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Comparative Economic Study of Mixed and Sole Cassava Cropping Systems in Nigeria

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Abstract

Agricultural economists continue to argue if mixed or sole cassava cropping system is more economically profitable and in terms of yield and returns to farmers particularly for Nigeria which is the world's largest producer of the crop. The study was carried out to analyse the economics comparatively of mixed and sole cassava cropping systems in Nigeria. The study made use of both primary and secondary data. Primary data were collected with the aid of well-structured questionnaires assisted with interview schedules. Field data collection was conducted between March and April, 2014. Multi-stage sampling technique was used to select four hundred and eighty (480) respondents across the six major cassava-producing states in Nigeria (Benue, Cross Rivers, Enugu, Kogi, Ondo, and Oyo). Data collected were analysed using descriptive statistics and comparative budgetary analysis. The study showed that mixed cropping system is more male-dominated than sole cropping system. The study also revealed that sole cassava cropping system is more economically profitable than mixed cassava cropping system while the later provides opportunities of all-year-round farm incomes to serve as a better poverty- alleviating mechanism.

Keywords:

Comparative economic study, mixed cropping, sole cropping, cassava, Nigeria.

Introduction

Nigeria is the world's largest producer of cassava while cassava continues to remain the most important crop in terms of production reaching a record high of 45 million tonnes in 2013. The low cost of production has made cassava to remain, the commodity with very high poverty reduction potentials for the Nigerian economy that is characterised with very poor citizens. In 1999, Nigeria produced 33 million tonnes, in 2000, the average yield per hectare was 10.6 tonnes, in 2010 production values reached about 37.5 million tonnes while yield and area values reached 12 tonnes per hectare and 3.13 million hectares respectively while a decade later, it produced approximately 45 million tonnes, which is almost 19% of production in the world. The production saw an increase of 15% between 2000 and 2006, with yields developing in correlation to production trends. The yield of cassava per hectare continues to increase due to several committed government initiatives and that of the international community in the crop (Adekanye et al, 2013; Asante-Pok, 2013; IITA, 2013).

There are two main categories of cassava varieties produced in Nigeria: *Manihot palmata* and *Manihot aipi*, or bitter and sweet cassava respectively (Nwabueze, 2009). Cassava is grown throughout the year, making it preferable to the seasonal crops of yam, beans or peas. It displays an exceptional ability to adapt to climate change (HarvestPlus, 2013) with a tolerance to low soil fertility, resistance to drought conditions, pests and diseases, and suitability to store its roots for long periods underground even after they mature. In Nigeria, the application of fertilizer for cassava production is very limited due to unavailability and high cost, and it is also grown on fallow lands (Adeniji et al, 2005). Harvesting of the roots after planting varies from 6 months to 3 years. There are four planting seasons in Nigeria, which vary according to the geo-ecological zone; these are from March to November in the rain forest, April to August in the derived savanna, May to July in the Southern Guinea savanna (SGS) and July to August in the Northern Guinea savanna (IITA, 2005). Pests and diseases are a concurrent cause of low cassava yields in Nigeria. The main pests affecting yields include the cassava green mite,

the cassava mealy bug, and the variegated grasshopper. The main diseases impacting the productivity of cassava are the cassava mosaic disease, cassava bacterial blight, cassava anthracnose disease, and root rot (Allison Oguru et al, 2008, IITA, 2007; PIND, 2011)

Economic importance of cassava in Nigeria

Cassava is by far the most important of the arable food crops grown in the Southern agro-ecological zones of Nigeria closely followed, in order of economic importance, by yam, maize and rice. It is the most paramount staple, food–security crop in the Sub-Saharan Africa and a mainstay of the rural and increasingly also the urban population. Famine rarely occurs in a community where cassava is widely grown, because in some places they are harvested continuously throughout the year, thus tidying farmers over hungry seasons after other crops have been planted but are not yet mature (IITA, 1982; IITA, 1997; Nweke, 1997; Kathundu and Chiwona-Karltun, 2001, Allison Oguru et al, 2008).

Nigeria's output of cassava is by far the highest in the world; about a third more than production in Brazil and almost double the respective volume of production of Indonesia and Thailand. Cassava production in each of the other African countries, who are also major producers, namely Democratic Republic of the Congo, Ghana, Madagascar, Mozambique, Tanzania and Uganda appears small in comparison to Nigeria's substantial output. By the year 2002, estimate of cassava output in Nigeria was put at about 34 million tonnes, but by 2003 the output has risen to about 37 million tonnes (CBN, 2002; FAO, 2004).

The production and marketing of cassava have several challenges which include high cost of input materials, high cost of labour, high cost of mechansation, inadequate extension services/ technical advice, inadequate funds, inadequate supply of high yielding cassava cuttings, bad access farm roads, effects of weather and climate, production and price fluctuations, lack of price control, preservation and storage, value addition among others (Bryceson et al, 2002; Daron et al, 2014; Mafimisebi, 2008; Anselm et al, 2005; Ajayi, 2014; Reed et al, 2013 and Richter et al, 2013)

Methods of cassava cultivation in Nigeria

The three conventional cropping systems practised in the world are sole cropping, mixed cropping and inter-cropping. Sole cropping is practised when a farm is planted with only one crop throughout a given cropping or farming season. This system of cropping is common among large commercial farms particularly in Europe, Australia and America. In mixed cropping, a major crop say plantain, cassava or yam with one or more supplementary crops are planted on a farm in a given cropping or farming season. This system of cropping is common among small-scale farmers in Africa, Asia, and Latin America. Lastly, inter-cropping is practised when two or more crops are planted together on a farm either in pure stands or in alternate rows (Allison-Oguru, 2004). Multiple or mixed cropping and inter- cropping are therefore known traditional cropping systems practised in most parts of Africa, Asia and Central America (Papendrick, et al, 1976; Beets, 1982; Francis, 1986, Allison Oguru et al, 2008).

Hoof (1987) and Reijtjes (1992) have observed that in most multiple cropping systems developed by small-holder farmers in the tropics, productivity in terms of harvestable products per land area is higher than under sole cropping. Steiner (1984) and Francis (1986) have also reported yield increases ranging between 20% and 60%. The relevant questions that readily come to mind are: what are the other advantages associated with multiple or mixed cropping and inter-cropping? Do these advantages translate to higher monetary returns i.e. could it be that multiple or mixed cropping enterprises are relatively more profitable than sole cropping enterprises? If multiple or mixed cropping and inter-cropping are so advantageous, how come that even in tropical Africa some farmers still practice sole cropping? This research is therefore set to addressing these questions in an empirical manner and to recommend among the two conventional cropping systems the one that is more profitable and suited to the factor of Nigeria. In view of above, the comparative economic study of mixed and sole cassava cropping systems in Nigeria was conducted with the following specific objectives which include to:

i. Examine the comparative socio-economic characteristics of mixed and sole cassava farmers in Nigeria
ii. Determine the comparative returns on mixed and sole cassava production in Nigeria
iii. Evaluate the comparative profitability of mixed and sole cassava production in Nigeria.

Materials and methods

The study area

The study was carried out in Benue, Cross Rivers, Enugu, Kogi, Ondo and Oyo States, Nigeria. These states were selected for the study because of their high cassava production figures and the availability of both mixed and sole cassava cropping systems.

Sampling technique and size

Multistage sampling technique was used in the selection of the respondents for this study. In the first stage, six (6) States were purposively selected on the basis of having the highest production figures for cassava in the country. Two (2) Local Government Areas (LGAs) were purposively selected in each of the states. In the second stage, two (2) cassava-producing communities were randomly selected in each of the LGAs using a list got from Agricultural Development Project of the Ministry of Agriculture and Rural Development of the States. This gives a total of twenty four (24) communities. Twenty farmers were purposively selected in each of the communities i.e. Ten (10) farmers were purposively selected on basis of having mixed cassava plots and another ten (10) farmers were selected on the basis of having sole cassava plots. The purposive sampling of farmers having each of mixed and sole cassava plots was made possible by snowball method. In this method, the farmer that has just being interviewed was asked to identify one or two other farmers that had mixed and sole cassava plot (s) in both categories in the last planting season. This gives a total of four hundred and eighty (480) cassava farmers and the enumerators proceeded to interview the identified cassava farmers.

Data and method of data collection

Primary data were used for the study. Data were collected by means of a well-structured questionnaire, which was pre-tested to improve data reliability. As a result of low literacy level of farmers, trained enumerators, who understood the local dialects, were used to administer the questionnaire on the farmers. A total of four hundred and eighty (480) questionnaires were administered, completed and returned. Field data collection was conducted between March and April, 2014.

Results and discussion

Comparative socio-economic characteristics of mixed and sole cassava farmers in the study area

Table 1 shows the comparative distribution of the respondents in the study area by their socio-economic characteristics. The results of age distribution from the table revealed that the respondents who were less than 30 years only accounted for 6.67% and 3.75% for mixed and sole cassava cropping systems respectively, while those older than 60 years accounted for 29.58% and 18.33% for mixed and sole cropping systems respectively. In all, 63.75% of the respondents were aged above 50 years for both categories in the study area. This implies that majority of the respondents were in their aging and less productive period. The young, agile and productive cassava farmers were few compared with the aged. Meanwhile sex distribution of the respondents indicates that 74.17% and 25.85% were male and female respectively for mixed cropping system while 65.42% and 34.58% were male and female respectively for sole cropping system. This indicates that mixed cropping system is more male-dominated than female. This is in accordance with the a priori theory that mixed cropping system is more strenuous and requires much more energy than the sole cropping system.

The results of marital distribution of the respondents indicate that mixed cropping system had more married respondents than the sole cropping system while sole cropping system had more single respondents than missed cropping system. The implication of this is that more married respondents for mixed cropping system will afford them the opportunity of getting family labour to be used for the more labour occasioned by cassava production with other crops on their farms. The distribution of level of education as also shown in Table 1 reveals that 57.08% and 32.00% had formal education up to primary school for mixed and sole cropping systems respectively. For mixed cropping, only 14.58% had secondary education while more than half (52.08%) for sole cropping system. The results for other categories of education remain fairly similar. This implies that cassava farmers who cultivated cassava as sole crop were more educated than those who cultivated the crop as mixed in the study area. The higher level of education

Socio-economic characteristics					
		Mixed cropping system		Sole cropping system	
	Range	Frequency	Percentage (%)	Frequency	Percentage (%)
Age of respondents (in years)	< 30	16	6.67	09	3.75
	31-40	41	17.08	29	12.08
	41-50	30	12.50	49	20.42
	51-60	82	34.17	109	45.42
	> 60	71	29.58	44	18.33
Sex of respondents	Male	178	74.17	157	65.42
	Female	62	25.83	83	34.58
Marital Status of respondent	Single	13	5.42	19	7.92
	Married	156	65.00	137	57.08
	Divorced	31	12.92	31	12.92
	Separated	25	10.42	34	14.17
	Widowed	15	6.25	19	7.92
Level of education	No formal education	41	17.08	18	7.50
	Primary school education	137	57.08	77	32.0
	Secondary school education	35	14.58	125	52.08
	Tertiary education	10	4.17	12	5.00
	Others	17	7.08	8	3.33
Family size	<5	103	42.92	143	59.58
	6 to 10	68	28.33	51	21.25
	> 10	69	28.75	48	20.00
Major source of finance	Personal savings	103	42.92	61	25.42
	Friends and relatives	68	28.33	23	9.58
	Cooperatives	30	12.50	18	7.50
	Microcredit institutions	20	8.33	46	19.17
	Commercial banks	19	7.92	92	38.33

Source: Computed from field survey, 2014

Table 1: Socio-economic characteristics of cassava farmers in the study area.

of sole cassava farmers could have influenced their adoption of sole cropping system as against the conventional mixed cropping system. Moreover, the percentage of respondents whose household size were either between 6 and 10 members or more than 10 members were 57.08% for mixed cropping system and 41.25% for sole cropping system. This implies that respondents who practice mixed cropping system had lager household size than those who practiced sole cropping system. This is expected, because the larger household size will find its use for increased labour occasioned by cultivating many crops on same plot.

Comparative cultural characteristics of mixed and sole cassava farmers in the study area

Table 2 shows the distribution of the respondents in the study area by their cultural practices. The distribution of the respondents according to farm size indicates that 61.67% and 21.67% of the respondents had farm size less than 1 hectare for mixed and sole cropping systems respectively. Those that had farm sizes ranging from 1 to 5 hectares constituted 23.75% and 20.42% for mixed and sole cropping systems respectively. Only about 7% and about 13% of the respondents had cassava farms bigger than 10 hectares for mixed and sole cropping systems respectively. It is therefore succinct to say that sole cassava farmers had larger farm size than mixed cassava farmers. The availability of large farm size explained why sole cropping was thriving among the sole cassava farmers in the study area. While combined use of both (42.08%) family and hired labour remained

Cultural practices					
		Mixed cropping system		Sole cropping system	
	Range	Frequency	Percentage (%)	Frequency	Percentage (%)
Farm size (in hectare)	< 1	148	61.67	52	21.67
	1 to 5	57	23.75	49	20.42
	6 to 10	18	07.50	108	45.00
	> 10	17	07.08	31	12.92
Experience in cassava faming (in years)	< 5	19	7.92	25	10.42
	6 to 10	41	17.08	87	36.25
	11 to 15	40	16.67	89	37.08
	15 to 20	49	20.42	26	10.83
	> 20	91	37.92	13	5.42
Type of labour	Family	72	30.00	56	23.33
	Hired	67	27.92	98	40.83
	Both	101	42.08	86	35.83
Method of weed control	Manual weeding	52	21.67	35	14.58
	Chemical control	57	23.75	148	61.67
	Both	131	54.58	57	23.75
Type of herbicides	Primextra	6	2.5	9	3.75
	Dansate	8	3.33	12	5.00
	Sarosate	115	47.92	147	61.25
	Weedoff	21	8.75	57	23.75
	Propan	4	1.67	8	3.33
	Select	4	1.67	4	1.67
	Nil	82	34.17	3	1.25
Extension service & Technical advice	Dev. agencies/ research inst	63	26.25	101	42.08
	ADP	87	36.25	81	33.75
	Farmers' association	50	20.83	40	16.67
	Fellow farmers	40	16.67	18	7.50

Source: Computed from field survey, 2014

Table 2: Cultural characteristics of cassava farmers in the study area.

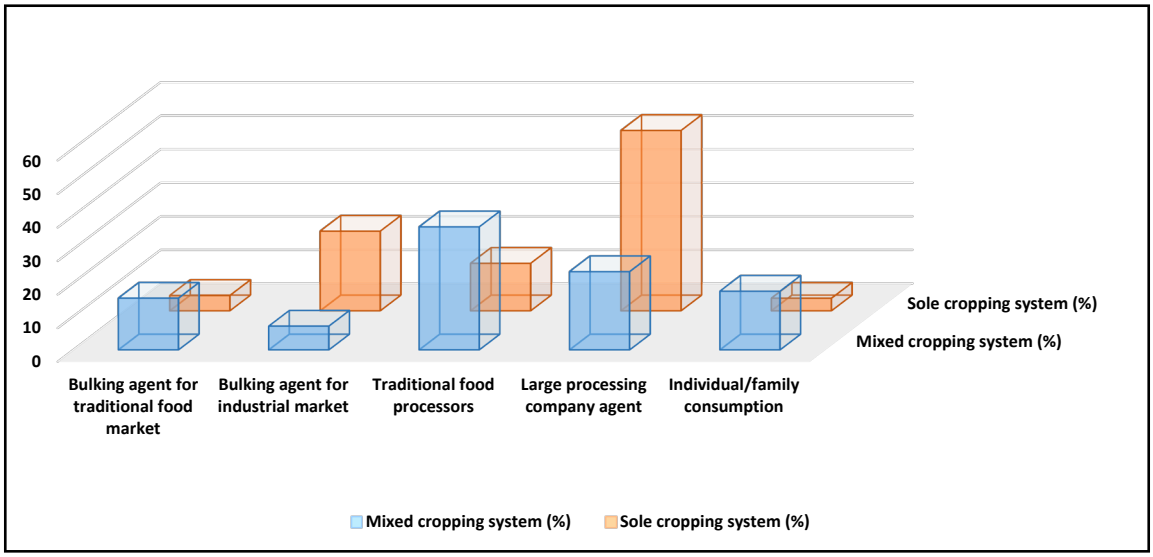
mostly preferred by the respondents from mixed cropping system, the use of hired labour (40.83%) remained the mostly preferred among respondents from sole cropping system. For both mixed and sole cropping systems, the use of both family and hired labour remained very popular. The respondents noted that, it is more cost effective and labour efficient to use both family and hired labour while providing opportunities of continuous farm income. From Table 2 also, the use of both (54.58%) manual weed and chemical control was the commonest among mixed cropping cassava farmers while use chemical control (61.67%) was the commonest among sole cropping cassava farmers in the study area. Sarosate remained the preferred herbicide for both mixed cropping cassava farmers (47.92%) and sole cropping cassava farmers (61.25%). However, most sole cropping cassava farmers used the herbicide than mixed cropping cassava farmers. Other herbicides used included Primextra, Dansate, Weedoff, Propan and Select. Meanwhile a large proportion (34.17%) of the respondents used no herbicide for mixed cropping system. Extension services and technical advice were mostly from Agricultural Development Project (ADP) (32%) for mixed cropping system while development agencies and research institutes (42.08%) provided the most of extension services and technical advice for sole cropping system. The development agencies and research institutes included the World Bank, Bill and Melinda Gates Foundation through the Cassava: Adding Value for Africa (C: AVA) project, the International Institute for Tropical Agriculture (IITA) and National Root Crops Research Institute (NRCRI).

Distribution of respondents by the type of cassava marketers in the study area

Figure 1 shows the distribution of the respondents by the type of cassava marketers the farmers sold their cassava to. Five types of cassava marketers were identified in the study area. They included bulking agent for traditional food market, bulking agent for industrial food market, traditional food processors, large processing company agent and individual/family consumption. From the figure, traditional food processors (36.67%) and large processing company agent (53.75%) were the largest customers for mixed and sole cassava farmers respectively. For mixed cropping system, the proportional of the respondents selling to bulking agent for industrial food market (23.75%) is significant higher than those of sole cropping system selling to the same customers (7.08%). Meanwhile individual/family consumption was higher in sole cropping system (17.50%) than in mixed cropping (3.75%). The traditional food processors included those processing the cassava roots into *gari, lafun, fufun* and *apu* while large company processing company agent involved those who buy cassava roots and process them into dry or wet starch, high quality cassava flour (HQCF) which further served as semi raw materials for food and bakeries, confectionary companies and pharmaceutical companies.

Profitability analysis of cassava production in the study area

The results of the comparative budgetary analyses used to determine the level of profit earned from cassava production from mixed and sole cropping systems are shown in Tables 3 and 4 respectively. The results reveal that the TVC per hectare for mixed cassava cropping system including the cost of other crops cultivated along cassava was ₦ 219,861 (USD 1357.17) while it was ₦ 126,812 (USD 782.79) without incorporating cost of other crops. Meanwhile TVC per hectare for sole cassava cropping system was ₦ 156,568 (USD 966.47). The corresponding value for the TFC per hectare however remained same for both mixed and sole cropping systems which was ₦ 31,658 (USD 195.42). Meanwhile, the TC per hectare was ₦ 252,947 (USD 1561.40) for mixed cropping system and ₦ 188,225 (USD 1161.88) for sole cropping system. This level of TC per hectare for cassava production is smaller and more affordable by farmers for sole cropping system than for mixed cropping system. This is because the TC of other crops add up for TC otherwise when considering the TC for cassava production alone in mixed cropping system, it is far smaller and cheaper than that of the sole cropping system. Hence, cassava production is more cost effective in mixed cropping system than in sole cropping system. Variable costs, which include cost of input materials, cost of labour, transportation among others accounted for 83.12% of TC while FC accounted for the balance. The result of the high percentage of variable costs agrees with the results of (Mafimisebi, 2008) where variable costs accounted for 80% of the TC. The TR, GM and NFI per hectare for mixed cropping



Source: Computed from field survey, 2014

Figure 1: Distribution of respondents by the type of cassava marketers in the study area.

Number of hectares		504			
Total output (in tonnes)		11,229			
Output per hectare (in tonnes)		22			
Price per tonne		16,000			
		Total		Per hectare analysis	
		Amount (in Naira)		Amount (in N)	Amount (in USD)
Variable cost	Input materials	19,005,670			
	Labour	22,488,670			
	Transportation	18,406,400			
	Others	4,012,300			
Total variable cost (TVC)		63,913,040	110,809,935	219,861	1357.166556
Fixed cost	Land and rent	14,685,567			
	Farm equipment	1,989,675			
Total fixed cost (TFC)		16,675,242			
Total cost (TC)= TVC+TFC		80,588,282	127,485,177	252,947	1561.399875
Total revenue (TR)= TO*P		179,664,000	398,561,560	790,797	4881.461395
Gross margin (GM)=TR-TVC		115,750,960.00	287,751,625	570,936	3524.294839
Net farm income=TR-TC		99,075,718.00	271,076,383	537,850	3320.06152

Source: Computed from field survey, 2014

Table 3: Profitability analysis of mixed cropping system of cassava production.

Number of hectares		552			
Total output (in tonnes)		14,186			
Output per hectare (in tonnes)		26			
Price per tonne		16,000			
		Total	Per hectare analysis	Per hectare analysis	
		Amount (in Naira)	Amount (in Naira)	Amount (in USD)	Amount (in USD)
Variable cost	Input materials	19,005,670	34,431	212.53433	
	Labour	34,000,670	61,595	380.21862	
	Transportation	29,406,700	53,273	328.84572	
	Others	4,012,300	7,269	44.868268	
Total variable cost (TVC)		86,425,340	156,568	966.46694	1357.166556
Fixed cost	Land and rent	14,685,567	26,604	164.224	
	Farm equipment	2,789,445	5,053	31.193472	
Total fixed cost (TFC)		17,475,012	31,658	195.41747	
Total cost (TC)= TVC+TFC		103,900,352	188,225	1161.8844	1561.399875
Total revenue (TR)= TO*P		226,976,000	411,188	2538.2	4881.461395
Gross margin (GM)=TR-TVC		140,550,660.00	254,621	1571.7331	3524.294839
Net farm income=TR-TC		123,075,648.00	222,963	1376.3156	

Source: Computed from field survey, 2014

Table 4: Profitability analysis of sole cropping system of cassava production.

system were ₦ 790,797 (USD 4881.46), ₦ 570,936 (USD 3524.30) and ₦ 537,850 (USD 3320.06) while the TR, GM and NFI per hectare were ₦ 411,188 (USD 2538.20), ₦ 254,621 (USD 1571.73) and ₦ 222,963 (USD 1376.32) respectively. The higher GM and NFI from mixed cropping system indicate a more but false profitability level than sole cropping

for cassava production. But when removing the GM and NFI of other crops cultivated alongside cassava in the mixed cropping system. The actual profit earned from cassava production indicate that cassava production under sole cropping system is by far better.

Conclusion

The results of analysis shows that mixed cropping system is more male-dominated than sole cropping system. This is in accordance with the a priori theory that mixed cropping system is more strenuous and requires much more energy than the sole cropping system while sole cassava farmers had larger farm size, were more educated than mixed cassava farmers. The study also revealed that with regards to GM and NFI from mixed cassava cropping and sole cropping systems, mixed cropping system appear to be a better income earner than sole cassava cropping systems. This is because of the aggregation of other incomes from other crops planted alongside cassava and the cost effectiveness of having to share cost with these crops. The scenarios above have been erroneously believed to made mixed cassava cropping system more profitable than sole cropping system. With adequate separation of cost and income of cassava alone under mixed cropping system through a detailed farm accounting system that appropriate individual costs and incomes to each individual crops that make up the mixed cropping system and compared with cassava under sole cropping system as shown in tables 3 and 4 and explained above, the returns to cassava under sole cropping system is higher than that of the mixed cropping system. The sole cropping system is therefore more economically profitable than mixed cropping system. The reasons are not far-fetched. It is usually practiced on commercial scale, there is little or no competition for soil nutrients, soil water, soil air and soil microbes by other crops. On the contrary, the mixed cassava cropping system has remained the more commonly practiced among the people of Nigeria because it provides the people with all-year-round farm incomes from the different crops that make the mix thereby serving a much more poverty-alleviating mechanism than the sole cassava cropping system.

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