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Resource-use Efficiency in Cassava Processing in Oyo North Area of Oyo State, Nigeria

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Abstract

The resource-use productivities and efficiency in cassava processing into "Gari" and Cassava flour (Lafun) were examined in this study. The study was conducted in the Oyo North Area (food-belt) of Oyo State.

A multi-stage random sampling procedure was used to select 100 cassava processors in the study area. The production function approach was used to estimate the cassava processing functions.

The analysis revealed that cassava tubers were under-utilized for both "Gari" and "Lafun" production respectively and that credit and years of processing experience tended to have diminishing effects in their use in both "Gari" and "Lafun" production respectively. Capital and years of schooling also tended to have diminishing effects of Lafun production.

There were increasing returns to scale in cassava processing both for "Gari" and "Lafun" with that of "Gari" being almost twice that of "Lafun", thereby implying that further expansion of the existing processing scale can lead to better efficiency among cassava processors.

Introduction

Cassava is such a versatile crop that its use cuts across many industries ranging from pharmaceutical (in the making of glucose), textile, paper manufacturing flour mills and recently dry cell battery industries. This is aside from its use for direct human consumption and as livestock feed. This multiple use of cassava has made it the toast of farmers of recent, as almost every arable crop farmer has the crop on his farm (Ikpi *et al*, 1987).

Cassava is particularly suited to small-farm production systems due to its extremely undemanding nature, and its tolerance of a variety of climatic and soil conditions on the farm. It is especially popular in the savannah part of the country where the emphasis is on arable crop production. In fact, it is the third most important crop in Oyo State after maize and yam (Oyo State Rural Sample Survey 1983).

A major disadvantage of cassava is that it contains prussic acid (HCN) at levels which can be dangerous to human health, unless the tuber is made to go through several stages of processing to bring the acid content to tolerable levels. The processing methods have been mastered by the processors over the years and it is being improved upon constantly. The processing and detoxification stages are necessary because of its rapid rate of deterioration and the high amounts of prussic acid it contains.

Apart from the tuber, other parts of the cassava plants are also of domestic significance. For instance, the green leaves are used in preparing vegetable stews, and the stem is the major means of its propagation. In spite of the above-stated disadvantage, cassava has become a staple food for most Nigerian (not only among the rural people but also among the urban dwellers) possibly because of the ease with which its major food product (gari) can be prepared and used as a source of energy.

Apart from the increasing importance of 'gari' in the diet of Nigerian, cassava is also processed into a variety of foods such as 'fufu' and cassava flour (lafun) both of which compare favourably with semovita. The largest use for cassava as seems to be in the human diet where it is consumed in various forms. In fact Okeke (1986) noted a deficit in supply of cassava for human consumption while competition from animal feed and industrial starch imposes higher production targets. Ikpi (1987) noted that cassava was consumed at least once a day in the rural household in Oyo State varying with season and family income.

Traditional processing of cassava tubers includes such procedures as peeling, grating, fermentation, boiling, pounding, frying and sundrying. Different sequencing and/or omission of some of these procedures results in different products being made.

In Nigeria, cassava production appears to be relatively stable, with a growth rate of 2 percent per annum (mostly for home consumption). Most production is however from small scale farmers who use very little of modern inputs (Ikpi et al. 1986).

The supply of cassava products to the market therefore depends on the rate and the method of processing the tubers. The efficiency of the processing methods needs to be investigated.

Alimi and Akinyemiju (1987) asserted that processing cassava tubers into gari was not economical and that harvesting and processing costs made up the bulk of the labour costs in Ile-Ife area of Osun State. Their study was carried out on the Obafemi Awolowo University Teaching and Research Farm in the 1985-86 cropping season. Karunwi and Ezumah (1989) however found out that cassava processing into gari was profitable to the producer even at the farmgate price in the humid forest ecology of Nigeria.

This study was conducted in the savannah (food belt) of Oyo State among small-holders who constituted the bulk of the producers and processors in order to take cognisance of the conditions prevailing on the farm.

The main objective of the study is to find out the efficiency of resource-use in the processing of cassava into 'gari' and cassava flour 'lafun' which happens to be the major forms in which cassava is consumed in the study area, and to make appropriate recommendations based on the findings.

Efficiency in the cassava processing industry presupposes the optimum combination of and use of resources. Any plan to achieve this optimality goal will require a thorough knowledge of the resource use patterns as well as an assessment of the productivities of resources. Such a knowledge will assist policy makers and prospective investors in detecting the possibilities of increasing the level of production by showing the direction of adjustments in resource use.

Methodology

Multi-stage random sampling technique was employed in selecting 100 cassava processors in the study area. The study was conducted between November 1987 and October 1988. Based on the population distribution obtained from the Oyo State Agricultural Development Programme (OYSADEP), the whole survey area was divided into 15 wards and a sample of 7 respondents was randomly selected from each ward.

Pretested questionnaires were administered on the processors to collect information on various socio-economic characteristics of interest to the study. The administration of the questionnaires was aided by the village extension officers of the ADP who were first trained on the objectives of the study.

Altogether, returns from 82 processors were satisfactorily completed for analysis and discussion. The distribution of respondents by towns and villages are shown in Table 1.

Table 1: DISTRIBUTION OF RESPONDENTS BY TOWNS AND VILLAGES

Local Government Area	Town/Village	Processors
Ifedapo	Ago-Are	05
	Irawo	05
	Ofiki	05
	Ogbooro	06
	Oke-Aje	04
	Tede	06
Irepo	Igbeti	07
	Igboho	01
	Igbope	03
	Iyeye	03
	Sooro	04
	Kisi	07
Kajola	Iganna	06
	Ilero	07
	Ilua	07
	Okeho	06
Total		82

Source: Field Survey, 1989.

The study area covers some 12,310 square kilometers or 32 percent of old Oyo State and includes three local government areas (Ifedapo, Irepo and Kajola) which are in the northern part of the State. The area is predominantly a food growing area containing the then Oyo North Agricultural Development Project (ONADEP) which has now gone statewide as the Oyo State Agricultural Development Programme (OYSADEP). The data collected were summarised into frequency tables.

Ordinary least squares regression technique was used to estimate the processing functions for both 'Gari' and 'Lafun'. A processing function can be specified between the processed output and the resource inputs used to bring it about. Two major processed output of cassava that are of commercial significance in the study area are 'Gari' and 'Lafun'.

The processing function can be expressed as:

$$Q_i = a + b_1 X_{1,i} + b_2 X_{2,i} + b_3 X_{3,i} + \dots + b_k X_{k,i} + e_i \quad (1)$$

- where Q_1 = output of processed cassava (bags of gari) produced per annum
 Q_2 = output of processed cassava (bags of lafun) produced per annum
 $X_{1,i}$ = total input of cassava tubers (in pickup loads);
 $X_{2,i}$ = total hired labour input (in mandays);
 $X_{3,i}$ = total family labour input (in mandays);
 $X_{4,i}$ = capital tools (in Naira); (Depreciation value of long-term assets)
 $X_{5,i}$ = value of firewood (in Naira);
 $X_{6,i}$ = years of cassava processing experience;
 $X_{7,i}$ = years spent in a formal school;
 $X_{8,i}$ = amount of credit used (in Naira);
 a = intercept
 e_i = error term.

Gari processing was found to be more involving than Lafun processing because it involves grating, frying, and separation into various particle sizes (Onwueme 1978). Lafun processing involves only peeling, retting and sundrying. The Gari processing function therefore included the cost of obtaining firewood $X_{5,i}$ as an independent variable.

Three functional forms of linear, semi-log, and double-log were tried and the one producing the 'best' fit was chosen as the lead equation. From the regression equation, parameters such as marginal physical product (MPP); elasticity of production (E_p) and the returns to scale (RS) were calculated.

*Note: The subscript $X_{i,j}$, where $j = 1, 2 \dots 8$ is used for Gari explanatory variables, $X_{i,2}$ is used for 'Lafun' explanatory variables.

Results and discussion

Table 2 shows the distribution of processors by socio economic characteristics. Over 90 percent of the processors are women who are either farmer's wife(s) and/or dependants who take to processing as a way of marketing their farm products and providing necessary food items for family sustenance. About 45 percent of the processors are within the age bracket of 51 to 65 years while about 40 percent are in the age bracket of between 36 to 50 years. The men age of processor is about 48 years.

Table 2: DISTRIBUTION OF PROCESSORS BY SOCIO-ECONOMIC CHARACTERISTICS

Variable	Class	Frequency	Rel. Freq (%)	Mean	SD
Age	35	04	4.88	47.93	10.21
	36-50	32	39.02		
	51-65	37	45.12		
	66-70	05	6.10		
	70	04	4.88		
Total		82	100.00		
Years of Experience	5	04	4.88	17.37	7.121
	5.1-11	14	17.07		
	11.1-18	21	25.61		
	18.1-25	33	40.24		
	25	10	12.20		
Total		82	100.00		
Use of hired labour (mandays)	01	07	8.54	280.573	101.446
	84-166	40	48.78		
	167-250	20	24.38		
	251-333	09	10.98		
	334-416	04	4.88		
Total		82	100.00		
Use of capital inputs (Naira)	100	10	12.19	448.14	298.285
	101-250	24	29.26		
	251-400	12	14.63		
	401-550	09	10.98		
	551-700	21	25.61		
Total		82	100.00		
Family size	5.0	01	01.22	11.304	4.556
	5.1-8.0	11	13.41		
	8.1-11.0	38	46.34		
	11.1-14.0	13	15.85		
	14	19	23.17		
Total		82	100.00		

Table 2 Contd.

Years spent in school	2.0	44	53.66	2.524	3.304
	2.1-4.0	10	12.19		
	4.1-6.0	24	29.27		
	9.0	04	04.88		
Total		82	100.00		
Amount of credit obtained	200	50	60.90	274.85	397.12
	201-400	03	03.66		
	401-800	17	20.73		
	801-1000	04	04.87		
	1000	08	09.76		
Total		82	100.00		

Source: Field Survey Results (1989)

The average size of the processors family is 11 and family labour supplied about 40 percent of the total labour input in the form of peeling and retting, while hired labour input was made use of mostly in the area of frying and transporting both the tuber inputs and the output. About 54 percent of the processors attended adult education classes, while about 75 percent do not have any other occupation. An average of N448.14 was employed as capital while an average of N275.00 was obtained as credit for their operations with most (54 percent) of the credit obtained from cooperative societies thereby emphasising the importance of cooperative societies in the extension of credit for processing.

Processing function results

Gari processing functions: The functions specified for Gari are presented in Table 3. Based on the specified criteria, for selection of the equation of best fit (i.e. the value of R^2 , the 't' and 'F' ratios and the reasonableness of the magnitude of the coefficients and the signs on the estimated parameters) the linear model was chosen as the lead equation for Gari processing. The input of cassava tubers has an expected positive coefficient that is statistically significant. This is because cassava tubers are the main raw material for producing gari.

The positive coefficient of the number of years spent in school is indicative of positive influence of the level of education on Gari production. Thus educated processors should obtain higher output of Gari. The variable was found to be statistically significant. The negative coefficient obtained for processing experience is contrary to *a-priori* expectation but it might be indicative of the fact that more aged processors are slower in adopting recently introduced semi-mechanised methods of processing thereby making it difficult for them to obtain higher outputs per unit of processed cassava tubers. Cassava processing (most especially gari production) has incorporated more innovations in terms of mechanisation of recent (Kwatia 1986).

Both hired and family labour inputs have the expected positive coefficients which are statistically significant; thus signifying the importance of those variables to gari production.

Table 3: ESTIMATED GARI PROCESSING FUNCTIONS

Variable		Linear		Semi-log		Cobb-Douglas	
		Coefficient	Standard Error	Coefficient of log variable	Standard Error	Coefficient of log variable	Standard Error
Cassava tubers	X _{1,1}	3.02037*	0.15833	18.32833*	2.43937	0.72482*	0.12577
Hired labour input	X _{2,1}	0.1059*	0.00500	-0.00025	0.00033	0.000009	0.000017
Family labour input	X _{3,1}	0.0372*	0.00892	0.000011	0.00032	-0.000004	0.000005
Capital	X _{4,1}	0.00459	0.00260	1.54367	1.61193	0.03620	0.08311
Cost of firewood	X _{5,1}	0.00921	0.03243	0.00011	0.00010	0.000005	0.000005
Processing experience	X _{6,1}	-0.15065	0.10518	-0.75423	3.63227	0.09039	0.18727
Years of schooling	X _{7,1}	0.38589*	0.18181	0.00021*	0.00010	0.000009	0.000005
Credit Intercept	X _{8,1}	-0.00652*	0.00175	-0.00022*	0.00010	-0.000008	0.000016
R ²		-7.64972		-13.42725		1.19761	
R ²		0.93247		0.66650		0.56111	
R ²		0.91703		0.59028		0.46079	
F-ratio		60.40955*		8.74361*		5.59325*	

Note: * Significant at 5 percent level

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The negative relationship of the amount of credit used is suggestive of the overuse of loan facilities - possibly to such an extent that its repayment affects the obtainable output of gari.

Altogether all the included variables were statistically significant at the specified 5 percent level as indicated by the F-value, suggesting that their joint effect on Gari output is significant. The included variables also explained about 92 percent of the variability in Gari output as indicated by the value of R^2 (coefficient of determination).

The estimated parameters for 'gari' production is presented in Table 4. The table reveals that all the Marginal Physical Products (MPP's) with the exception of credit and processing experience were positive which is suggestive of the fact that a unit increase in each of the variables will result in an increase in the quantity of gari to be obtained. Only the amount of cassava tuber used as raw materials has the highest expected impact of almost three times per unit used input on the output of gari obtained which might be indicative of the conversation ratio of cassava tubers to gari in the study area.

Table 4: THE ESTIMATED PARAMETERS FOR GARI PRODUCTION

Variable	MPP	E_p	MVP	O.C*	RS**
$X_{3,1}$	0.00921	0.012	1.29	50.00	3.911
$X_{4,1}$	0.00459	0.151	0.65	1.17	
$X_{1,1}$	3.02037	0.912	422.85	120.00	
$X_{7,1}$	0.38589	0.095	54.02	730.84	
$X_{8,1}$	-0.00652	-0.128	-0.91	1.17	
$X_{6,1}$	-0.15065	-0.213	-21.09	728.17	
$X_{2,1}$	0.1059	2.58	14.83	10.00	
$X_{3,1}$	0.0372	0.502	5.21	10.00	

Source: Field Survey Results (1989)

*The O.C. of the resources are the current market prices. The average amount of cost of firewood is inputted; the average cost of a pick-up load of cassava tubers was used as O.C. for cassava; while the net returns obtainable per ton of cassava tubers processed into Gari was inputted for years of schooling and years of processing experience, while the average wage rate on cassava processing site was inputted for both hired and family labour.

**RS = Returns to scale.

The negative coefficient of credit might be suggestive of the fact that repayment conditions are not totally favourable; while the negative coefficient of processing experience indicates that recent innovations in form of mechanisation in processing are not being adopted by the more experienced and older processors thereby resulting in lowered processed output for the experienced ones.

The elasticity coefficients obtained indicated a rational use of the resources as they lie between 0 and 1. Only hired labour has an elasticity coefficient of more than one

which is suggestive of irrationality in use. The reasons for the underuse of hired labour is not farfetched. This is because the labourers massed around each heap of a pick-up load of cassava tubers (both adults and children) doing the job in a task form. This allows underuse because many people are used, and supervision is not thorough.

The MVP's indicated that only credit and processing experience contribute negatively to the output of gari. Thus viewed from the angle of resource-use productivity, the expected increases in the output of gari from the use of additional units of resources inputs ranges from N0.65 for capital to N422.85 for cassava tubers. From Table 4 only the cassava tubers and hired labour are being used below optimal levels. This means that more of cassava should be used while efforts are made to organise the hired labour better to get the maximum use out of them. However, the other inputs are being overused and efforts should be made to bring their level of use to the optimal levels.

The MVP value of N422.85 for a tonnes of cassava tuber is just suggestive of the price that should be charged on a pick-up load of cassava. Incidentally, the range of the prices each tonne of cassava was being sold (1989/90) was around the N400 value. The low MVP value of capital is indicative of the overuse of the capital resources acquired by the processors. The processors will however improved their earnings if the intensity of use of the capital resources is reduced.

The negative MVP of the credit useage suggests that there is the need for a review of the rate of interests and the repayment plans in the administration of credit in the study area. This is most important to cooperative societies which most processors patronise, or alternatively other institutions should endeavour to break the virtual monopoly of the cooperative societies by providing more suitable repayment plans.

The returns of scale value of 3.911 obtained is indicative of an increasing returns to scale. This means that if all the variables are increased by a unit in the same proportion, the output of gari will increase almost fourfolds.

Lafun processing functions: The functions obtained for lafun processing are as showed in Table 5. The linear model was also selected as the 'lead' equation and for discussion based on the number of significant explanatory variable estimates and the level of explanation offered by the level of R^2 .

The labour inputs (disaggregated into family and hired labour) were both significant and bear positive relationships with the output of lafun obtained. This is in line with the *a priori* expectation and is similar to what obtained for gari processing. This goes on to emphasise the importance of the labour inputs in cassava processing.

The amount of cassava tuber inputs used was also significant at the specified level and bears an expected positive relationship with the output of lafun.

Both credit and years of processing experience had negative coefficients which is suggestive of overuse. The finding is similar to that of gari processing where negative coefficients were obtained too. The coefficients were, however, not significant which raises cautionary note in the interpretation of these findings.

The negative relationship of capital inputs which is contrary to what obtained for gari processing is not unexpected since the amount of capital needed for lafun production is not up to that needed for gari production, hence overuse of capital inputs

Table 5: ESTIMATED CASSAVA FLOUR (LAFUN) PROCESSING FUNCTIONS

Variable		Linear		Semi-log		Cobb-Douglas	
		Coefficient	Standard Error	Coefficient of log of variable	Standard Error	Coefficient of log of variable	Standard Error
Cassava tubers	X _{1,2}	4.88387*	0.28275	92.68450*	14.57910	0.81682*	0.15279
Hired labour input	X _{2,2}	0.05746*	0.01897	48.36028*	18.29646	-0.00002	0.00015
Family labour input	X _{3,2}	0.7918*	0.02536	-0.00276	0.001418	0.45847*	0.10757
Capital	X _{4,2}	-0.00623	0.00916	2.84481	10.26354	0.13459	0.10757
Processing experience	X _{6,2}	-0.02617	0.41992	-1.73109	20.43849	0.15288	0.21421
Years of schooling	X _{7,2}	-0.31873	1.14978	0.00372	0.0071	0.00009	0.00007
Credit	X _{8,2}	-0.00696	0.00749	-0.00942	0.00696	-0.00011	0.00007
Intercept		-30.17854		-362.28423		-2.19023	
R ²		0.97888		0.69282		0.67067	
R ²		0.97395		0.62114		0.59375	
F-ratio		198.63201*		9.66608*		8.72523*	

Note: * Significant at 5 percent

is likely. The non-significance of the years of school might be because the level of mechanisation incorporated in lafun production is not as sophisticated and involving as that of gari production, hence a high degree of literacy might not be needed for lafun production.

Altogether the included variables explained about 97 percent of the variations observed in lafun output. The F-ratio is also significant at the specified 5 percent level meaning that the joint effect of all the included variables is statistically significant.

The estimated parameters from the lafun processing function are presented in Table 6. From the table, it could be seen that only the input of cassava tubers, hired and family labour inputs will increase output of lafun if their use is increased by a unit as revealed by the value of the MPP:

Table 6: ESTIMATED PARAMETERS FOR LAFUN

Variable	MPP	E_p	MVP	O.C*	RS
$X_{4,2}$	-0.00623	-0.10672	-0.511	1.17	1.99
$X_{1,2}$	4.88387	1.20814	400.48	120.00	
$X_{7,2}$	-0.31873	0.02131	-26.14	868.11	
$X_{6,2}$	-0.02617	-0.01532	-2.15	868.11	
$X_{2,2}$	0.05745	0.49768	4.71	10.00	
$X_{3,2}$	0.07919	0.50872	6.49	10.00	
$X_{8,2}$	-0.00696	-0.07196	-0.57	1.17	

Source: Field Survey Results (1989)

*The O.C. of the resource are the current market prices. The net returns obtainable per ton of cassava tubers processed into lafun was inputed for both years of schooling and processing experience, while the other resources were inputed as in gari production.

The elasticity coefficients of all the variables except for cassava input indicated a rational use of resources since they lie between 0 and 1. The elasticity coefficient obtained for cassava tubers is indicative of underuse, hence more of cassava tubers should be brought under processing into lafun.

Compared with the results obtained for gari, it is noteworthy that processing experience and credit usage were also negative in their contributions to output of lafun, however, capital and years of schooling contribute negatively to lafun output as opposed to positive contributions to gari output. This might be due to the rapid rate of new innovations introduced to gari production in terms of mechanisation of some stages in the processing which is lacking in lafun processing.

The MVP values also shows that the expected increases in Naira values of lafun output obtainable from the use of additional units of resource inputs varies from N4.71 for hired labour to N400.48 for cassava tubers. The higher MVP value obtained for family labour over hired labour is indicative of the relative importance of family labour in lafun production. The reverse is, however, the case with gari production where the MVP of hired labour is larger than that of family labour inputs

stressing the importance of hired labour in gari production activities. However, the MVP value of cassava tubers indicated an underutilization of the resource, suggesting that more of it should be brought under use to boost income.

The returns to scale value of 1.999 is indicative of an increasing returns to scale. This means that if all the variables are increased by a unit each, the output of lafun will increase by about twice the value of the unit increase. This rate of returns is lower than that obtained for gari production and it may be the reason for the widespread acceptance of gari production as compared to lafun production.

Conclusions and recommendations

This study has revealed some conclusions that can be drawn as regards the processing of cassava into gari and lafun respectively. The average size of processors family is 11 and that they supply about 40 percent of the total labour input in the processing activities. The processing functions revealed that credit and years of experience tend to have negative effects in their use in gari production, whereas capital, years of schooling, credit and years of processing experience were found to have negative effects in their use in lafun production.

Education of would-be processors on the advantages of the introduced innovations in cassava processing could ensure that the more experienced processors also adopt these innovations thereby increasing their output. They may also need credit facilities at favourable terms to enable them adopt the new gari production technology.

Elasticity coefficients obtained confirmed a rational use of resources except that cassava tubers was underutilized for gari and lafun production respectively. More of this input would therefore need to be put to use in an effort to expand the processing business.

There were increasing returns to scale in cassava processing both for gari and lafun with that of gari being higher than that of lafun.

The MVP criterion for deciding the resource-use efficiency suggests that only input of cassava tubers was underutilized since it had an MVP: opportunity cost ratio of more than unity. All the other inputs were overutilized in the processing of cassava both into gari and lafun. Therefore, more cassava tubers are needed to be brought under processing in order to enhance the profitability of the processing business.

The recommendation that can be readily made from this study is the need for greater involvement of the processors in a form of "backward integration". This will ensure that more and adequate amount of cassava tubers are available at affordable prices for processing into either gari or lafun. It will also ensure that the processors obtain the favoured variety of cassava tubers at the appropriate time and place, and also exploit the profitability of the production phase. The increasing returns to scale observed in the processing functions is indicative of the fact that there exists the potential for expanding these business also, the possibility of selective harvesting makes it less susceptible to market 'glut'.

The importance of credit in processing also calls for the provision of loan facilities on soft terms and on timely basis in order to exploit fully the profitability of the business. This service can be provided by the newly established 'Peoples Bank'.

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