization and associated changes in family occupational structures (Fabusoro 2000). According to Ernstain and Larcon (2002), as women enter the labour force, the opportunity cost of their time increases and convenient foods such as rice, which can be prepared quickly, rise in importance. Similarly, as men work at greater distances from their homes in the urban setting, more meals are consumed from the market where the ease of rice preparation has given it a distinct advantage. Iheke and Nwaru (2008) noted that these trends have meant that rice is no longer a luxury food but has become a major source of calories for the urban poor and low-income food-deficit countries.

On the other hand, the government of Nigeria had in the past three decades, actively intervened in domestic rice economy, but policy has not been consistent. The policy on rice has oscillated between import tariffs and import restrictions. For instance, from 1986 to the mid 1990s, imports were illegal. In 1996, the tariff was reduced to 50 percent but increased to 85 percent in 2001. From 2002 till date, there has been a 100 percent import tariff and consumer tax on rice. The erratic policy reflects the dilemma of securing cheap rice for consumers and a fair price for producers (Ezedinma 2001). Notwithstanding the various policy measures, domestic production has not increased sufficiently to meet the increased domestic demand. The inconsistency and inability of domestic rice production in Nigerian to meet domestic demand has raised a number of important questions both in the policy circle and amongst researchers.

Intensification of rice production systems using a combination of various technological packages may be a good strategy to increase output in the different rice production ecologies of Nigeria, and this can be achieved with appropriate policies and institutional support measures that increase farmers' incentives. Taking cognizance of this, this paper seeks to answer the question: what are the alternative technological packages available as well as costs, output and revenue associated with each of the rice production systems in Nigeria; and which of the production systems and alternative technologies should be recommended to farmers to ensure increased output and income? Policies are very important as they shape the prices of inputs and outputs, and influence the relative profitability and competitiveness of technologies.

MATERIALS AND METHODS

The study was carried out in Southeastern Nigeria. The region lies in the humid tropical agro ecological zone of Nigeria, within latitude 04° 24'N to 07° 00'N and longitude 05° 34'E to Longitude 09° 24'E. The humid tropical ecology is characterized by two distinct seasons, namely the dry season, which starts from November to late March and the rainy season, which starts from April to October with a short

Table 1: Rice Production Systems Practiced in Nigeria and the Alternative Technologies under each System

System	Intensification ↓
I	**Upland**
	Single Rice Cropping
	Single Rice + Fertilizer (+kg)
	Single Rice + Fertilizer (-kg)
	Single Rice + Fertilizer + Herbicide
II	**Inland Valley/Swamp**
	Single Rice Cropping
	Single Rice + Fertilizer (+kg)
	Single Rice + Fertilizer (-kg)
	Single Rice + Fertilizer (-kg) +Herbicide
	Single Rice + Fertilizer (+kg) + Herbicide
III	**Double Rice Cropping**
	Double Rice + Fertilizer (+kg)
	Double Rice + Fertilizer (-kg)
	Double Rice + Fertilizer (-kg) + improved Irrigation
	Double Rice + Fertilizer (+kg) + improved Irrigation

dry spell in August. The general vegetation consists of woodland savannah in the northern part of the zone and mangrove forests in the deep Niger Delta area.

The study was concentrated in the major rice producing states in the region comprising of Ebonyi, Enugu, Anambra, Imo and Abia states. Data were collected from a sample of 150 rice farmers stratified into upland and lowland (75 upland and 75 lowland) in eight (8) communities using a pretested questionnaire. The communities include: Akaeze, Uburu, Eda and Abakaliki (Eboyi state); Adani (Enugu state); Uzuakoli and Akoli Imenyi (Abia state) and Okigwe in Imo State. The questionnaire elicited responses from the respondents on their rice output, revenue from sale of output, cost of tradable inputs, factor costs (land, labour and capital) and other capital items for 2008 cropping season. Policy analysis matrix (PAM) (Pearson and Monke 1989; Adesina and Coulibaly 1998) was used to analyze the financial competitiveness of rice-based systems under alternative technologies. The social profitability of (upland, lowland and double) rice production systems at social prices was computed, while the existing alternative technologies in each of the production systems at different levels of fertilizer use and other inputs were also analyzed. The alternative technologies considered in each of the rice production systems include local rice production with varying quantities of inorganic fertilizer and with alternative resource management technology (the use of herbicide and improved irrigation).

Data on yields were collected from farmers' rice fields. The financial prices were real local market prices while the social prices were determined by multiplying the market price by a conversion factor, which is assumed to be a foreign exchange premium (Pearson and Monke 1989; Adesina and Coulibaly 1998). Table1 shows the various rice production systems and technology options under each system practiced in Nigeria, which was used for the study. The systems are considered on a spectrum of intensity. System I is 'low technology'; making relatively high use of domestic resources such as land and labour, while the 'high technology' end of the spectrum is system III with irrigation production. As one moves down the table, production is intensified.

Least Square Difference (LSD) for multiple comparisons was used to ascertain whether there is any significant difference in the output and profitability associated with the various rice production systems.

RESULTS AND DISCUSSION

Table 2 shows a brief demographic distribution of upland and lowland rice farmers in Southeastern Nigeria. A total of 72.01% and 70% of the lowland and upland rice farmers ranged in age between 31 and 50, implying that this age group are physically able to embrace new technologies and in learning new concepts than older farmers. Respondents under age 30 represented only 13.33% and 16%, reflecting that they are new to rice farming. Formal education plays an important role in technology adoption through more rapid adjustment in resource use towards achieving economic optimum. About 21.34% and 21.33% of lowland and upland rice farmers were at least college educated, which is much lower than the percentage without a college education. In the context of education in this study, where six years is the least accepted level for one to be considered educated in Nigeria, the trend is encouraging when compared with previous findings (e.g. Obibuaku 1979) where none of the rice farmers attended secondary or post secondary education.

About 45.33% and 52% of lowland and upland

Table 2: Survey respondents' demographic distribution

Criteria		Frequency		Percentage	
		Lowland	Upland	Lowland	Upland
Age	21-30	10	12	13.33	16.00
	31-40	16	17	21.33	22.00
	41-50	38	36	50.68	48.00
	Over 50	11	10	14.66	12.73
Education	Under College education	59	59	78.66	78.66
	College education and above	16	16	21.34	21.34
Years of farming experience	≤ 10	41	36	54.67	48.00
	11-20	20	24	26.67	32.00
	Over 20 years	14	15	18.66	20.00
Size of farm holdings (ha)	≤ 2.0	22	14	29.33	18.67
	2.1-4.0	23	24	30.67	32.00
	Over 4.0	30	37	40.00	49.33

Source: Field survey data, 2008.

rice farmers respectively had over eleven years of farming experience in rice production, while 70.67% and 81.33% cultivated above 2 hectares of farmland. This shows that upland rice farmers have more years of rice farming experience and cultivated relatively larger area than their lowland counterpart, reflecting more land availability for upland rice production.

Three indicators[1] of economic efficiency under the policy analysis matrix were used to assess the three (upland, lowland and double) rice production systems. The indicators of economic efficiency include the Nominal Protection Coefficient (NPC), Effective Protection Coefficient (EPC) and Domestic Resource cost (DRC). Nominal Protection Coefficient (NPC) is the ratio of the private price of the commodity to its social price, and measures the extent of policy intervention on the output (i.e. it indicates the impact of policy and any market failure that

Table 3: Policy Analysis Matrix table for upland, lowland and double rice production systems in Southeastern Nigeria.

Upland	Revenue (N)	Cost of Tradable Inputs (N)	Cost of Domestic Resources (N)	Profit (N)
Private	74,880.00	9,250.00	38,900.00	26, 480.00
Social	93,600.00	11,562.50	35,165.00	46,872.50
Policy Effect	-18,720.00	-2,312.50	3,735	-20,392.50
Indicators: PCR=0.59, DRC=0.43, NPCto=0.80, NPCti=0.8, EPC=0.80, PPC=0.56				
Inland				
Private	102,960.00	9,500.00	39,800.00	53,660.00
Social	128,700.00	11,562.00	35,750.00	81,387.50
Policy Effect	-25,740.00	-2,062.50	4,050.00	-27,727.50
Indicators: PCR=0.43,DRC=0.31,NPCto= 0.80,NPCti= 0.80,EPC=0.80 PPC=0.66				
Double cropping				
Private	196,560.00	19,000.00	81,700.00	95,860.00
Social [2]	245,700.00	23,750.00	70,810.00	151,140.00
Policy Effect	-49,140.00	-4,750.00	10,890.00	-55,140.00
Indicators: PCR= 0.46, DRC= 0.32, NPCto=0.80, NPCti=0.80, EPC=0.80, PPC=0.63				

Source: Field survey data, 2008.
*See appendix II for calculation of these indicators.

[1] *Calculations of all economic indicators are based on the prevailing US Dollar – Nigerian Naira exchange rate as at August, 2008. The exchange rate was US$1 = N115*
[2] *Private price is lower than social price because private price is multiplied by a conversion to give the social price.*

Table 4: LSD for Multiple comparisons

Comparisons		Mean difference	Std error	Sig	95% confidence Interval	
Systems					Lower Boundary	Upper Boundary
1.00	2.00	-19.9000*	9.133	0.032	-38.0533	-1.7467
Upland	3.00	-75.9667*	9.133	0.000	-93.1200	-56.8133
2.00	1.00	19.9000*	9.133	0.032	1.7467	-38.0533
Lowland	3.00	-55.0667*	9.133	0.000	-73.2200	-36.9133
3.00	1.00	74.9667*	9.133	0.000	56.8133	93.1200
Double rice	2.00	55.0667*	9.133	0.000	36.9133	73.2200

LSD 0.05 = 19.9 (significant).
* = Significant at 5 percent

causes a divergence between the private and social prices. Effective Protection Coefficient (EPC) is an indicator used to assess whether government policy tends to tax or protect consumers and producers while Domestic Resource Cost (DRC) is an indicator that measures the ratio of domestic factors (at social price) to the value-added to the system at social prices (total revenue less cost of tradable inputs).

Table 3 shows the policy analysis matrix for upland, lowland and double rice production systems in southeastern Nigeria. Four rice varieties were cultivated by farmers in the region. They include faro 44 (*wuriwuri*), faro 52 (*wita 4*) for inland; and faro 46 (*wita 50*) and faro 55 (*Nerica 1*) for upland production system. The social revenue was calculated by multiplying the market revenue by a conversion factor, which is an assumed foreign exchange premium. 1.25 is used for revenue and tradable inputs, 1.00 for non-tradable inputs (domestic factors), 0.28 for fixed factors and 0.37 for credit facilities (Pearson and Monke, 1989). Social costs for the considered items were also calculated in the same way. See appendix III for upland rice production. Input cost of machinery was not considered here because the average farm size for upland and inland are 3 and 4 hectares respectively. Therefore, the farmers use manual labour in all their farming activities. In addition, transportation cost was not considered here as the paper does not focus on marketing and profitability of rice output; rather it focuses on production and prices.

The results show a private cost ratio (PCR) of 0.59, 0.43 and 0.46; domestic resource cost (DRC) of 0.43, 0.31 and 0.32; nominal protection coefficient (NPC) on tradable inputs and output of 0.80 and private profitability coefficient (PPC) of 0.56, 0.66 and 0.63 for upland, lowland and double rice cropping systems respectively. The results indicate that rice farmers in the three production systems have comparative advantage (DRC<1) in rice production with lowland system having the highest comparative advantage. The results further show that rice farmers in the three systems are receiving considerably less than the world market price equivalent of their rice even in the event of input subsidies (EPC<1). The private profitability[3] coefficient (PPC) is less than one in the three systems indicating that rice is a profitable crop for farmers to grow. The positive signs of private and social profits[4] show that rice farmers in the study area can still produce without transfers from the government.

The results further indicates that social profit which shows the magnitude of benefit (profit) accruing to the society from each of the rice production systems is highest in double rice production system followed by lowland, and least in upland rice system. This is because some lowland rice farmers seem to have a relatively higher rice yield per unit area than upland rice producing farmers.

The analysis of financial competitiveness

[3] *Private profit refers to observed net revenue reflecting actual market prices received or paid by farmers, merchants or processors in the agricultural system. Its calculations show the competitiveness of the agricultural system, given the current technologies, output levels, input costs and policy transfers.*

[4] *Social profit valuations measure comparative advantage or efficiency in the agricultural commodity system. Efficiency outcomes are achieved when an economy's resources are used in activities that create the highest level of output and income.*

(Table 5, 6, and 7) of rice under alternative technologies was carried out using three measures of profitability assessment. They include: net private profitability (NPP), which is the profit evaluated at the private market prices; net social profitability (NSP) defined as the profit evaluated at the social price for both output and inputs; and domestic resource cost (DRC) referred to as the ratio of costs at social prices of non-tradable domestic resources used in production of the commodity to the value added at social prices. The DRC is used as a measure of comparative advantage.

Analysis of financial profitability in the three production systems (table 5, 6 and 7) show that all the systems had a positive Net Private Profitability (NPP), indicating that rice farmers in the study area have financial incentives to produce under the existing technologies. This explains the impact of the recent agricultural loan given to rice farmers by the federal government as part of the strategies to increase local rice production in Nigeria. While all the production systems and technologies are socially profitable (Net Social Profitability (NSP) >0), the result further shows that input transfers were all negative, indicating the existence of input subsidies for rice farmers in the region, which the government used as a motivating factor to boost rice production in the region.

The computed Domestic Resource Cost (DRC) value for all the systems and technologies are positive and less than one, suggesting that farmers have comparative advantage in all the existing technologies while they have the highest comparative advantage in single rice + 50kg fertilizer +Herbicide technology in the case of upland and lowland, and double rice + 100kg fertilizer + Improved irrigation technology (both having the lowest computed DRC value). The negative signs of net policy for all the systems and technologies show that recent government interventions on importation of foreign rice in Nigeria have had positive impact on the financial and social profitability of local rice production. With respect to revenue, double rice cropping system gives the highest revenue, which was optimized under double rice +100kg fertilizer + improved irrigation technology.

Table 6 (the Least Significant Difference) shows that at 5 percent level, there exist significant differences in output and revenue (profit) between the three systems while the difference is more between systems I (Upland) and II (lowland) as P- value (0.032) < 0.05 and LSD 0.05 = 99.9. Therefore, there is a significant difference in the output and profit associated with upland, lowland and double rice cropping systems with double rice system being the most profitable in the study area.

RECOMMENDATIONS

The results from this study suggest a number of such factors that will help improve local rice production not only in southeast Nigeria but also in Nigeria at large.

First, results reveal that the three rice production systems are profitable with double rice cropping giving the highest profit followed by rice produced in lowland systems. Rice production systems are location specific. Therefore, the choice of a particular system should depend on such factors as topography and availability of inputs like fertilizer, water and herbicides. In any case, 50kg fertilizer with herbicide per hectare is recommended for optimal output, as this technology gives the lowest DRC (highest comparative advantage) among all the technologies within each system.

Second, results show that Domestic Resource Cost (DRC) for the three production systems are less than unity, implying that farmers have comparative advantage in the three systems with double cropping giving the highest comparative advantage and profit. Therefore, rice farmers, especially in lowland areas, can maximize land use and consequently improve their farm income through double rice cropping since the rainfall regime of the study area can accommodate two rice crops in a year. The use of appropriate technologies such as blow dryers, power tillers and improved irrigation using water retention dykes and bunds will intensify rice production. The dykes will help retain water, long after the rainy season, while the blow dryers will enable farmers dry their early rice crop output, which is likely to be harvested within the rainy months.

Third, results indicate that government policy shifts had positive effect on the private and social profitability of local rice production, as the Nominal Protection Coefficient (NPC) is less than unity in all the systems. Policy inconsistency in the rice sub sector has actually discouraged local production over the years. Since the removal of the ban on rice imports in 1992, growth in domestic rice output declined significantly justifying the urgent need for government positive and proactive intervention. The policy imposes a tax on rice imports as well as a 100% tariff. This import substitution strategy should be maintained to encourage domestic rice production and improve local unemployment.

Fourth, for efficient performance of the rice sector in Nigeria, private sector participation with institutional and market support services should be encouraged by the government. This approach requires private sector participation, especially in the areas of credit, transport, resource inputs, storage facilities, and institutional inputs for research, infrastructure and a consistent policy environment from government. This will serve as a key to commercialization of rice production in Nigeria.

CONCLUSION

The economic analysis shows a high level of financial and social profitability of various technologies in rice production systems. The high financial incentive for rice production suggests that farmers can easily adopt new technologies provided such technologies would increase their output and income. The high social profitability of rice production calls for increased attention in these technologies, as they represent a socially efficient use of domestic resources. There is need to increasingly target rice-based production technologies into areas where preconditions for their adoption exist. Recent policy shifts on rice importation in Nigeria have created a positive impact on local rice production. Therefore, effective and conducive policies are important to stimulate local uptake of improved technologies. This is important for Nigeria to gain economics of scale, efficiency and self-sufficiency in domestic rice production, ensure food security, better nutrition, poverty alleviation and improvement of rural livelihood.

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Appendix I

Table 5: Policy Analysis Matrix for Alternative Technologies in Upland Rice Production System in Southeastern Nigeria (Net Financial Profitability)

Technology	Revenue	Costs		Net Private Profitability (NPP)	Revenue	Costs		Net Social Profitability (NSP)	Net effects of policy distortion				
		Tradable input	Domestic factor			Tradable input	Domestic factor		Output transfer	Input transfer	Factor transfer	Net Policy	DRC
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	
Single rice cropping	56130	3250	38900	13980	70162.0	3750	35165	31247.0	-14032.0	-500	3735	-17267.0	0.50
Single rice +100kg fertilizer	70880	12250	38900	19730	88662.5	15000	35165	38497.5	-17782.5	-2750	3735	-18767.5	0.40
Single rice + 50kg fertilizer	73005	9250	38900	24855	91256.25	11250	35165	44841.25	-18251.25	-2000	3735	-19986.25	0.39
Single rice + 100kg fertilizer + Herbicide	71130	12500	38900	19730	88912.5	15312.5	35165	38435.0	-17782.5	-2812.5	3735	-18705.0	0.40
Single rice + 50kg fertilizer + Herbicide	74880	9500	38900	26480	93600.0	11562.5	35165	46872.5	-18720.0	-2062.5	3735	-20392.5	0.38

Source: Field survey data, 2008
US$1 = 115 Nigerian Naira
NB: A =revenue valued at private price; B = tradable inputs valued at private prices; C = domestic factors valued at private prices; D =NPP = A – B- C.
E = revenue valued at social price; F = tradable inputs valued at social prices; G = domestic factors valued at social prices;
H = NSP = E – F – G; Output transfers I = A – E; tradable input transfers J = B – F; K = C – G; net transfer for policy effects L = D – H; DRC = G/E.

Table 6: Policy Analysis Matrix for Alternative Technologies in lowland Rice Production System in Southeastern Nigeria (Net Financial Profitability)

Technology	Revenue	Costs		Net Private Profitability (NPP)	Revenue	Costs		Net Social Profitability (NSP)	Net effects of policy distortion				
		Tradable input	Domestic factor			Tradable input	Domestic factor		Output transfer	Input transfer	Factor transfer	Net Policy	DRC
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	
Single rice cropping	78960	3250	39800	35910	98700	3750	35750	59200.0	-19740	-500	4050	-23290.0	0.36
Single rice +100kg fertilizer	98280	12250	39800	46230	120000	15000	35750	69250.0	-21720	-2750	4050	-23020.0	0.30
Single rice + 50kg fertilizer	102960	9250	39800	53910	125700	11250	35750	78700.0	-22740	-2000	4050	-24790.0	0.28
Single rice + 100kg fertilizer + Herbicide	100560	12500	39800	48260	122700	15312.5	35750	71637.5	-22140	-2812.5	4050	-23377.5	0.29
Single rice + 50kg fertilizer + Herbicide	102960	9500	39800	53660	128700	11562.5	35750	81387.5	-25740	-2062.5	4050	-27727.5	0.27

Source: Field survey data, 2008.
US$1 = 115 Nigerian Naira
NB: A = revenue valued at private price; B = tradable inputs valued at private prices; C = domestic factors valued at private prices;
D =NPP= (A – B – C).
E =revenue valued at social price; F = tradable inputs valued at social prices; G = domestic factors valued at social prices;
H = NSP = (E – F – G); Output transfers I = (A – E); tradable input transfers J = (B – F); K = (C – G); net transfer for policy effects L = (D – H); DRC = G/E.

Table 7: Policy Analysis Matrix for Alternative Technologies in Double Rice Production System in Southeastern Nigeria (Net Financial Profitability)

Technology	Revenue	Costs		Net Private Profitability (NPP)	Revenue	Costs		Net Social Profitability (NSP)	Net effects of policy distortion				
		Tradable input	Domestic factor			Tradable input	Domestic factor		Output transfer	Input transfer	Factor transfer	Net Policy	DRC
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	
Double rice + 100kg fertilizer	172245.0	21500	81700	69045.0	248336.2	20250	70810	157276.2	-76091.2	1250	10890	-88231.2	0.285
Double rice +50kg fertilizer	179737.5	18500	81700	79537.5	241745.6	17250	70810	153685.6	-62008.1	1250	10890	-74148.1	0.293
Double rice +100kg fertilizer + Improved Irrigation	190560.0	22000	81700	86860.0	255273.7	26750	70810	157713.7	-64713.7	-4750	10890	-70853.7	0.277
Double rice + 50kg fertilizer + Improved Irrigation	196560.0	19000	81700	95860.0	245700.0	23750	70810	151140.0	-49140.0	-4750	10890	-55280.0	0.288

Source: Field survey data, 2008.
US$1 = 115 Nigerian Naira
NB:A = revenue valued at private price; B = tradable inputs valued at private prices; C = domestic factors valued at private prices;
D = NPP = (A – B – C).
E = revenue valued at social price; F = tradable inputs valued at social prices; G = domestic factors valued at social prices;
H = NSP = (E – F – G); Output transfers I = (A – E); tradable input transfers J = (B – F); K = (C – G); net transfer for policy effects L = (D – H); DRC = G/E.

Appendix II

Calculation of indicators shown on table 3

Upland Rice Production System

a) Private Cost Ratio (PCR): $\frac{\text{Private cost of domestic resources}}{\text{Private revenue – Private cost of tradable inputs}}$

$$\frac{38900}{74880\text{-}9500} = \frac{38900}{65380} = 0.59$$

b) Domestic Resource Cost (DRC): $\frac{\text{Social cost of domestic resources}}{\text{Social revenue – Social cost of tradable inputs}}$

$$\frac{35165}{93600\text{-}11562.5} = \frac{35165}{82037.5} = 0.43$$

c) Nominal Protection Coefficient (NPC) on tradable output : $\frac{\text{Private revenue}}{\text{Social revenue}}$

$$\frac{74880}{93600} = 0.8$$

d) Nominal Protection Coefficient (NPC) on tradable inputs: $\frac{\text{Private cost of tradable inputs}}{\text{Social cost of tradable inputs}}$

$$\frac{9500}{11562.5} = 0.8$$

e)Effective Protection Coefficient (EPC) : $\frac{\text{Private revenue – Private cost of tradable inputs}}{\text{Social revenue – Social cost of tradable inputs}}$

$$\frac{74880\text{-}9500}{93600\text{-}11562.5} = \frac{40670}{82037.5} = 0.8$$

f) Private Profitability Coefficient (PPC) : $\frac{\text{Private profit}}{\text{Social profit}}$

$$\frac{26480}{46872.5} = 0.56$$

Inland Rice Production System

a) Private Cost Ratio (PCR): $\frac{\text{Private cost of domestic resources}}{\text{Private revenue – Private cost of tradable inputs}}$

$$\frac{39800}{102960-9500} = \frac{39800}{93460} = 0.43$$

b) Domestic Resource Cost (DRC): $\frac{\text{Social cost of domestic resources}}{\text{Social revenue – Social cost of tradable inputs}}$

$$\frac{35750}{128700-11562.5} = \frac{35750}{117137.5} = 0.31$$

c) Nominal Protection Coefficient (NPC) on tradable output : $\frac{\text{Private profit}}{\text{Social profit}}$

$$\frac{102960}{128700} = 0.8$$

d) Nominal Protection Coefficient (NPC) on tradable inputs : $\frac{\text{Private cost of tradable inputs}}{\text{Social cost of tradable inputs}}$

$$\frac{9500}{11562.5} = 0.8$$

e) Effective Protection Coefficient (EPC) : $\frac{\text{Private revenue – Private cost of tradable inputs}}{\text{Social revenue – Social cost of tradable inputs}}$

$$\frac{102960-9500}{128700-11562.5} = \frac{93460}{117137.5} = 0.8$$

f) Private Profitability Coefficient (PPC) : $\frac{\text{Private profit}}{\text{Social profit}}$

$$\frac{53660}{81387.5} = 0.66$$

Double Rice Cropping System

a) Private Cost Ratio (PCR): $\frac{\text{Private cost of domestic resources}}{\text{Private revenue – Private cost of tradable inputs}}$

$$\frac{81700}{196560-19000} = \frac{81700}{177560} = 0.46$$

b) Domestic Resource Cost (DRC): $\frac{\text{Social cost of domestic resources}}{\text{Social revenue – Social cost of tradable inputs}}$

$$\frac{70810}{245700-23750} = \frac{70810}{221950} = 0.32$$

c) Nominal Protection Coefficient (NPC) on tradable output : $\frac{\text{Private profit}}{\text{Social profit}}$

$$\frac{196560}{245700} = 0.8$$

d) Nominal Protection Coefficient (NPC) on tradable inputs : $\frac{\text{Private cost of tradable inputs}}{\text{Social cost of tradable inputs}}$

$$\frac{19000}{23750} = 0.8$$

e) Effective Protection Coefficient (EPC) : $\frac{\text{Private revenue – Private cost of tradable inputs}}{\text{Social revenue – Social cost of tradable inputs}}$

$$\frac{196560 - 19000}{245700-23750} = \frac{117560}{221950} = 0.8$$

f) Private Profitability Coefficient (PPC) : $\frac{\text{Private profit}}{\text{Social profit}}$

$$\frac{95860}{151140} = 0.63$$

Appendix III

Table 8: PAM Simple for Upland Rice Production System

		Units	Qty	Market Price (N/kg)	Conversion Factor	Social Price (N)	Market Value (N)	Social Value (N)	Transfers
1	**Revenue**								
	Rice output /50kg (milled)	Kg	12.8	5850	1.25	7312.5	74880	93600	-18720
2	**Tradable inputs**								
	seeds	Kg	50	60	1.25	75	3000	3750	-750
	fertilizer	Kg	50	120	1.25	150	6000	7500	-1500
	agrochemical	-	2	250	1.25	312.5	500	312.5	-62.5
3.	**Not tradable inputs**								
	(Domestic factors)	Manday							
a	Labour	"	4	600	1.00	600	2400	2400	0.00
	Nursery	"	6	700	1.00	700	4200	4200	0.00
	Land Clearing	"	6	800	1.00	800	4800	4800	0.00
	Land Preparation	"	4	700	1.00	700	2800	2800	0.00
	Transplanting	"	4	600	1.00	600	2400	2400	0.00
	Fertilizer Application	"	4	1500	1.00	1500	6000	6000	0.00
	1st Weeding	"	4	1000	1.00	1000	4000	4000	0.00
	2nd Weeding	"	1	2000	1.00	2000	2000	2000	0.00
			4	1200	1.00	1200	4800	4800	0.00
b	Bird Scaring	ha	1	3000	0.28	840	3000	840	2160
c	Harvesting& threshing	N/ha	1	2500	0.37	925	2500	925	1575
	Land Costs								
	Interest on capital								

Indicators: PCR = 0.59 DRC = 0.31 NPC_{to} = 0.80
NPCti = 0.82 EPC = 0.80 PPC = 0.56

Note: the conversion factor is an assumed foreign exchange premium.1.25 is used for revenue and tradable inputs, 1.00 for non-tradable inputs (Domestic factors), 0.28 for fixed factors and 0.37 for credit facilities (Pearson and Monke, 1989).