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COMPARATIVE ANALYSIS OF ENTERPRISE COMBINATION COSTS AND RETURNS IN CASSAVA-BASED FOOD CROP FARMING SYSTEMS IN DELTA STATE, NIGERIA

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ABSTRACT

Comparative analysis of Enterprise combination costs and returns in cassava–based food crop farming systems in Delta State, Nigeria were studied with the purpose of establishing the most profitable number and types of enterprises (in terms of net farm income generation) to combine Cross sectional data were collected from a sample of 443 farmers, selected using multi-stage sampling technique during the 2004/2005 and 2005/2006 cropping seasons. The results showed that cassava production is basically carried out on small-scale basis, with average holding, net farm income and returns to investment of about 1.69 hectares, N16711 and 24% respectively. Labour constituted the single most important cost item, accounting for about 79% of total cost of production on the average. Generally, all forms of enterprise combinations generated higher net farm income per unit of land cultivated than cassava sole cropping. In all, combining four enterprises significantly generated the highest net farm income, with Cassava + Yam + Maize + Vegetable combination giving the highest of about **N**21514 per hectare. It is recommended that appropriate spatial arrangements of crop should be worked out to make possible the profitable use of mechanised devises so that mixed cropping can be practiced on large scale basis thereby reducing labour cost and increased volume of output per resource. Also, appropriate policies to enable the farmers have easy access to sufficient land for cultivation and affordable production credit should be put in place. The study has shown that combing two or more enterprises is more profitable then sole enterprises.

Keywords: cassava production, enterprise combination, economic land equivalent ratio, Delta State, Nigeria.

INTRODUCTION

Roots and tuber crops comprise crops covering several genera. They are staple food crops, being the source of daily carbohydrate intake for the large populace of the world. The carbohydrates are mostly starchy in nature, found in storage organs, which may be enlarged roots or tubers (O' Hair, 1990). The root crops, typified by cassava, are 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.

The name cassava is a collection of many species belonging to the group Manihot of the family Euphorbiaceae. The crop originated from Southern America, from where it was introduced to the African continent by Portuguese traders, first into West Africa via the Gulf of Benin and the Congo River during the second half of the 16th century and, secondly, into East Africa towards the end of the 18th century (IITA, 1990). The two popular species are Manihot utilisima and Manihot esculenta.

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 (IITA, 1997). Famine rarely occurs in a community where cassava is widely grown, because in some places they are harvested continuously through out the year, thus tidying farmers over hungry seasons after other crops have been planted but are not yet mature (IITA, 1982; Nweke, 1997; Kathundu and Chiwona-Karltun, 2001).

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). At national levels, Benue and Kogi state in the North Central Zone of Nigeria are the highest producers of cassava. Cross River, Akwa Ibom, Rivers and Delta states dominate cassava production in the South-South (FOS, 1995; PCU, 2003; IITA, 2004).

In Nigeria, cassava is produced either as sole crop or in association with other crops in intercropping farming systems. In a study by (Nweke, 1997), out of 494 fields surveyed where cassava was grown, 36%, 38% and 26% of the farmers grew the crop as sole, major and minor crop respectively. This implied that in about 74% of all cassava farms surveyed, the crop was grown as a major component. The complex crop associations, as obtains in intercrop farms, serve as an insurance against crop failure, erosion control and enhance the use of available resources as well as providing more balanced diets for the farming households (Unamma, *et. al*, 1989; Polson and Spencer, 1992; Okigbo, 1995; Sullivan, 2001; Alabi and.Esobhawan, 2006).

While farmers have different reasons for the cropping systems adopted and the enterprises combined, two major reasons our most outstanding, that of net income stabilization and maximisation. Income

maximization entails comparison of costs and returns from the different enterprises combined. As a decision guide to farmers towards the realization of their production goals, it is necessary that they know the most reliable number and types of enterprises to combine. In Delta State, as it is in most of the southern agro ecological zones of Nigeria, farmers grow cassava in mixtures with maize, melon, cocoyam, yam and vegetables while some grow it sole (Unamma, *et. al*, 1989). Traditionally, an average of three to five crops is combined in a mixture. The best combination to give farmers the results desired is a decision they often take by trial and error method, the outcome of which is usually uncertain. This study therefore, seeks to determine the costs and returns as well as economic land equivalent ratio (ELER) and its relationship with net farm income for different enterprise combination in cassava–based food cropping systems in Delta State, Nigeria, with a view to establishing the most profitable number and types of combinations.

MATERIALS AND METHODS

The data used for this study was based on a cross sectional survey of cassava farmers during the 2004/2005 and 2005/2006 cropping seasons in Delta State, Nigeria. The State lies roughly between longitude $5^o\ 00^/$ and $6^o\ 45^/$ east and latitude $5^0\ 00^/$ and $6^0\ 30^/$ north of the equator. It is bounded by Edo, Ondo, Anambra, Rivers and Bayelsa States to the north, north-west, east and south–east respectively.

The rainfall regime of Delta State can be described as humid to sub-humid with distinct dry and wet seasons in most parts with the former, which occurs between December and April, characterised by a dry and dusty north-easterly harmattan-inducing wind. The average rainfall is about 266.5cm in the coastal areas and 190.5cm in the northern part with the month of July recording the heaviest rainfall (Proper Communications Ltd, 1997; Aweto, 2002). The daily temperature ranges from 29°C to 44°C with an average of about 30°C. Generally, a number of crops well adapted to the rainforest humid tropical climates are grown, some of which are cassava, yams, cocoyams, maize, and rice. Also of importance are assorted vegetable, livestock productions and capture fishery, as well as forest and wildlife products. Samples for the study were drawn using multi–stage selection process using systematic random sampling technique. Out of the 25 local governments of the state, five were purposively dropped from the universe on the ground of low cassava production intensities, namely, Bomadi, Burutu, Patani and Warri north, where the major rural occupation is fishing (Akatugba–Ogisi, 1994) and Warri south, which is a major oil industrial area. Five out of the remaining 20 LGAs namely, Aniocha South, Ethiope East, Isoko North, Oshimili North and Ughelli North drawn from the three Agricultural Development Programme (ADP) Agro–Ecological Zones were randomly selected. The target population was farmers who produce cassava either as sole crop or as the major component of different mixed crop arrangements. Data were collected from 443 (of 450 intended) cassava farmers. The study spanned over 24 months period (March, 2004 to February, 2006).

Input-output data on cassava–based food crop farms were collected from each of the selected farm households. Besides input–out data, information was also collected on other socioeconomic characteristics of the farmers. These include; farming experience, age and formal education level of head of respondents, access to credit facilities, cropping systems, yield of cassava tubers and other crops, variable input and output prices, and capital assets among others.

Data were analysed using descriptive statistics, economic land equivalent ratio (ELER), net farm analysis and analysis of variance (ANOVA). Differences in mean net farm income among enterprise combinations were separated by means of Fischer's least significant difference (FLSD).

The economic land equivalent ratio (ELER) was calculated by modification of the land equivalent ratio as suggested by (Sylvia, 1999). Land equivalent ratio according to (Mead and Willey, 1980) is defined as the total land area of sole crops required to produce the same yields as would be obtained when they are intercropped. The LER was calculated using the formula

$$LER = \sum_{i=1}^{n} \left(Q_{m_i} / Q_{s_i} \right), \qquad (1)$$

where Q_m is the yield of each crop in the intercrop or mixed crop farms, and Q_s is the yield of each crop in the sole crop farms. For each crop a ratio is calculated to determine its partial LER, and then the partial LERs are summed to give the total LER for the intercrop. An LER value of 1.0 indicates no difference in yield between the intercrop and the collection of monocultures. Any Value greater than 1.0 indicates a yield advantage for intercrop (Mazaheri and Oveysi, 2004; Mazaheri, *et. al*, 2006). An LER is a ratio between quantities. To measure ratio between values of crops under mixed and sole cropping systems, an economic land equivalent ratio (ELER) was calculated. Economic land equivalent ratio is defined as the total land area of sole crops required to generate the same revenue as would be obtained when they are intercropped. The economic land equivalent ratio was obtained following from (Sylvia, 1999) by multiplying the relative quantities of output by their unit market price as follows:

$$ELER = \sum_{i=1}^{n} \left(P_i Q_{m_i} / P_i Q_{s_i} \right) = \sum_{i=1}^{n} \left(R_{m_i} / R_{s_i} \right), \qquad (2)$$

where P_i is the market unit selling price of *i*th crop and R is the revenue generated.

RESULTS AND DISCUSSIONS

Summary statistics of variables showing age of farmers, their educational levels (in terms of numbers of years of formal educational attainments), mean farm size, labour input, capital input and rent on land, as well as gross value of output, net farm income and percentage returns on investment are as given in Table-1. The farmers

were aged between 21 and 69, with a mean of about 42 years. Educationally, they spent on the average about 9 years acquiring formal education, although some of them had no formal education at all. They were quit experienced in farming activities with some having as much as 31 years and an overall mean of about 16 years.

Table-1. Summary statistics of variables for all farmers.

Variable	Mean	Standard deviation	Minimum	Maximum
Age of farmer (Years)	41.57	7.33	21	69
Education of farmer(Years)	8.71	5.03	0	22
Farming experience (Years)	16.34	5.12	1	31
Farm size (hectare)	1.69	0.37	0.19	4.68
Labour input (₦/ha)	55849.20	14098	20099	67321
Capital input (₦/ha)	12464.17	6701	1893	18910
Rent on land (₦/ha)	2396.40	434	1035	5567
Value of output(₦/ha)	87420.79	16526	36909	134195
Net farm income (₦/ha)	16711.02	10709	5876	45609
Returns on investment (%)	23.63	9.18	5.67	33.21

Source: Field data 2006.

The farmers are characteristically smallholders with farm size in hectares ranging from 0.19 to 4.68 and an average of about 1.69. Expenses on labour, capital and rent on land per hectare were about ₦55849, ₦12464 and N2396 respectively. This shows that labour constitute the single most important cost item in cassava–based food cropping systems in the state. Capital input is made up of expenses on planting materials, fertilizers, other agrochemicals and depreciation costs of farm fixed assets as well as other annual fixed costs. Mean gross value of output/ha, net farm income/ha and percentage returns on investment were about ₦87421, ₦16711 and 24% respectively. This result, as also was noted by (Olayide *et. al*, 1980) shows that cassava–based food crop production is labour intensive. Similarly, (Chukwuji, 2006) also observed that labour constituted about 57% of the total cost, leaving only about 43% to be shared by other variable inputs and fixed costs. Although, the percentage returns on investment is high compared to the current average savings interest rate of about 5% per annum, the fact that many of the farmers cultivate farms less than one hectare means that they earn less than ₦17000 per annum as their net income. The only way they can reap benefits of the high returns on investment is to be empowered to increase the scale of their holdings. This can be done through appropriate policies to enable them have easy access to sufficient land for cultivation and affordable production credits.

The revenue, economic land equivalent ratio (ELER), cost and net farm income analysis of the farmers by their different number and types of enterprise combinations are presented in Table 2. In terms of the number of enterprises combined, four enterprise combinations was the most popular among them, with 183 (about 41%) of the farmers combining four different crops in their farms. Out of this, 89 (about 20%) practice Cassava + Yam + Maize + Vegetable enterprise combination. About equal number (about 14%) of the farmers practice five, three and two enterprise combinations respectively, while about 17% practice cassava sole cropping. The economic land equivalent ratio ranged from 1.00 in Cassava sole enterprises to 1.94 in Cassava + Yam + Maize + Vegetable, the overall mean being 1.43. This shows that all forms of enterprise combinations in cassava–based food crop production systems in the state produce higher net revenue per unit of land than cassava sole cropping. The higher intercropped yield appeared to be achieved by increased efficiency in the use of available soil nutrients and efficient conversion of light energy into biomass arising mainly due to factors such as niche overlap, beneficial interactions, and modification of the microclimate by the components in the mixtures as was noted by (Alabi and.Esobhawan, 2006).

The last column of Table 2 gives the net farm income of the producers obtained as the difference between gross revenue and total cost of production per hectare. In all, combining four enterprises significantly generated the highest net farm income, with Cassava + Yam + Maize + Vegetable combination giving the highest of about ₦21514 per hectare. Generally, five and three enterprise combinations produced statistically the same amount of net farm income per hectare. Sole cassava enterprises produced the least amount of net farm income of all the different number of combinations, with a mean of about ₦12792. From all indications therefore, combination of four enterprises appears to be the optimum, as all combinations less than and more than four produced lower net farm income.

Table-2. Enterprise combination costs and returns in cassava-based crop farms.

Crop mixture	Number of farms	Gross revenue/ha (₦)	*Economic land equivalent ratio (ELER)	Total cost/ha (₦)	**Net farm income/ha (₦)
Cassava + Yam + Maize + Vegetable	89 (20.09)	103204	1.94	81690	21514[a]
Cassava + Yam + Maize	13 (2.93)	93086	1.75	73152	19934[b]
Cassava + Maize + Yam + cocoyam + vegetable	61 (13.77)	92764	1.53	75367	17397[c]
Cassava + Maize + Vegetable	21 (4.74)	83556	1.65	66212	17344[c]
Cassava + Yam	11 (2.48)	95616	1.38	78609	17007[c]
Cassava + Maize + Cocoyam	9 (2.03)	85577	1.22	68719	16858[c]
Cassava + Maize	31 (7.00)	77831	1.27	60982	16848[c]
Cassava + Yam + Maize + Cocoyam	26 (5.87)	89429	1.31	73035	16393[d]
Cassava + Yam + Vegetable	10 (2.26)	84604	1.31	68587	16017[d]
Cassava + Vegetable	7 (1.58)	80215	1.06	64575	15640[d]
Cassava + Yam + Cocoyam + Vegetable	30 (6.77)	76894	1.32	61987	14907[e]
Cassava + Yam + Cocoyam	5 (1.13)	84718	1.20	69840	14878[e]
Cassava + Cocoyam	12 (2.71)	82429	1.01	67928	14501[e]
Cassava + Cocoyam + Vegetable	4 (0.90)	80688	1.19	66199	14489[e]
Cassava + Maize + Cocoyam + Vegetable	38 (8.58)	80369	1.39	66660	13710[f]
Cassava only	76 (17.16)	77041	1.00	64250	12792[g]
TOTAL	443 (100)	87421*	1.43	70710*	16711*
Mean for 4 enterprise combinations	183	92192	1.63	74109	18083[aa]
Mean for 5 enterprise combinations	(41.31)	92764	1.53	75367	17397[ab]
Mean for 3 enterprise combinations	61 (13.77)	85925	1.49	68706	17220[ab]
Mean for 2 enterprise combinations	62 (14.00)	82216	1.21	65940	16276[ac]
Mean for Cassava sole enterprise	61 (13.77)	77041	1.00	64250	12792[ad]
Mean for all farms	76 (17.16)	87421*	1.43*	70710*	16711*
	443 (100)				

** Means with different super scripts are significantly different ($P \leq 0.05$)
* Weighted mean values

Source: Field data, 2006.

The predictive equation of net farm income on the economic land equivalent ratio (ELER) as presented in Table-3 shows that positive relationship exists between them. The equation indicates that enterprises with higher economic land equivalent ratio ceteris paribus generates higher net farm income all things being equal than those with lower economic land equivalent ratio. With an R^2 of 0.72, it means that about 72% variation in net farm income can be predicted on the basis of the level of economic land equivalent ratio.

Table-3. Relationship between economic land equivalent ratio and net farm income.

$NFI = \underset{(1625.50)*}{6570.84} + \underset{(1187.06)*}{7203.71}ELER$	
Correlation coefficient (R)	0.851208
R square value (R^2)	0.724555
Adjusted square value (R^2)	0.704881
F Value	36.82691

NFI = Net farm income
ELER = Economic land equivalent ratio
Figures in parentheses are standard errors
* Coefficients significant at $P \leq 0.05$
Source: Field data, 2006.

CONCLUSIONS

The study shows that cassava production is basically carried out on smallholder basis, with average farm size per holder of about 1.69 hectares, mean net farm income of ₦16711 per hectare as well as returns to investment of about 24%. The results further show that combination of two or more enterprises in cassava–based food crop production systems in the state produce higher revenue per unit of land used than cassava sole cropping. The higher intercropped yield appeared to be achieved by increased efficiency in the use of available soil nutrients and efficient convention of light energy into biomass arising mainly due to factors such as niche overlap, beneficial interactions, and modification of the microclimate by the components in the mixtures.

In order to reap benefits of the high returns on investment the farmers have to be empowered to increase the scale of their holdings. This can be done with appropriate policies to enable them have easy access to sufficient land for cultivation and affordable production credits. Also, since mechanization is difficult under mixed cropping systems, it is recommended that spatial arrangements of crop to make possible the use of mechanized devises should be worked out so that mixed cropping can be practiced on large scale basis where the use of mechanization is profitable. The availability of affordable mechanization devises will make cassava–based crop production depend less on labour intensive production systems and thus reduce labour costs.

In all, combining four enterprises significantly generated the highest net farm income, with Cassava + Yam + Maize + Vegetable combination giving the highest of about N21514 per hectare. The predictive equation indicates that enterprises with higher economic land equivalent ratio generates higher net farm income all things being equal than those with lower economic land equivalent ratio.

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