RETURNS, PRODUCTIVITY AND CONSTRAINTS ANALYSES OF CASSAVA/MAIZE/MELON MIXED CROPPING ENTERPRISE IN ISI-UZO LOCAL GOVERNMENT AREA, ENUGU STATE, NIGERIA

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Abstract
The study was conducted in Isi-Uzo LGA of Enugu State, and evaluated the productivity and profitability of cassava/maize/melon mixed cropping with the aim to determine the degree and direction of influence of the production factors and identification of constraints militating against the enterprise. Multistage and purposive random sampling procedures were used to select 75 farmers who engaged in the enterprise during the 2016/2017 cropping and harvesting seasons. Data were collected from primary source made up of the respondents through the administration of structured questionnaire. Data collected were analysed for costs and returns, productivity index and ordinary least squares regression. The findings of the study showed that the enterprise was generally profitable. The partial productivity indices of planting materials, labour, and land were 2.38, 5.88, and 13.37, respectively, while the total factor productivity index was 2.15. The regression analysis result showed that planting materials, farm size, labour, and education positively and significantly influenced productivity at 1% and years of farming experience at 10% levels, while age inversely influenced productivity at 1%. The major limiting factors of the enterprise were high costs of fertilizer, labour, planting materials and poor access to credit. Efforts should therefore be geared towards supporting the farmers by making credit, planting materials and other inputs available and affordable at the right time in order to increase their productivity. Similarly, the farmers would need to be educated through extension agents on the modern farming practices to further enhance their performance.

Keywords: Productivity, Cassava, Maize, Melon and Enterprise

Introduction

In the traditional farming systems of Nigeria and mainly in the Southeast agro economy, there is usually simultaneous cultivation of different crops on the same piece of land in a mixed cropping system. The farmers engage in this system for varied reasons which include insurance against crop failure, yield increment, food security, weed control, labour distribution, and hedging against low farm revenue (Poggio, 2005, Mba *et al.,* 2003). Intercropping of cereals, legume and root/tuber crops is one of the common mixed cropping enterprises in Southeast Nigeria farming system. This study therefore, involves a cereal (maize), a legume (melon), and root/tuber (cassava). Maize commonly features together with cassava and melon, while cassava is usually the base crop in the mixture. According to Iken and Amusa (2004), Ogbonna and Obi (2010), Ijoyah *et al.,* (2012), about 70% of cassava, 73% of maize and 55% of melon in Nigeria are produced under intercrop system. It was observed that intercropping cassava, maize and melon gave land equivalent ratio value of 2.51, and 2.47 respectively in years 2010 and 2011 indicating that higher productivity per unit area was achieved by growing the three together than by growing them separately (Ijoyah *et al.,* 2012). Intercropping provides yield advantages in the form of increases in overall productivity and minimization of cost and crop failure (Sullivan, 2001). In similar vein, Fasornti (2006) indicated that mixed cropping has the advantage over

sole cropping as diversification guards against crop failure, leading to higher yield stability and risk reduction.

In Enugu State in particular, small scale farmers dominate the farming occupation and most of them engage in cassava/maize/melon production enterprise. No doubt, as empirical and commonplace knowledge holds, the productivity and efficiency of such mixed cropping enterprise would be influenced by several factors which include among others, availability of improved planting materials, farm size, labour, education, availability of fertilizer, extension contact, aging of the farmers and access to finance. Often, the level at which these resources are available to the farmers results in their productivity being quite low. It is against this background that the study evaluated the productivity, profitability and determined the extent and direction of influence of the factors involved in the enterprise in Isi-Uzo LGA of Enugu State.

The Study Area

The study was conducted in Isi-Uzo LGA of Enugu State, which is located in Enugu East Agricultural Zone of the State and lies within coordinates 6^0 $47^{/}$ N and 7^0 $43^{/}$ E, with a population of 148, 415 with an area of 877Km^2 (https://en.wikipedia.org/wiki/isi-uzo). The local government experiences two distinct seasons, namely rainy season (April – October) and dry season (November-March). The annual rainfall ranges from 750mm to 1200mm and the mean temperature of 36^{0C}. Farming is the predominant occupation of the people. The majority of the farmers are smallholders. They cultivate crops such as yam, cassava, maize, rice, vegetables, sweet potato, oil palm, and orange, and as well rear livestock such as goat, sheep and poultry on small scale also.

Sampling Procedure

Multistage and purposive random sampling procedures were used for the study. Purposive sampling was adopted to select only farmers who engaged in cassava/maize/melon mixed intercrop. For multistage random sampling, five communities were randomly chosen, from each of which three villages were randomly selected, making it a total of 15 villages that were surveyed. Finally, in each of the villages selected, 6 farmers who cultivated cassava/maize/melon mixed intercrop were chosen giving a total of 90 farmers who made up the sample at the initial stage.

Data Collection

Collection of the data was conducted between April 2016 and February 2017 to cover the planting and harvesting of the crops. Data for the study were generated from primary sources, precisely from the 90 respondents (arable farmers) originally selected at the onset of the study. All through data collection, Extension Agents (EAs) in the L.G.A assisted the researchers in sample selection and administration of questionnaire to the respondents. Socioeconomic and production data were generated. The socioeconomic data included relevant personal profile of the farmers including age, marital status, education, experience in farming, and extension contact. The production data included quantity of planting materials, labour utilization, farm size, agrochemicals, fertilizers, insecticides and herbicides. Because the study was an enterprise analysis, price data were also required to determine the cost of production inputs and value of output. Where necessary, imputed values were used, especially in estimating the approximate cost of labour, much of which was provided by respondents' households. The approach was also applied in estimating the value of unharvested output and own consumption by the households.

In order to ensure validity of production data including market prices of output, the study employed the technique of repeated visits to the respondents, by which the production cycle was covered from land

preparation through harvesting and sales. For socioeconomic data, a once-and-for-all data collection visit was done. After collation and editing of data, it became necessary to use the responses of 5 farmers from each of the 15 villages, hence giving a total of 75 farmers who formed the final sample.

Techniques of Data Analysis

The data collected were analysed by means of farm budgeting and gross margin analysis, productivity index and Ordinary Least Squares (OLS) technique. The farm budgeting and gross margin was used to analyse the cost and return of the cassava/maize/melon mixed enterprise. This was aimed at evaluating the profitability of the business. The expressions are stated as follows:

GM = GI - TVC

NFI = GM – TC, or NFI = GI - TC

TC = TVC + TFC

where: GM = Gross Margin, GI = Gross income or revenue, NFI = Net farm income or revenue, TC = Total cost of production, TVC = Total variable cost, TFC = Total fixed cost.

Return per naira invested (RNI) was obtained by dividing the gross income (GI) by total cost (TC). Therefore, RNI = GI/TC where RNI = Return per naira invested, GI = Gross Income and TC = Total cost. If RNI >1; it implies there is profit in cassava/maize/melon intercrop production, RNI = 1, the farmers are at break-even, RNI < 1, the farmers are at loss. Productivity is an index that measures output (goods and services relative to inputs (land, labour, materials, etc.) used to produce the output. As such it can be expressed as output/input ratio (Coelli et al., 1998). Productivity is usually expressed in one of the three forms; partial factor productivity, multifactor productivity and total factor productivity (Hughes, 2001). Partial factor productivity considers only a single input which appears as output/labour, output/capital or energy. A multifactor productivity measures more than a single factor, example both labour and capital while total factor combines the effect of all the resources used in the production of goods and services (Fakoyede, 2009).

To evaluate the Total Factor Productivity (TFP) and Partial Factor Productivity (PFP) of the factors used in the production of the cassava/maize/melon mixed enterprise, productivity index was estimated. This is stated thus:

$$TFP = \frac{\text{Gross Value of Output (₦)}}{\text{Gross Value of Inputs (₦)}}$$

$$PFP = \frac{\text{Value of Output (₦)}}{\text{Value of a particular input (₦)}}$$

The determination of the factors that influence the productivity of the enterprise was achieved using multiple regression analysis involving Ordinary Least Square (OLS). The production function was fitted with four functional forms, Linear, Semi-log, Double-log and Exponential and the lead equation was selected based on established statistical and econometric criteria. The implicit form of the multiple regressions is specified thus:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, U) \quad \ldots\ldots 1$$

where: Y = Gross value of output (₦), X_1 = Age (Year), X_2 = Education (Years), X_3 = Farming experience (Years), X_4 = Extension contact, X_5 = Material inputs (Kg), X_6 = Farm size (Ha), X_7 = Labour (Mandays), U = Error.

Results and Discussion

Profitability of the Cassava/Maize/Melon Mixed Intercrop Enterprise

Table 1 shows the cost and return analysis which was used to determine the profitability of the mixed crops involved in the study area on per hectare basis. The cost items of production for an average hectare of cassava/maize/melon mixed crop enterprise were maize and melon seeds, cassava cuttings, fertilizer, herbicides, labour, and depreciation on farm tools, rent, and land improvement. Very few of the farmers paid for rent and lease as most of them were indigenes of the area; therefore, they inherited their farm land, but they spend more money on maintaining the soil because the fertility of the soil is declining. The total cost of the enterprise was ₦ 166,515.00. Out of this, total variable cost was ₦ 137,950.00 which represents 82.85% of the total cost while fixed cost was ₦ 28,565.00. The costs involved were planting materials (cassava cuttings, maize and melon seeds, fertilizer, and herbicides) ₦ 87,750.00, labour ₦ 48,000.00, depreciation of farm tools ₦ 1,750.00 and land ₦ 26,815.00 representing 54.02%, 28.82%, 1.05%, and 16.10%, respectively. The total income from the three crops was ₦ 358,600.00, gross margin ₦ 220,650.00 and net income ₦ 192,685.00. The return per naira invested was 2.16. This implies that in every one naira invested in the enterprise the farmer gets ₦ 1.16. This depicts that cassava/maize/melon mixed intercrop enterprise is profitable in the study area. The result agrees with the findings of Poggio (2005) who reported that cassava/maize/melon intercrop enterprise resulted to yield increment and higher monetary return.

Productivity of the Cassava/Maize/Melon Mixed Intercrop Enterprise

Table 2a shows the gross value of output from the three crops, cassava, maize and melon alongside the total value of the crops. The Table shows that the farmer realised ₦ 207,000.00, ₦ 84,000.00 and ₦ 67,600.00 from cassava, maize and melon, respectively, while the total revenue generated from the enterprise was ₦ 358,600.00. The Table also depicts the gross value of production factors. It shows that planting materials, labour and land cost ₦ 89,750.00, ₦ 48,000, and ₦ 26,915.00 while the combined cost of the three factors was ₦ 163,965.00.

Table 2b shows the productivity indices of the production factors. It shows that the partial productivity indices of planting materials, labour, and land were 2.88, 5.38, and 13.37, respectively, while the total factor productivity was 2.16. This implies that all the factors were productive in the study area since the indices are greater than one. Considering the three key production factors, land, labour and planting materials, land had the highest productivity among the three categories. This implies that land is the most productive input of the three. This could be that the farmers were the rightful and private owners of the land; therefore they ensured that the fertility of the land is maintained.

Determinants of Productivity of the Cassava/Maize/Melon Mixed Intercrop Enterprise

Table 3 shows the results of multiple regression analysis of the factors that influence the productivity of cassava/maize/melon mixed cropping enterprise in the study area. The result showed that double log was the lead equation based on conformity with *a priori* expectation of signs, magnitude of coefficients and overall significance of the functional form (F-statistics). The Table shows that R^2 was 0.905; this implies that 90.5% of the total variation in the total productivity was explained by the joint action of independent variables included in the model while 9.5% was due to error of estimation and other factors outside the scope of this study. It also implies that the model gave a good fit. F-value was statistically significant at 1% indicating that the factors included in the model best explained the productivity.

Table 3 further shows that six factors out of seven were significant. Planting materials, farm size, labour, and education were positive and significant at 1% level while farming experience was at 10% leveled. Age was negatively signed and significant at 1% level. The positive and significance of

education and farming experience at 1% and 10% levels respectively, implies that as the literate level and years of experience of the farmers increase, there would be an increase in the productivity of the farmers as highly experienced and educated farmers are expected to adopt improved practices that would enhance the productivity of their enterprise. This result is in line with Onyenweaku (1988) who noted that farming experience of a farmer increases his production efficiency and productivity and helps to overcome inherent farm production constraints. Also the positive sign and significance of planting materials and farm size imply that productivity will increase significantly if improved planting materials are adopted on larger farm sizes. This is in tandem with the findings of Tshikalma (2011) who reported that agricultural productivity can be increased through increase in the use of improved planting materials and also an increase in farm size would increase farmers' output. This result is in line with *a priori* expectation. In a similar way, the result shows that labour is an important factor in cassava/maize/melon mixed intercrop enterprise with coefficient of 0.0694. This implies that 1% increase in the amount of labour put in the enterprise would increase productivity by 6.94%. This agrees with Okoye (2006) who noted that labour constitutes an important factor in agricultural productivity. Similarly, the study confirms the result obtained by Adeyemo and Kuhlmann (2009) which indicated that labour had a positive effect on output of food crops. Conversely, age of the farmer inversely influenced the productivity at significance level of 1%. This explains that as the age of the farmer increases, productivity decreases significantly. This is expected because as the farmer is aging, he begins to be weak, hence the productivity starts declining. This finding corroborates with Eze *et al.* (2016) who noted that old age affects farmer's productivity as farming activities require strength and bending down while working, like planting, weeding, making of mounds. The extension contact was positive but not significant. This implies poor extension outreach to the farmers. This could mean neglect of the farmers by the change agents as some of the farmers still engage in the traditional systems of cultivation. This is detrimental to agricultural development as the farmers' access to improved technologies and technical assistance offered by extension services are limited (Ume and Nwaobiala, 2012).

Constraints Militating against Cassava/Maize/Melon Mixed Intercrop Enterprise in the Study Area

Table 4 shows the constraints militating against the cassava/maize/melon mixed intercrop enterprise in the study area. The Table shows that 92% of the respondents reported high cost of labour as a militating factor while 71% of them complained of aging of the farmers. The aging of the farmers seemed to be one of the major contributors to the high labour cost in the study area because the able bodied young men and women who would have been the source of labour in the area had migrated to urban areas in search of higher paid jobs, hence leaving the aged people in the rural area to face the farm work. Governments in an attempt to reduce the high cost of labour introduced tractor hiring services but the tractors are either inaccessible to the poor farmers who need them most or the tractors are always in a state of disrepair (Nwaogu et al., 2016).

Seventy two percent of the farmers faced the problem of decline in the quality of land. This constraint was as a result of erosion which is prevalent in Southeast and other poor soil management practices which if not properly checked, farmers efforts would be rewarded with misery (Okoronkwo, 2008). The Table also shows that 93% of the respondents reported high cost of fertilizer as a hindrance. The high cost of the input as reported by the farmers was the respondents could only source the input from open market. They complained that the ones supplied by government were always diverted, hence marking the resource to be scarce. Sixty nine percent (69%) of the respondents encountered high cost of planting materials as a problem while 58% reported use of local varieties as a constraint. This agrees with NCRI (2004) who noted that high cost of planting materials has a negative implication on

agricultural development as substantial number of farmers resort to the use of local varieties which had genetically broken down, resulting to poor yield. Small size of farm land was identified as a hindrance to cassava/maize/melon mixed cropping enterprise in the study area.

The small size of farm land as indicated by 67% of the farmers could be as a result of the land tenure system that is prevalent in the area. The communal, individual and inheritance methods of land acquisition in the area had subjected the land to fragmentation which makes most of the farmers to go into the mixed cropping. This result is in tandem with Onumadu et al. 2014) who observed that most farmers practice mixed cropping system as a result of small size of land. Other factors that impede the enterprise were poor access to credit (72%), and pest and disease infestation (56%). The poor access to credit could even be an obstacle to other factors which include among others, pest and disease control because of lack of fund which could hinder the farmer from purchasing the much needed pesticides for effective control and this could lead to low yield (Ezedinma, 2003). Poor extension services (56%), poor access to good road (54%) and uncontrollable climatic conditions (47%) were also identified as bottleneck to the mixed intercrop enterprise in the study area respectively.

Conclusion

The findings of the study show that cassava/maize/melon/ mixed cropping is a profitable enterprise from the standpoint of the partial productivity indices obtained. With a combination of a root tuber, a cereal, and a legume in one enterprise, the farmers succeed in spreading their production risks across wider agronomic characteristics. From the result of the regression analysis, it is quite instructive that issues relating to farm size, labour supply, and provision of improved planting materials are crucial to encouraging young educated people to engage in crop production in their study areas and elsewhere in Nigeria. This calls to mind the need to engage strategically in agripreneurship capacity building among Nigeria youths. Alongside this effort, it is rather vital that subject matter extension agents with specialization in agronomy need to be trained in large numbers, equipped and properly motivated to take on on-farm adaptive corroboration with farmers. The major limiting factors to the cassava/maize/melon mixed cropping enterprise in the study area are high costs of fertilizer, labour and improved planting materials, poor access to credit, decline in land quality, small size of land and aging of farmers. Therefore, policy measures should aim at provision of the inputs (fertilizer, planting materials and credit) at subsidized and low interest rates and make these inputs available and affordable to the resource poor farmers. Also small labour saving machinery and equipment should be purchased and hired out to the farmers at a reduced cost. This will equally serve as incentive to youths to go into farming. Finally, there is need for land redistribution policy so as to make more land available to the farmers.

Table 1: Cost and Returns of Per Hectare Cassava/Maize/Melon Mixed Cropping Enterprise

Variable	Unit Price (₦)	Quantity	Value(₦)	Percentage
Variable Cost				
Cassava cutting (Bundle)	600	40	24,000	14.41
Maize seed (Kg)	300	12.5	3,750	2.25
Melon seed (Sachet)	100	10	1,000	0.60
Fertilizer (Kg)	100	500	50,000	50.03
Herbicides (Litre)	1,300	8	11,200	6.73
Land preparation (M/D)	1,100	12	13,200	7.93
Planting (M/D)	800	6	4,800	2.88
Fertilizer application (M/D)	900	6	5,400	3.24
Herbicide application (M/D)	800	4	3,200	1.92
Weeding (M/D)	900	12	10,800	6.49
Melon harvesting & washing (M/D)	800	4	3,200	1.92
Maize harvesting & threshing (M/D)	700	6	4,200	2.52
Cassava harvesting (M/D)	700	5	3,200	1.92
Total Variable Cost			**137,950**	
Fixed Cost				
Depreciation on tools			1,750	1.05
Rent			5,500	3.30
Cost of land improvement			21,315	12.80
Total Fixed Cost			**28,565**	
Total Cost			**166,515**	
Revenue				
Revenue from melon			67,600	
Revenue from maize			84,000	
Revenue from cassava			207,000	
Total Revenue			**358,600**	
Gross Margin			**220,650**	
Net Income			**192,085**	
Return on Investment			**2.15**	

Source: Field survey 2016/2017
Note: M/D = Manday

Table 2a: Gross Value of the three Crops, Land, Labour and Material Inputs Factors

		Gross Values of Production Factors (₦)			
Crop	**Gross value of output (₦)**	**Land**	**Labour**	**Material Inputs (planting materials, fertilizer, and herbicides**	**Total**
Maize	84,000	26,815	48,000	89,750	164,765
Melon	67,600				
Cassava	207,000				
Total	358,600	26,815	48,000	89,750	164,765

Source: Field survey 2016/2017

Table 2b: Partial Productivity Indices of Land, Labour and Material Inputs

Production Factor	Gross Value (₦)	Productivity Index	Decision
Land	26,815	13.37	Productive
Labour	48,000	5.38	Productive
Material inputs (planting materials, fertilizer and herbicides)	89,750	2.88	Productive
Total Factor	166,515	2.15	Productive

Source: Field Survey 2016/2017

Table 3: Multiple Regression on the Factors that Influence Productivity of Cassava/maize/melon Mixed Cropping Enterprise in the Study Area

Factor	Linear	Semi-log	Double-log	Exponential
Constant	6,823	-4.937	6.316	1.626
	(0.549)	(-0.101)	(2.149)**	(3.349)***
Age	-0.013	9.779	-0.967	0.010
	(-2.893)***	(2.151)**	(-5.162)***	(5.811)***
Education	6.823	6.316	1.626	-4.937
	(0.549)	(2.149)**	(3.349)***	(-0.101)
Farming experience	3.648	8.657E05	0.659	133.86
	(3.602)***	(1.545)	(1.872)*	(1.829)*
Extension contact	-0.615	-1.362	0.124	4063.548
	(-0.372)	(0.027)	(1.129)	(1.557)
Planting Materials	2.332	2.260	15.541	0.331
	(1.228)	(2.035)**	(2.829)***	(0.960)
Farm size	0.019	3.568	4.139	-697.626
	(0.014)	(0.887)	(3.743)***	(-0.106)
Labour	0.699	155.4	0.0694	2.88E-006
	(12.652)***	(7.833)***	(4.139)***	(4.703)***
R^2	0.815	0.900	0.905	0.802
Adj. R^2	0.801	0.891	0.902	0.787
F- statistic	207.90***	11.340***	14.796***	54.550***
DW-statistic	2.608	2.260	2.618	2.654

Source: Field survey 2016/2017

Note: ***Significant at 1%, ** Significant at 5%, * Significant at 10%

Table 4: Distribution of Respondents According to Constraints to Cassava/Maize/Melon Mixed Cropping Enterprise

Factor	*Frequency	Percentage
High cost of improved planting materials	52	69
High cost of labour	69	92
Poor access to credit	54	72
Pest and disease infestation	42	56
Small size of farm land	50	67
Poor extension services	42	56
High cost of fertilizer	70	93
Use of local varieties	44	58
Aging of the farmers	53	71
Poor access to good road	41	54
Uncontrollable climate conditions	35	47
Decline in the quality of land	54	72

***=Multiple responses recorded**
Source: Field Survey 2016/2017

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