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Input Use and Profitability of Arable Crops Production in Nigeria

Diran Olawale Awotide[1], Olukunle John Ikudaisi[2], Sam Oyewole Ajala[3] & Joseph Hussaini Kaltungo[4]

[1] Department of Agricultural Economics and Farm Management, Olabisi Onabanjo University, Yewa Campus, Ayetoro, Ogun State, Nigeria

[2] Department of Agricultural Economics, Obafemi Awolowo University, Ile-Ife, Oyo State, Nigeria

[3]International Institute of Tropical Agriculture (IITA), Ibadan, Oyo State, Nigeria

[4] AfDB-CBARDP, Bauchi, Bauchi State, Nigeria

Correspondence: Diran Olawale Awotide, Department of Agricultural Economics and Farm Management, Olabisi Onabanjo University, Yewa Campus, Ayetoro, Ogun State, Nigeria. Tel: 234-803-345-3423. E-mail: w_awotide@yahoo.com

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Abstract

The study accessed the profitability of the usage of all input in crop production through Community-Based Agricultural and Rural Development Project (CBARDP) among rural dwellers in the Northern part of the country with the view of comparing the input usage to recommended practices. The study was carried out in five States where the IITA/AfDB-CBARD project was implemented. The States were Adamawa, Bauchi, Gombe, Kaduna and Kwara. Multi-stage sampling technique was used to randomly select 720 farmers for the study for primary data generation. Farmers in study areas cultivated so many crops but the two most important crops (maize and cowpea) were used for the study. The analytical techniques used were descriptive statistics, Gross Margin and Income-Expenditure Ratio. The results showed that maize and cowpea production were profitable in the study area. However, farmers underutilized available production resources with the exception of land input. In addition, farmers did not comply with the recommended agronomic and management practices. The low usage of inputs especially fertilizer would affect the efficiency levels of maize and cowpea farmers implying that famers were not using the available inputs optimally therefore, effort must be geared towards enhancing input use to promote competitiveness of maize and cowpea production in the area. Finally, since land input was overutilized, there may be need for farmers to reduce land under cultivation for better utilization of resources.

Keywords: cowpea, input usage, maize, Nigeria, profitability

1. Introduction

Agriculture has moved from the traditional means of planting and harvesting to sustainable agricultural production through efficient use of productive resources in order to ensure food security, and eradicate poverty. Challenges facing agriculture which include declining soil fertility, declining yields, and low farmer incomes are often associated with low agricultural input use suggesting that agricultural input use must increase for significant productivity growth. In effect, there is need to foster private sector–led development of agricultural input markets (Freeman & Kaguongo, 2003) to eradicate unavailability of agricultural inputs.

The increase in output and productivity of agriculture could only be achieved by division of work and specialization as well as use of improved agricultural inputs. However, the substantial differences in agricultural productivity between Asia and Africa can be largely explained by differences in use of modern inputs. In 2002 – 2003, Sub–Saharan African farmers used on average 9 kg of fertilizers per ha of arable land compared to 100 kg per ha in South Asia, 135 kg/ha in Southeast Asia and 73 ka/ha in Latin America (Crawford *et al*., 2006). While agricultural production and productivity soared in Asia and Latin America during the last four decades, they have largely stagnated in Africa (Nigeria inclusive), resulting in a rising dependency on imported grains and an increase in the number of undernourished people (Wiggins & Brooks, 2010; Future Agricultures, 2010).

In many African countries, liberalization efforts have not necessarily resulted in the private sector taking over where the government agencies left off. However, private investment in input distribution, especially of fertilizer, is discouraged by an unfavorable business climate characterized by continued government procurement and

distribution of inputs, which undercut private markets, increase the uncertainty of input marketing, and result in high levels of rent seeking (Morris *et al*. 2007). Macroeconomic instability, inadequate regulatory systems, and an abundance of taxes and fees also limit the active involvement of the private sector (Morris *et al*. 2007). With few exceptions, the agricultural input sectors in African countries are small and limited in geographic dispersion (Morris *et al*. 2007). Many dealers were concentrated in urban or semi-urban areas, and very few were located in the rural interior near smallholders' farms. Farmers often must travel at least 20 to 30 kilometers to purchase fertilizer, seeds, and other inputs, which raises the cost of using inputs to farmers (Morris *et al*. 2007).

The adoption of modern agricultural inputs has been considered slow in Sub-Sahara African (SSA) countries including Nigeria. Among others, lack of access to complementary inputs is often one of the constraints. Such constraint becomes more binding if farmers lack access to efficient markets for various inputs so that surplus inputs can be traded easily with deficient inputs. In Nigeria, the substitutability of inputs, for example between seed and irrigation, is still low. In spite of modern development in breeding nutrient efficient maize varieties, higher yields still depend on adequate water supply (Idinoba *et al*., 2004). Inputs markets are imperfect with high transaction costs for irrigation pump (Takeshima *et al*., 2010) and there is lack of timeliness in seed delivery (particularly at the planting time) to farmers (Manyong *et al*., 2003; Odoemenem and Obinne, 2010; Omonona, 2006; Saka *et al*., 2005). Majority of farmers in Nigeria are still significantly poor with little access to credit or insurance and their liquidity constraints often limit their ability to best exploit market conditions to purchase needed inputs (Hiroyuki, 2011).

Fertilizer is considered a 'lead' practice, which predisposes the farmer to adopt other improved practices, thus, recognized as a major factor in increasing food production. It has become the 'backbone' of agricultural development programmes in many countries. According to Crawford *et al.* (2006) the improvements in soil fertility needed to stimulate agricultural productivity growth, improved food security, and increases in rural incomes will require substantial increases in fertilizer use in combination with improved land husbandry practices. In every region of the world, the intensification of crop-based agriculture has been associated with a sharp increase in the use of chemical fertilizer (Morris *et al.*, 2007). Hence, this study aimed at comparing the actual use of input with international recommendations, examine the cost and returns of input use in Community-Based Agricultural and Rural Development Project (CBARDP) states and make recommendations based on empirical findings.

2. Methodology

2.1 Study Area

The study was carried out in five States where the International Institute of Tropical Agriculture/Africa Development Bank - Community-Based Agricultural and Rural Development (IITA/AfDB-CBARD) project was implemented. The States were Adamawa, Bauchi, Gombe, Kaduna and Kwara. The project had been executed in nine Local Government Areas (LGAs) in each selected State and three Rural Village Areas (RVAs) per LGA, giving a total of 27 RVAs. Multi-stage sampling technique was used for the study. In the first stage, all the RVAs in each State were stratified into three districts in order to avoid biasness. In each district, four (4) RVAs were selected using simple random sampling technique. In the third stage, farmers were stratified into three (3) groups in each RVA: large, medium and small scale farmers following Ozowa classification (2002). In each group, 4 farmers were selected randomly from each group to give a total of 144 farmers per State. Altogether, 720 farmers were selected for the study. Primary data were employed for this study. Data were collected with the use of pre-tested and structured questionnaire. Information collected include quantity and prices of input use, sources of procurement, output and prices of crops, land use etc. Farmers in study areas cultivated so many crops; however, maize and cowpea were used for the study. The analytical techniques used were descriptive statistics, Gross Margin and Income Expenditure Ratio.

3. Results and discussion

3.1 Socio-Economic Characteristics of Respondents

The socio-economic characteristics of respondents observed in the study area were age, measured in years; sex, level of education (measured in years invested in formal education) and marital status. Others include household size and family labour. Table 1 presents a summary of socio-economic characteristics of respondents. In the project area, males dominated cropping activities, this is in agreement with previous studies (Jibowo, 1992 & Atibioke *et al.*, 2012). The mean age was 47 years meaning that most farmers are in their late forties, still agile to work. The number of respondents who had formal education was found to be above two-third in the project area. Studies have shown that education level of peasant farmers would contribute to adoption of improved technologies as well as their response to extension services (Welch, 1970; Wozniak, 1984, 1987; Krueger, 1993;

Lleras-Muney & Lichtenberg, 2002). On the average, household size was about 11, however, the household members that contributed immensely to farm labour were about five suggesting that half of household members worked on the farm.

Table 1. Socio-economic characteristics of respondents

Socio-Economic Characteristics	States					
	Adamawa	Bauchi	Gombe	Kaduna	Kwara	Across the States
Males (%)	62.50	77.78	74.31	78.47	94.44	77.5
Mean Age	45.79	40.86	46.71	47.92	52.42	46.71
Farmers with formal education (%)	63.89	82.64	73.61	72.92	48.61	68.33
Married (%)	90.28	92.36	92.36	93.75	97.92	93.33
Mean Household Size	10.65	11.46	13.88	12.43	8.86	11.45
Mean Family Labour	5.01	3.87	5.85	4.88	2.66	4.45

Source: Field survey, 2013

Two crops were used for the studied namely maize and cowpea. Table 2 presents the frequency of the selected maize and cowpea across the states. Results showed that 668 of 720 respondents cultivated maize meaning that maize was a major crop in the project area and in all the states while 400 of 720 respondents cultivated cowpea.

Table 2. Selected maize and cowpea farmers of each crop per State

Crops	States					
	Adamawa	Bauchi	Gombe	Kaduna	Kwara	Total
Maize	140	118	136	130	144	668
Cowpea	77	92	128	53	50	400

Source: Field survey, 2013

3.2 Input Usage for Maize and Cowpea Production

Among the 668 (93 %) maize farmers, 497 (74.40 %) ranked maize as their main crop; about 468 (70.06 %) of them planted improved varieties of maize of which 320 (47.90 %) had their seeds originating from IITA while 148 (22.16%) had their seeds from ADP. Table 3 presents the average use of maize inputs per hectare across states. It was observed that the mean farm size cultivated in the project area was 3.38 ha ranging between 0.4 ha and 25 ha. This simply shows that most of the farmers in the project area were peasant small scale farmers who were predominantly subsistent. The average labour used in cultivating maize stood at 35 man days/ha. On the average, 1.71 litres of pre-emergence herbicides were used per ha while 0.88 litres were the mean post-emergence herbicides used per ha in the project area. Fertilizer usage among respondents were 93.05 kg of NPK per ha, 50.12 kg of urea per ha, and 13.23 kg micro-nutrient per ha. The mean manual weeding rate was 1.47 times while about 1.77 seeds were planted/hole on the average.

Comparing agricultural practices of maize respondents with recommended practices, results shows that about 67 % of respondents complied with 2 times fertilizer application rate with standard deviation of 0.86. Although, most maize farmers applied fertilizer 14 days after planting; it was observed that the average age of fertilizer application across the states was 16 days after planting. The recommended spacing along and across rows is 75cm by 30cm; it was observed that most farmers did not comply with this standard, about 26 % complied. As touching the number of seeds recommended per hole, majority (65.42 %) complied with this. A closer look at Table 3 reveals that most of the farmers did not comply with the standard on fertilizer application, herbicide and

labour use. Notably, the use of NPK and urea were under-utilized while micro-nutrients were over-utilized as well as labour. Besides, most farmers did not test their soils before usage, results showed that only six farmers out of 720 (four from Gombe and two from Kaduna) tested their soil before fertilizer application.

Table 3. Use of maize inputs per hectare across the project area

States	Adamawa	Bauchi	Gombe	Kaduna	Kwara	Mean across the States	**Recommended	Standard Deviation
Mean Farm Size (ha)	3.54	3.37	3.57	3.63	2.77	3.38	N.A	2.78
Mean Man Days (man days/ha)	29.06	26.93	35.21	45.83	31.27	33.65	24 man days	34.84
Mean Pre-emergence Herbicides used (litre/ha)	3.22	0.82	1.03	1.77	1.72	1.71	3 litres/ha	2.99
Mean Post-emergence Herbicides used (litre/ha)	1.77	0.73	0.30	0.29	1.33	0.88	3 litres/ha	1.96
Mean NPK used (kg/ ha)	73.37	77.13	115.05	107.92	91.89	93.05	300 kg/ha	108.12
Mean Urea used (kg/ha)	47.95	43.21	54.66	67.07	37.84	50.12	100 kg/ha	53.61
Mean Micro-Nutrient (kg/ha)	14.70	33.43	6.68	6.78	4.51	13.23	1.3 kg/ha	73.36
Mean Manual Weeding Rate (times)	0.94	1.53	2.22	1.20	1.49	1.47	2 times	0.98
Mean Seed used (seed/hole)	1.81	1.59	1.90	1.56	1.97	1.77	2 seeds/hole	0.65

Source: Field survey, 2013

**Values are from IITA (2003): Growing Maize in Nigeria - commercial crop production guide series

Among the 400 (55.56 %) cowpea farmers, 25 (6.25 %) ranked cowpea as their main crop; about 86 (21.50 %) of them planted improved varieties of which 57 (14.25 %) had their seeds originating from IITA while 29 (7.25%) had their seeds from Agricultural Development Programme (ADP). Table 4 presents the average use of cowpea inputs per hectare across the project area. It was observed that the mean farm size cultivated in the project area was 1.39 ha ranging between 0.25 ha and 20 ha. This simply shows that most of the farmers in the project area were peasant small scale farmers who were predominantly subsistent but have commercialized farming in focus. The average labour used in cultivating cowpea stood at 23 man days. On the average, 0.55 litres of pre-emergence herbicides were used per ha while 0.13 litres were the mean post-emergence herbicides used per ha in the project area. Fertilizer usage among respondents were observed; 22.94 kg of NPK per ha, 4.45 kg of urea per ha, and 11.64 kg micro-nutrient per ha. The mean manual weeding rate was 0.82 times while about 1.08 seeds were planted/hole on the average. In addition, an average of 0.68 litres per hectare of pesticides was used across the states for cowpea cultivation.

Table 5. Use of cowpea inputs per hectare across the project area

States	Adamawa	Bauchi	Gombe	Kaduna	Kwara	Mean across the States	**Recommended	Standard Deviation
Mean Farm Size (ha)	1.39	1.57	2.58	0.64	0.75	1.39	N.A	2.08
Mean Man Days (man days/ha)	33.04	20.28	28.65	20.38	11.04	22.68		94.16
Mean Pre-emergence Herbicides used (litre/ha)	1.34	0.26	0.16	0.65	0.35	0.55	4 litres/ha	1.69
Mean Post-emergence Herbicides used (litre/ha)	0.13	0.15	0.09	0.10	0.18	0.13	3 litres/ha	0.62
Mean NPK used (kg/ha)	15.98	13.33	49.34	20.75	15.28	22.94	100 kg/ha	60.88
Mean Urea used (kg/ha)	7.78	2.55	4.05	7.93	-	4.45	100 kg/ha of SUPA	21.67
Mean Micro-Nutrient used (kg/ha)	0.35	54.02	0.98	2.80	-	11.64		149.37
Mean Manual Weeding Rate (times)	0.57	1.11	1.46	0.45	0.49	0.82	2 times	1.04
Mean Seed used (seed/hole)	0.96	1.29	1.67	0.83	0.64	1.08	2 /hole	1.02
Mean Pesticides used for Spraying (litre/ha)	0.59	0.85	0.92	0.54	0.49	0.68	0.6 – 1.0 litre/ha	1.21

Source: Field survey, 2013

**Values are from Dugje, I.Y., L.O. Omoigui, F. Ekeleme, A.Y. Kamara, and H. Ajeigbe (2009): Farmers' Guide to Cowpea Production in West Africa and IITA (2003): Growing Cowpea in Nigeria - commercial crop production guide series.

Comparing agricultural practices of cowpea respondents with recommended practices, Table 4 shows that about 45.25 % of respondents complied with one time fertilizer application rate with standard deviation of 0.62. Although, most cowpea farmers applied fertilizer 14 days after planting; it was observed that the average age of fertilizer application across the states was 4 days after planting. The recommended spacing along and across rows is 75 cm by 50 cm; it was observed that most farmers did not comply with this standard, about 1.75 % complied. As touching the number of seeds recommended per hole, majority (87.50 %) complied with this. The mean volume of pesticide used for spraying cowpea was 0.68 litre per ha. This complied with recommendation. Table 4 further reveals that most of the farmers did not comply with the standard on fertilizer application, herbicide and labour use. Notably, the use of NPK and super phosphate fertilizer (SUPA) were under-utilized while pesticide use was adequate. Under-utilization of fertilizer may be due to rich soil nutrient availability. In addition, it was observed that only five farmers out of 720 (three from Gombe and two from Kaduna) tested their soil before fertilizer application.

3.3 Economic Analyses of Maize and Cowpea Production

Costs and returns structure for maize farmers across the five states is presented in Table 5. Kwara State had the highest Average Variable Cost (AVC) among the states (₦ 62,425.05/ha) while Bauchi had the least AVC (₦ 32,203.00/ha). In addition, highest yield was recorded in Kwara (1,860.90 kg/ha) with the highest Gross Margin (GM) ₦ 66,628.34/ha from Gombe State. The highest yield in Kwara State can be attributed to fertilizer usage which also influenced their cost. The average yield across the states was 1,643.97 kg/ha as presented in Table 5.

Costs and returns structure for cowpea farmers across the five states is presented in Table 6. Adamawa State had the highest Average Variable Cost (AVC) among the states (₦ 27,070.32/ha) while Kwara had the least AVC (₦ 19,307.01/ha). The average yield across the states was 338.39 kg/ha as presented in Table 6. This is far below the world average of 450 kg/ha. However, highest yield was recorded in Gombe (364.52 kg/ha) with the highest Gross Margin (GM) in Kaduna (₦ 19,540.13/ha).

Table 5. Cost and returns estimates for maize farmers across the five states

Items	Adamawa	Bauchi	Gombe	Kaduna	Kwara	Mean across the states
Land Clearing	2,776.92	1,906.13	2,327.81	3,127.04	9,152.56	3,859.11
Land Cultivation	6,997.38	3,807.53	4,916.68	6,571.83	12,763.29	7,019.34
Planting	2,679.25	2,148.51	1,742.39	2,176.24	3,447.00	2,439.04
Manual Weeding	5,204.59	3,479.40	6,502.15	5,698.50	8,798.12	5,943.74
Herbicides	2,675.14	1,435.74	1,064.32	2,193.04	2,977.14	2,069.79
Fertilizer	14,483.78	12,966.94	18,462.81	19,503.84	14,481.36	16,066.35
Fertilizer Application	2,586.84	3,437.14	3,280.78	2,554.97	4,897.70	3,352.48
Herbicide Application	742.52	182.06	141.60	541.80	275.05	376.38
Harvesting	3,447.59	2,338.10	3,274.83	3,351.59	4,003.64	3,283.05
Threshing, Winnowing & Packaging	2,944.41	2,591.12	3,464.86	4,464.28	1,629.18	3,016.76
Yield kg/ha	1,706.36	1,047.29	1,857.15	1,748.87	1,860.90	1,643.97
Price (₦/kg)	60	60	60	60	60	60
Average Total Revenue (₦/ha)	102,381.34	62,837.21	111,428.76	104,932.43	111,653.79	98,637.96
Average Variable Cost	44,538.41	32,203.00	45,015.87	50,183.13	62,425.05	46,868.49
Gross Margin (₦/ha)	57,842.93	30,859.35	66,628.34	54,749.30	49,228.75	51,857.72
IER	2.30	1.95	2.48	2.09	1.79	2.10

Source: Field survey, 2013 NOTE: All input cost are in ₦/ha and 1$ = ₦150 at the survey time

Table 6. Cost and returns estimates for cowpea farmers across the five states

Items	Adamawa	Bauchi	Gombe	Kaduna	Kwara	Mean across the states
Land Clearing	2,122.59	1,147.42	1,669.35	1,228.43	2,490.34	1,732.32
Land Cultivation	4,926.83	3,139.80	3,793.54	2,691.72	4,369.87	3,785.87
Planting	1,863.95	1,190.90	1,359.16	994.92	1,439.40	1,370.19
Manual Weeding	5,432.97	2,080.60	4,677.52	1,515.50	2,051.41	3,153.87
Herbicides	1,915.79	746.00	411.56	794.07	1,240.05	1,021.81
Fertilizer	2,600.10	6,970.89	5,942.44	3,377.62	1,680.56	4,115.35
Herbicide & Pesticide Application	901.62	402.34	1,168.41	1,240.09	2,363.59	1,215.18
Pesticides	878.89	970.36	1,175.01	350.17	793.17	834.19
Harvesting	2,891.29	1,887.47	3,299.60	1,395.68	1,910.33	2,278.10
Threshing, Winnowing & Packaging	3,536.30	1,680.99	2,466.21	1,623.27	968.29	2,055.61
Yield kg/ha	344.75	326.61	364.52	330.97	325.07	338.39
Price (₦/kg)	105	105	105	105	105	105
Average Total Revenue (₦/ha)	36,198.32	34,293.72	38,275.04	34,751.61	34,132.25	35,531.27
Average Variable Cost	27,070.32	20,216.76	25,962.78	15,211.48	19,307.01	21,562.49
Gross Margin (₦/ha)	9,128.00	14,076.95	12,312.26	19,540.13	14,825.24	13,968.78
IER	1.34	1.70	1.47	2.28	1.77	1.65

Source: Field survey, 2013 NOTE: All input cost are in ₦/ha and 1$ = ₦150 at the survey time

3.4 Profitability Analyses of the Crops

Profitability index (PI) is the ratio of payoff to investment of an enterprise. It is a useful tool for ranking enterprises because it allows the investor to quantify the amount of value created per unit of investment. Based on this, income-expenditure ratio (IER), a measure of profitability index, was used to measure the returns on investments for the five crops considered for the study as presented in Table 5 and 6. The Tables revealed that maize had IER of 2.1 while cowpea had IER of 1.65. Economic implication of IER is that the higher the ratio, the more rewarding is the enterprise. For example, a IER of 2.1 for maize implies that for every ₦1 spent on maize production, ₦1.1 is realized or ₦1.1 is created per unit of investment.

4. Concluding Remarks

Based on the evidence provided in the study, maize and cowpea production were profitable in the study area. However, farmers underutilized available production resources with the exception of land input. In addition, farmers did not comply with the recommended agronomic and management practices. The low usage of inputs especially fertilizer would affect the efficiency levels of maize and cowpea farmers implying that famers were not using the available inputs optimally therefore, effort must be geared towards enhancing input use to promote competitiveness of maize and cowpea production in the area. Finally, since land input was overutilized, there may be need for farmers to reduce the land under cultivation for better utilization of resources or increase other inputs usage.

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