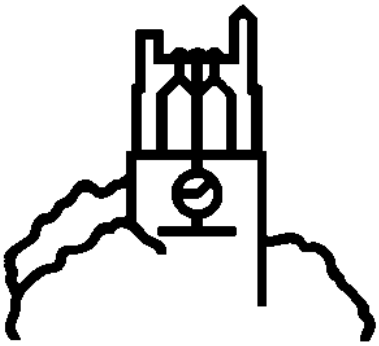
Staff Paper

COMPARING THE PROFITABILITY OF CASSAVA-BASED PRODUCTION SYSTEMS IN THREE WEST AFRICAN COUNTRIES: COTE D'IVOIRE, GHANA AND NIGERIA

by Youssouf Camara, John M. Staatz, Eric Crawford

Staff Paper No. 2001-03 **February 2001**



Department of Agricultural Economics
MICHIGAN STATE UNIVERSITY
East Lansing, Michigan 48824

Youssouf Camara, John M. Staatz, Eric Crawford
camaray1@msu.edu, staatz@msu.edu, crawfor5@msu.edu

ABSTRACT

Sub-Saharan Africa (SSA) cassava-producing countries such as Nigeria, Ghana, and Côte d'Ivoire have developed, in recent years, a renewed interest in cassava as an alternative food crop. This has led to a major expansion in cassava-based production systems in Nigeria and Ghana, whereas there has been a slower growth in Côte d'Ivoire (Nweke et al., 1998). This paper is based on the argument that the difference in various factors such as agricultural policies (i.e., trade and price policies, domestic production taxes or subsidies), location and technologies (production and processing) between Nigeria, Ghana and Côte d'Ivoire the difference in the level of growth in cassava-based production systems.

The paper examines, using the Policy Analysis Matrix (PAM), the magnitude of the impact of these factors on the private and social profitability of cassava production and post-production processing in Côte d'Ivoire, Ghana and Nigeria. The topic has not been examined in previous studies. The paper relies primarily on data for Côte d'Ivoire, Ghana and Nigeria from the Collaborative Study of Cassava in Africa (COSCA) survey.

The baseline results demonstrate the similarity in efficiencies of production in these West African countries. The simulation findings indicated that, in Côte d'Ivoire, farmers benefited from the depreciation of the equilibrium exchange rate while farmers in Ghana and Nigeria suffered losses. Simulation results also indicated that Ivorian and Ghanaian cassava/maize farmers could benefit from growing IITA's improved variety and adopting mechanized processing methods.

46 pages

COMPARING THE PROFITABILITY OF CASSAVA-BASED PRODUCTION SYSTEMS IN THREE WEST AFRICAN COUNTRIES: COTE D'IVOIRE, GHANA AND NIGERIA.

1. Introduction

In most Sub-Saharan African countries, the agricultural sector has always, and still accounts for the major share of GDP, foreign exchange, and employment. Yet, per capita food production has not been able to keep pace with a rapidly expanding demand for food. As a result, Sub-Saharan African (SSA) countries have become increasingly dependent on commercial imports and food aid (World Bank, 1996). To reverse this trend, most Sub-Saharan African (SSA) governments have been designing research programs and policy initiatives aimed at achieving national food security. One of the many food crops being considered currently in this effort in SSA is cassava; both in terms of its potential to ensure adequate food supply for all and generate rural household income, thereby increasing access to food. While this has led to a major expansion in cassava- based production systems in Nigeria and Ghana, there has been a slower growth in Côte d'Ivoire (Nweke, 1998).

Cassava is an important commodity in many farming systems in Sub-Saharan Africa (Nweke *et al*., 1994). Its relative importance stems from its adaptability to a wide range of agro-ecologies, including marginal lands and erratic rainfall conditions (Nweke *et al*., 1994). Regardless of the production environment, compared to other crops, cassava has lower production risks, and provides the possibility of maintaining a continuous food supply throughout the year (Nweke et al, 1994).

This paper is based on the argument that the difference in various factors such as agricultural policies (i.e., trade and price policies, domestic production taxes or subsidies), location and technologies (production and processing) between Nigeria, Ghana and Côte d'Ivoire explains the difference in the level of growth in cassava-based production systems. The paper uses the policy analysis matrix (PAM) model to examine the magnitude of the impact of these various factors on

the private and social profitability of cassava/maize production systems in Nigeria, Ghana and Côte d'Ivoire.

The intent of this comparative study is to use policy analysis matrix (PAM) approach to push analysis of the factors influencing profitability further than can be done within the context of a single country. The main advantage of carrying out similar policy studies in a number of countries is the scope presented for obtaining comparative insights.

2. Methodological Framework

2.1. A Short Description of the Policy Analysis Matrix (PAM) Model

The Policy Analysis Matrix (PAM) is the analytical framework used in this paper. The PAM is a product of two accounting identities. The first identity holds that profit equals revenues minus costs, measured either in financial or economic terms. The second identity measures the effects of divergences between financial and economic values. The main empirical task is to construct accounting matrices of revenues, costs and profits for each selected enterprise based on representative synthetic farm-level and marketing budgets, using data on farming, farm-to-processor marketing, processing, and processor-to-wholesaler marketing (Monke and Pearson, 1989).

The concept of profit is fundamental in PAM analysis. Profit, whether calculated at observed market prices or at imputed social (efficiency) prices, is defined as the difference between revenues (the value of outputs) and costs of all inputs. Measurement of costs and returns at private market prices reveals the presence of any excess profits (defined as the difference between total returns and the costs of all inputs, including capital) and the actual competitiveness of the enterprise. If market prices for inputs or outputs differ from their values in alternative production or consumption uses, actual competitiveness and profitability may be misleading indicators of the potential for growth.

The most common source of such divergences is policies (Pearson *et al*., 1995).

Policy analysis can help explain the level of allocation of resources devoted to food production by considering food as seen from the standpoint of different socioeconomic and political agents. The commercial farmer sees food mainly as a source of income; the subsistence farmer sees food as a means of subsistence and survival; and the policy-maker sees food as a source of government income and as a strategic commodity, which can be used as a means of control or as an instrument of social welfare. Food prices are policy instruments to the government, returns to farmers and costs to the consumer. Agricultural input prices are policy instruments to the government, costs to the farmers, and returns to the owners of factors of production (*e.g.,* wages for agricultural labor).

As an empirical framework, the PAM provides measures of economic efficiency and of transfer effects of policy on particular commodities, technologies, and regions. This information is used to explore several topics of interest to policymakers, such as the pattern of competitiveness and the potential for the government to exploit competitive advantage; the formulation of public investment policy to support particular commodities, regions and farm types; and the allocation of public research and development expenditures within the agricultural sector. PAM results thus serve as an information baseline for monitoring and evaluating the effects of policy and for identifying policy-relevant research needs.

In this paper, first, private and social profitability of cassava/maize production systems in each country is presented and analyzed under a baseline scenario. This is followed by the discussion policy analysis matrix (PAM) results for each country. These results are organized by country to provide a basis for: a) cross-country comparisons of technologies that dominate cassava/maize production in West Africa, and b) comparisons of technologies within Nigeria. Comparisons

between similar systems in different countries are also possible through a further extension of the PAM analysis, from which policy-impact ratios (e.g. DRC, EPC) are produced.

Finally, the paper analyzes these "baseline" results further by considering the implications of two scenarios for future change in selected technical parameters. The first scenario simulates increases in yields in Cote d'Ivoire and Ghana. The second scenario considers the effects of changes in the foreign exchange rates in the three countries.

2.2. Data

This study is based on data for Côte d'Ivoire, Ghana and Nigeria from the Collaborative Study of Cassava in Africa (COSCA) survey. COSCA report number 2 provides a detailed discussion of the data collection procedures and the associated sampling method. The survey covered the period 1989/1991.

Data available in the COSCA survey that are used include farm-level technical coefficients, processing costs, transformation rates of cassava root into processed products, sources of cassava roots and destination of cassava products, unit storage costs, unit transportation costs, product and input market prices and taxes and subsidy levels. In the case of green maize, data used were obtained not only from the COSCA survey but also from primary sources of earlier studies and from secondary sources such as the Office of Agricultural Statistics of each country's Ministry of Agriculture.

In addition, macroeconomic data needed in the estimation of economic prices (i.e., import parity prices and shadow exchange prices) were obtained mostly from secondary sources such as National Statistical Reports and from the IMF.

Unfortunately, the COSCA study did not record maize yields on its sample fields. Therefore, in computing the enterprise budgets developed in this study, it was assumed that those fields got the

average maize yield for the country which was then converted to the number of fresh corn ears using the "Ear-Weight Method" discussed in the appendix. The numbers of corn ears were subsequently valued at the fresh corn price.

3. Empirical Analyses

Cassava/maize production systems are examined in this section using a combination of financial analysis, economic analysis and policy analysis. The tasks involved are the following:

1. To identify and select relevant estimates of private profitability (farm level and post-farm level) and social profitability from the first two essays on Cote d'Ivoire and Nigeria.
2. To develop enterprise budgets (financial and economic) for cassava/maize systems in Ghana under a "baseline scenario".
3. To construct a Policy Analysis Matrix (PAM) for Ghana, using the information from the enterprise budgets and estimate ratio indicators such as DRC, NPC, etc.
4. To undertake sensitivity analyses in order to contrast the relative comparative advantage of each country in cassava/maize production.

3.1. Private Profitability (PP)

In this subsection, separate financial farm–level and post-farm level budgets are developed for Ghana, whereas estimates of private profitability (PP) indicators are taken from the previous essays on Cote d'Ivoire and Nigeria.This provides the database for establishing the relative profitability of cassava/maize production systems in each country. Previous chapters not only present a summary of the rationale that underlies farm budgets analysis, but also discuss in detail the construction of farm budgets. The PP indicator shows the incentives, for each production system, to alter the existing allocation of resources. If PP is positive, resources are encouraged to flow into the

activity. If PP is negative, the direction of the flow is likely to be away.

3.1.1. Farm level Analysis

Cassava/maize enterprise budgets for the three countries are presented in tables A-1 through A-3 in the appendix. Table 1 below summarizes the results of the baseline runs of the farm level financial profitability analysis for Cote d'Ivoire, Ghana and Nigeria. The summary focuses mainly on performance measures that can be used to identify the country where enterprises have the highest financial return and lowest cost of production.

Table 1: Summary Estimates of Farm-Level Financial Budget Indicators (in US$ using prevailing Exchange Rates) for Cassava/Maize Production Systems, by Country,1989/91

Countries/Production Technologies	Returns to Family Labor Per Ha	Returns to Family Labor Per Person- day	Total Production Costs/ha	Net Enterprise Profits/ha
COTE D'IVOIRE				
Local/maize	804.56	6.00	755.49	487.20
IITA/maize	*NA*	*NA*	*NA*	*NA*
GHANA				
Local/maize	742.58	5.34	1266.50	419.33
IITA/maize	*NA*	*NA*	*NA*	*NA*
NIGERIA				
Local/maize	519.65	3.24	903.60	320.80
IITA/maize	742.70	4.29	962.18	530.24

Source: tables A-1, A-2 and A-3 in the appendix
Note: in terms of prevailing exchange rates, 1US dollar= 266 fcfa (in Cote d'Ivoire) = 430 cedis (in Ghana) = 17 nairas (in Nigeria)

Results in table 1 clearly show that the production system that is common to the three countries is the local landrace variety /maize system. However, the PP estimates as shown in table 1 also clearly indicates that IITA's improved cassava varieties generate the highest net profits.

When converted to a per person-day basis, the returns to family labor for local land race variety/maize systems (RFL) are US $ 6.00 in Cote d'Ivoire, US $ 5.34 in Ghana and US $ 3.24

dollars in Nigeria. In the three countries, the RFL per person-day is higher than the average daily wage rate paid to the hired labor, which are $2.40 in Cote d'Ivoire, $2.33 in Ghana and $1.23 in Nigeria. Thus, there is no financial advantage to family members in any of these countries to seek wage employment in urban areas or other farms, when they are needed on their farms in the village. Furthermore, results in table 1 underline the remarkable stability of the RFL per person-day as a proportion of agricultural wage rates across countries (ranging from 2.3 to 2.6 times the agricultural wage rates).

Results in table 1 also indicate that price incentives have enabled local landrace variety/maize systems to earn positive private profits per hectare that do not vary enormously across countries: US $ 487.20 in Cote d'Ivoire, US $ 419.33 in Ghana and US $ 320.80 in Nigeria.

3.1.2. Post-harvest Level Financial Analysis

It is assumed that green maize is harvested and consumed or sold at the farm level. Therefore, only cassava roots harvested are taken to the next level (the village) to be processed. Cassava processing methods involve a combination of activities such as peeling, grating and toasting. Of these activities, grating is the most labor intensive. In this study, a process is defined as traditional if grating is performed manually. Mechanized processing method involves the use of various types of mechanical cassava graters, which are driven by electrical, petrol, or diesel engines. The major form into which cassava roots are processed in Nigeria and Ghana is *gari*, which is made of toasted cassava granules. In Cote d'Ivoire, *attieke* (steamed cassava granules) is the major form into which roots are processed.

Transformation coefficients were computed and used to calculate actual *attieke* and *gari* yields under each technology combination. The technology combination common to the three

countries was the "*Locman*"[1]. Yields were valued by the weighted average consumer price based on COSCA village survey data. It should be noted that prices vary a lot from season to season, mainly because of changing season conditions (e.g., abundance vs. hungry seasons). To account for this diversity, the weighted average price was estimated. Since farmers do not own processing machines, no fixed costs was assigned processing enterprises. Table 2 summarizes the results of the post-farm level budget analysis for the three countries under the technology combination "*Locman*". Table 3 summarizes the results of the post-farm level budget analysis for Nigeria under alternative technology combinations.

Table 2: Summary Estimates of Post-farm Level Financial Budget Indicators (in US$ using prevailing Exchange Rates) for Processed Products (*Attieke* in Cote d'Ivoire and *Gari* in Ghana and Nigeria*)* Production, by Country: 1989/91

Countries	Returns toFamily Labor Per Person-day	Average Costs of Production Per Kg of *Attieke/Gari*	Net Enterprise Profits Per ha
COTE D'IVOIRE	1.36	0.18	-57.20
GHANA	2.12	0.27	-6.65
NIGERIA	1.00	0.19	-15.12

Source: tables A-4, A-5 and A-6 in the appendix.
Note: using the prevailing exchange rates, 1 US dollar= 266 fcfa (in Cote d'Ivoire) = 430 cedis (in Ghana) = 17 nairas (in Nigeria)

Table 3: Summary Estimates of Postfarm-Level Financial Budget Indicators (in US$ using prevailing Exchange Rates) for Gari Production, by Technology Combinations: Nigeria, 1989/91

Technology Combinations	Returns to Family Labor Per Person-day	Average Costs of Production Per Kg of *Gari*	Net Enterprise Profits Per ha
Impmech	1.94	0.16	49.41
Locmech	1.18	0.18	-1.65
Locman	1.00	0.19	-15.12
Impman	0.76	0.19	-40.65

Source: table A-19 in the appendix

Results in table 2 indicate that processing costs differ slightly between the three countries.

[1] The production and processing technology combination "*Locman"* is defined as follows: local cassava variety + manual grating method

Attieke production in Cote d'Ivoire is cheaper than *gari* production in Ghana or Nigeria. However, profits are negative in the three countries.

Results in table 3 show that in Nigeria, only cassava/maize systems under "*Impmech*" technology combination had a positive net enterprise profits (NEP). These results also show that mechanized processing methods have a definite cost-saving advantage over traditional processing methods. The "*Impmech*" technology combination has the lowest cost of production per kilogram of *gari* ($0.16 US/kg). This implies that farmers have incentives to adopt that technology combination. In fact, these findings are consistent with farmers' behavior in Nigeria. As mentioned earlier, COSCA data for Nigeria show that, in the 65 villages representing cassava-growing areas, most farmers (85 percent) grew the improved varieties. Of these farmers, 54 percent used mechanized processing method.

However, it should be noted that the negative NEPs observed under the other technology combinations do not mean that farmers are losing money. Rather, they mean that net margin is not enough to yield a positive return to the management factor when the costs of other factors are taken into account. In fact, the post-farm level financial budgets presented in tables A-4 through A-6 in the appendix show that all the NEPs, assuming zero opportunity cost of labor, are positive.

The COSCA survey data indicate that women control post-harvest activities in the three countries and receive all the benefits from those activities. In addition, when asked why they were involved in this activity only, their answer was that there is no better alternative. That is, they have fewer or no opportunities for employment at the assumed "prevailing" rural wage.

This situation reflects the segmentation of the rural labor market for cassava farming systems in West Africa. Women manage a very important part of cassava production systems: 1) they predominate in cassava processing and *attieke and gari* preparation and, 2) they devote a large

amounts of time in obtaining the fuel and water required to make cassava processed products ready for sale or home consumption. . Yet this analysis suggests that returns to women from these activities are below the rural wage rate, which is available mainly to men.

3.2. Social Profitability (SP)

The COSCA data indicate that, in Nigeria, about 79 percent of farmers who produce gari are net sellers, in Ghana about 70 percent of farmers who produce gari are net sellers, and in Cote d'Ivoire about 65 percent of farmers who produce attieke are net sellers. Therefore, this analysis focuses on commercial cassava/maize systems only.

The farm level economic returns for each country were calculated using import parity prices (tables A-7 through A-9b in the appendix) of cassava roots and financial prices of green maize at selected regional markets: Bonoua and N'douci in Cote d'Ivoire, Koforidua and Kumasi in Ghana and Abeokuta and Onitsha in Nigeria. These markets were selected because they are located in regions where farmers ranked cassava as the most important crop in the farming system (Nweke *et al.,* 1998*).* The economic budgets are presented in tables A-10 through A-15 in the appendix.

The economic budgets were estimated according to the following assumptions: 1) It is assumed that green maize is nontraded and that its price is not distorted by government policies. Therefore, its financial price (the observed market price) reflects its shadow price; 2) *Gari*, the main cassava product in Nigeria and Ghana, and *attieke*, the main cassava product in Cote d'Ivoire, are not traded internationally, but tapioca, another cassava product and the closest substitute of *attieke* and *gari* is traded internationally. Consequently, the price of imported tapioca was used to estimate the import parity of cassava root; and 3) the official exchange rates (266 francs cfa to $1US for Cote d'Ivoire, 430 cedis to $1US for Ghana and 17 nairas to $1US for Nigeria) were adjusted to reflect their equilibrium values net of distortions. The premium used for this adjustments were 48 percent

for Cote d'Ivoire, 50 percent for Ghana and 30 percent for Nigeria respectively (Stryker, 1990).

Net social profit (SP), measured in world prices or their equivalent, in fact, diverges widely from the PP. The SP indicators shown in tables 4 and 5 below indicate that there is significant variation in SP among countries and between techniques. However, these SP indicators also suggest that all countries are able to substitute profitably local production of cassava/maize for imports. The only exceptions are systems under the technology combination "*Impman*" in Nigeria when outputs are sold in Abeokuta.

However, the systems under the "*Impmech*" technology combination in Nigeria, are clearly the most efficient use of national resources. They generate significantly higher net social profits (NSP) per hectare at both regional output markets (US$ 290.00 in Abeokuta and US$ 684.32 in Onitsha). The net social profit (NSP) refers to the difference, valued in border and shadow prices, between the gross value of output and the total costs of all inputs (traded and nontraded intermediary and primary inputs).

A more efficient use of resources means that one can produce more from what one has and attain a higher level of welfare. Measures of NSP, like DRC, may give an idea of the comparative advantage in the agricultural commodity system. In addition, measures of NSP may give an idea of the comparative advantage or efficiency in the agricultural commodity system. Thus, NSP measures are very informative for decision-makers and allocators of research funds, if the technical changes they might introduce would attempt to break labor or other constraints in cassava/maize systems.

It should be noted that all systems are more profitable financially than they are socially. That is, there are net transfers to farmers (tables A-10 through A-15 in the appendix). The subsequent PAM analysis will help illustrate the sources of these transfers.

Table 4: Summary Estimates of Farm-Level Economic Budget Indicators (in US$ using Shadow Exchange Rate) For Commercial Cassava/Maize Production Systems at Each Regional Output Market, by Country:1989/1991

Countries/Regional Markets		Returns to Family Labor Per Ha	Returns to Family Labor Per Person-day	Total System Production Costs Per Ha	Net Social Profits Per Ha
COTE D'IVOIRE	*Bonoua*	306.54	2.18	535.30	81.08
	N'douci	413.26	2.89	534.06	184.60
GHANA	*Koforidua*	417.36	2.87	846.62	192.56
	Kumassi	557.60	3.52	858.90	311.83
NIGERIA	*Abeokuta*	235.18	1.81	647.80	113.00
	Onitsha	420.00	2.51	722.64	261.50

Source: tables A-10, A-12 and A-14 in the appendix.
Note: using the shadow exchange rates, 1US $ equals 394 fcfa (in C.I.), equals 645cedis (in Ghana), equals 22 nairas (in Nigeria).

Table 5: Summary Estimates of Farm-Level Economic Budget Indicators (in US$ using Shadow Exchange Rates) For Commercial Cassava/Maize Production Systems at Each Regional Output Market, by Production and Processing Technology Combinations, Nigeria: 1989/1991

Regional Markets/ Technology Combinations	Returns to Family Labor Per Ha	Returns to Family Labor Per Person-day	Total System Production Costs Per Ha	Net Social Profits Per Ha
Abeokuta				
Impmech	460.80	2.60	794.23	290.00
Locmech	303.00	2.40	674.80	180.82
Locman	235.20	1.81	674.80	113.00
Impman	112.30	0.64	794.23	-3.5
Onitsha				
Impmech	858.04	4.73	783.00	684.32
Locmech	504.00	3.05	722.64	345.60
Locman	420.00	2.54	722.64	261.50
Impman	392.14	2.13	783.00	218.41

Source: COSCA data and tables A-9a and A-9b in the appendix

3.3.Policy Matrix Analysis

By completing a PAM for a production system one can simultaneously determine the

economic efficiency of the system, the degree of policy-induced transfers on the input /output markets, and the extent to which resources are transferred among agents (Yao, 1997). First, the PAM was constructed using the information on costs and returns obtained from the financial and economic analyses. Second, the extent of policy-induced transfers is computed. Third, six PAM policy-indicators were derived for policy analysis. They are: the Domestic Resource Cost (DRC), the Nominal Protection Coefficient on Tradable Output (NPCO), the Nominal Protection Coefficient on Tradable Input (NPCI), the Effective Protection Coefficient (EPC), the Profitability Coefficient (PC), and the Subsidy to Producers (SP)[2].

3.3.1.Baseline Results

The PAM of cassava/maize production systems for each country is presented in tables A-16 through A-18 in the appendix. The policy-induced transfers (in the output and input markets) are summarized in tables 6 and 7 below. Results from these two tables indicate that there are substantial differences between countries in the magnitudes of public incentives offered to encourage cassava/maize production systems.

However, all countries display the same patterns. The baseline results indicated that, farmers operating at the Bonoua markets near urban centers (i.e., Bonoua in Cote d'Ivoire, Koforidua in Ghana and Abeokuta in Nigeria), benefited from a small implicit price support whereas farmers operating in markets distant from urban centers (N'douci in Cote d'Ivoire, Kumasi in Ghana and Onitsha in Nigeria) were subject a small implicit tax.

This is the result of farm-gate financial prices (15 fcfa in Cote d'Ivoire, 22 cedis in Ghana and 0.57 nairas in Nigeria) for cassava root departing from the estimated import parity prices in each

[2] DRC= domestic factors in social prices/ (revenues in social prices – tradable inputs in social prices), NPCO = revenues in private prices / revenues in social prices, NPCI= tradable inputs in private prices/ tradable inputs in social prices, EPC= (revenues in private prices –tradable inputs in private prices)/ (revenues in social prices –tradable inputs in social prices), PC= private profits/ social profits, SP= (private profits- social profits)/ revenues in social prices.

country (tables A-7 through A-9b in the appendix) depending on the point of sale.

It should be emphasized that these differentials are relatively small. With this in mind, here are some plausible explanations of why market (financial) prices and economic prices (import parity prices) did not equal in markets close to port cities and markets distant from port cities. The divergences between these two prices could be due to a combination of the effect of the food import policies (i.e., ban on cereals import in Nigeria, rice import tariffs in Ghana and Cote d'Ivoire) and the effect of the overvaluation of each country's local currency. The indirect effect of such food import policies will be an increase in the financial price of cassava root relative to the economic price in all the markets. On the other hand, the currency overvaluation will have the effect of lowering the financial price of tradables such as roots and transport in both markets.

However, the magnitude of the reduction in prices will be large in markets far away from port cities and small in the ones close to port cities because the share of transport costs in the import parity price is relatively large for N'douci, Kumassi and Onitsha (distant from port cities) and relatively small for Bonoua, Koforidua and Abeokuta (close to port cities). Transportation costs thus provide a natural protection to domestic producers who supply markets located far from the import point.

Thus, the net effect is as follows: 1) in N'douci, Kumassi and Onitsha : an increase in the financial price of roots due to the import tariff and a relatively large decrease in the financial price of roots due to the currency overvaluation (via its impact on tradable goods such as cassava and transport costs); and 2) in for Bonoua, Koforidua and Abeokuta: an increase in the financial price of roots due to the import tariff and a relatively small decrease in the financial price of roots due to the currency overvaluation.

. It should be noted that the results from tables 6 and 7 are calculated using the weighted

average of peak-season and off-peak season wage rate across cassava production zones. The off-peak season rate is two third of the peak-season rate in Cote d'Ivoire, half of the peak-season rate in Ghana and. half of the peak-season rate in Nigeria.

Table 6: Summary of the Net Effects (in US$ using Shadow Exchange Rates) of Policy-Induced Transfers For *Commercial* Cassava/Maize Systems, by Country: 1989/1991.

Regional Output Markets	Output Transfers	Tradable Inputs Transfers	Domestic Factors Transfers	Net Policy Transfers
COTE D'IVOIRE				
Bonoua	87.00	-5.00	-0.4	92.00
N'douci	-36.00	-5.00	-0.4	-31.00
GHANA				
Koforidua	129.00	-7.00	-1.00	137.00
Kumassi	-25.00	-7.00	-1.00	-17.00
NIGERIA				
Abeokuta	187.00	-16.00	-1.00	205.00
Onitsha	-24.00	-16.00	-1.00	-95.00

Source**:** tables A-16, A-17 and A-18 in the appendix.

Table 7: Summary of the Net Effects of Policy-Induced Transfers For Commercial Cassava/Maize Systems in Nigeria: 1989/1991.

Mkts/Technology Combinations	Output Transfers	Tradable Inputs Transfers	Domestic Factors Transfers	Net Policy Transfers
Abeokuta				
Impmech	119.00	-23.00	-2.00	143.00
Locmech	120.00	-16.00	-1.00	137.00
Locman	187.00	-16.00	-1.00	205.00
Impman	467.00	-23.00	-2.00	492.00
Onitsha				
Impmech	-289.00	-21.00	-2.00	-266.00
Locmech	-108.00	-15.00	-1.00	-91.00
Locman	-24.00	-15.00	-1.00	-7.00
Impman	177.00	-21.00	-2.00	200.00

Source: table A-16 in the appendix.

As for the tradable inputs and domestic factor transfers, they are negative everywhere. However, it should be noted that these transfers are relatively smaller compared with the transfers occurring in the outputs markets. The reason is that while the output (cassava roots) is assumed to be tradable, only 20 percent of the inputs (e.g., local transportation) used in its production process is

treated as such. The key difference is that, compared with a nontradable commodity or resource, the domestic price formation of tradable commodity or resource is influenced to greater extent by the world market for that commodity or resource.

Thus, results in table 6 imply that, when outputs and inputs were valued at their social (efficiency) prices, the effect of government policy was: a) some type of support system to both cassava/maize systems in regional output markets closer capital cities, a tax to cassava/maize farmers selling at remote regional output markets; b) the provision of a subsidy, through an overvalued exchange rate, on sale of all inputs (imported and produced domestically).

Within Nigeria, some generalizations can be made concerning policy-induced transfers of different technology combinations. Results in table 7 suggest that when outputs and inputs were valued at their social (efficiency) prices, the effect of government policy was: 1) some support to cassava/maize systems under each technology combination at the Abeokuta market and 2) some tax on systems at the Onitsha market, except for systems under "*Impman*" combination. It is worth noting that the largest amount of negative transfers to producers occurs under the "*Impmech*" combination. In other words, farmers growing improved cassava varieties and producing *gari* using modern technology have been taxed more compared to other cassava/maize farmers. This difference can be explained as follows: COSCA data indicate that the average farm-gate market price for cassava root was 0.57 nairas in Nigeria during the survey period. This price departs from the estimated import parity prices under each technology (tables A-9a and A-9b in the appendix) of roots when Abeokuta or Onitsha is used as a point of sale. As already discussed above, overvalued large transportation costs combined with the cereals imports ban of 1985 explain this difference.

The calculation of domestic resource cost (DRC) coefficients for different countries permits a ranking of relative efficiencies in production. For example, given a desire to expand cassava/maize

production systems in West Africa, the country with the lowest DRC is the most efficient avenue for expansion. Thus, DRC rankings indicate which country can expect the highest social rate return on its investment in farm and post farm technologies. Two main types of prices policy instruments can be used to alter prices of agricultural outputs and inputs. Quotas tariffs, or subsidies on imports and quotas, taxes, or subsidies on exports directly decrease or increase amounts traded internationally and thus raise or lower domestic prices. Domestic taxes or subsidies, in contrast, create transfers between the government treasury and domestic producers or consumers.

In addition to price and macro policies, governments influence their agricultural sectors through public investment policy. Government budgetary resources can be invested in agriculture to increase productivity and reduce costs (Monke and Pearson, 1989).

Table 8: Ratio Indicators for Commercial Cassava/Maize, by Country: 1989-1991.

Countries/ Regional Output Mkets		**DRC**	**NPCO**	NPCI	**EPC**	**PC**	**SP**
COTE D'IVOIRE	Bonoua	0.86	1.14	1.00	1.15	2.14	0.15
	N'douci	0.74	0.95	1.00	0.96	0.83	-0.04
GHANA	Koforidua	0.81	1.12	0.67	1.13	1.71	0.13
	Kumassi	0.73	0.98	0.67	0.98	0.95	-0.01
NIGERIA	Abeokuta	0.84	1.24	0.77	1.28	2.81	0.26
	Onitsha	0.71	0.98	0.77	0.99	0.97	-0.01

Source: PAM Model constructed by the authors

Table 9: Ratio Indicators for *Commercial* Cassava/Maize Production Systems Under Alternative Production and Processing Combinations and by distance in Nigeria, 1989-1991.

Mkts/Tech. Comb.	**DRC**	**NPCO**	**NPCI**	EPC	**PC**	**SP**
Abeokuta						
Impmech	0.71	1.11	0.77	1.14	1.49	0.13
Locmech	0.77	1.14	0.77	1.17	1.76	0.16
Locman	0.84	1.24	0.77	1.28	2.81	0.26
Impman	1.09	1.64	0.77	1.77	-7.39	0.67
Onitsha						
Impmech	0.50	0.80	0.77	0.80	0.61	-0.81
Locmech	0.65	0.90	0.77	0.91	0.74	-0.09
Locman	0.71	0.98	0.77	0.99	0.97	-0.01
Impman	0.76	1.18	0.77	1.22	1.91	0.20

Source: PAM Model constructed by the authors

Note: **DRC**= Domestic Resource Cost, **NPCO**= Nominal Protection Coefficient on Tradable Output, **NPCI**= Nominal Protection Coefficient on Tradable Input, **EPC**= Effective Protection Coefficient, **PC**= Profitability Coefficient and **SP**= Subsidy to Producers

The DRC coefficients presented in table 8 clearly show that, not only they are less than unity in all three countries, but also the three countries have similar comparative advantage in cassava/maize production in West Africa using local varieties. DRC coefficients taken from the essay on Nigeria are presented in table 9 to push the efficiency comparisons further. They indicate that, cassava/maize systems under the "*Impmech*" technology have a greater comparative advantage when outputs are sold in Onitsha. Given that governments in West Africa are involved extensively in their agriculture economies, it is of interest to describe how overvalued exchange rate policies create private incentives. An overvalued exchange rate is an implicit tax on producers of tradable products because too little domestic currency is earned by exports or paid out for imports. In the absence of commodity price policy, the world price of a tradable good determines its domestic price. When the exchange rate is overvalued, the domestic price is lower than its efficiency level and domestic producers are effectively taxed.

To examine the relationships between government policy and the cassava/maize economy in Cote d'Ivoire, Ghana and Nigeria, policy-impact ratios, which cancel all units of measure, were calculated. These ratios are presented in the tables 8 and 9 above. The analysis that follows will focus on the NPCO, the NPCI and the EPC.

Of the three countries, Cote d'Ivoire demonstrates the lowest level of government interference on both the input and the output sides in N'douci, a market located farther away from the capital city. The NPCO, the EPC and the NPCI all are close to unity unity. In all three countries, the NPCO and the EPC assume the same patterns in markets located closer to capital cities: they are greater than unity, suggesting a certain positive protection to cassava/maize farmers in those markets. However, in Ghana and Nigeria the NPCI are less than unity everywhere, implying government policies in those countries have permitted inputs prices to be lower than they would be

under open trade.

3.3.2. Sensitivity Analysis

The sensitivity analysis carried out in this sub-section aims to test the robustness of the results under the baseline scenario. Two scenarios are considered: the first scenario simulates a change in yields of cassava and a change in processing costs; and the second considers the effects of change in the shadow exchange rate.

Yields and Processing Cost. This sensitivity analysis is broken into two parts: the first part investigates the effects of an increase in cassava yields in Cote d'Ivoire and Ghana on the DRC ratios. It is assumed that farmers in both countries have adopted the IITA variety; therefore cassava yields equal ITTA variety yields in Nigeria (19,210 kilograms of roots per hectare).

Post-farm budgets analyses (tables 2 and 3) show that mechanized processing technology decreases processing cost by 6 percent for farmers who grow local landrace cassava varieties, varieties that are common to all three countries. Therefore, in the second part of the sensitivity analysis, the impact of a decrease in processing costs is considered. The results are shown in table 10.

Table 10: Effects of Changes in Cassava Yields and Processing Costs on the DRC for Root Production in Cote d'Ivoire and Ghana: 1989/1991

Countries/ Markets	Effects of Increase (79% for CI and 43% for Ghana) in Cassava Yields			Effects of a 6% Decrease in Processing Costs		
	DRC Ratio					
	Baseline	Elasticity	Simulation	Baseline	Elasticity	Simulation
COTE D'IVOIRE						
Bonoua	0.86	-0.60	0.46	0.86	-1.94	0.76
N'douci	0.74	-0.57	0.41	0.74	-1.58	0.67
GHANA						
Koforidua	0.81	-0.57	0.61	0.81	-2.26	0.70
Kumassi	0.74	-0.63	0.54	0.74	-1.80	0.66

Source: PAM Model constructed by the authors

To help in assessing comparative costs across the three countries, DRC elasticties were calculated. They are defined as the percentage change in DRC divided by percentage change in yield or processing costs. Results of table 10 show that DRC elasticity values with respect to yields and processing cost range from -0.57 to -0.60 and from -1.58 to -2.26 in Cote d'Ivoire and Ghana, respectively. The larger the value of the elasticity, the more effect the relevant parameter has on the DRC coefficient. However, the question is how much it costs get a 1 percent change in yield versus a 1 percent in processing cost in order to evaluate whether it would be better to invest in yields or processing method.

Shadow Exchange Rates. The sensitivity analysis undertaken here is designed to examine the effects of an appreciation of the real exchange rate on net social profitabilities (NSP) and selected policy-indicators (DRC and EPC) ratios. Previous studies (Babo, 1996; Barry, 1998; and Nweke, 1998) have shown that market prices in Cote d'Ivoire, Ghana and Nigeria have changed with a decline in the shadow exchange rate, which led to recent currency devaluation in all three countries. Therefore, these post-devaluation prices were used in carrying out this analysis. Tables 11 and 12 present the results.

Table 11: Effects of Change in the Shadow Exchange Rate on the Net Social Profit (NSP in $US using Shadow exchange rates), by Country: 1989/1991

Countries/Regional Mkts		Baseline	Simulation	Profit Elasticity
COTE D'IVOIRE	Bonoua	81.06	266.84	6.55
	N'douci	184.60	329.94	2.25
GHANA	Koforidua	192.55	-152.45	-0.85
	Kumassi	311.83	-250.63	-0.86
NIGERIA	Abeokuta	113.00	18.44	-0.29
	Onitsha	261.50	19.65	-0.32

Source: PAM Model constructed by the authors
Note: it is assumed that the percentage changes in the equilibrium exchange rates are: 35% for Cote d'Ivoire, 210% for Ghana and 280% for Nigeria.

Table 12: Effects of Change in the Shadow Exchange Rate on Selected Policy Indicators, by Country: 1989/1991

Countries/Mkts	Policy Indicators					
	DRC Ratio			**EPC Ratio**		
	Baseline	% Change	Simulation	Baseline	% Change	Simulation
COTE D'IVOIRE						
Bonoua	0.86	-25	0.64	1.15	-32	0.78
N'douci	0.74	-20	0.59	0.96	-28	0.70
GHANA						
Koforidua	0.81	62	1.31	1.71	-18	1.40
Kumassi	0.73	119	1.60	0.97	64	1.59
NIGERIA						
Abeokuta	0.84	17	0.98	1.28	-50	0.64
Onitsha	0.71	37	0.97	0.99	-36	0.63

Source: PAM Model constructed by the authors
Note: it is assumed that the percentage changes in the equilibrium exchange rates are:35% for Cote d'Ivoire, 210% for Ghana and 280% for Nigeria.

As the profit elasticities in table 10 indicate, social profitability levels are very sensitive to changes in the shadow exchange rates. Following 35 percent, 210 percent and 286 percent decline in the equilibrium exchange rate in Cote d'Ivoire, Ghana and Nigeria respectively, results from table 11 show that, while cassava/maize systems show considerable benefit from the exchange rate depreciation in Cote d'Ivoire, systems in Ghana suffered a huge loss. This result can be explained by the fact that in Ghana, farm level wage rates rose from 1000 cedis to 4000 cedis (a 300 percent increase) while output price rose from 22 cedis to 65cedis (a 195 percent increase).

The results of table 12 show the effect of changes in the exchange rates on the DRC, the EPC. The simulated values of the domestic resource cost (DRC) ratios are greater than unity in Ghana, suggesting that the decrease in the equilibrium exchange rate combined with the increased valued of domestic labor have caused that country to suffer a comparative disadvantage. However, the EPC estimates are also greater unity, suggesting that farmers are receiving positive protection.

That is, they could have received a lower return if they faced border prices instead of domestic prices on both outputs and inputs.

4. Conclusions

This paper is an application of the policy analysis matrix (PAM) for cassava/maize production systems in Cote d'Ivoire, Ghana and Nigeria. The purpose was to analyze and compare the competitiveness of cassava/maize systems in these three West African countries. The baseline results compared in this study demonstrate the narrow range of efficiencies of production. All three countries have almost similar comparative advantage in cassava/maize production systems, although labor input for Nigeria and Ghana is 15 to 30 percent higher than for Cote d'Ivoire.

However, PAM is a static model which cannot capture changes in prices and productivity (Yao, 1998); therefore, a sensitivity analysis was carried out. The simulation findings indicate that, in most instances, the decline in the equilibrium exchange rate has allowed the differences in efficiencies across countries to be maintained.

The results of this study have several implications for the three West African countries' goal of reaching regional self-sufficiency in food crops in West Africa. First, all cassava/maize systems under existing techniques are financially and socially profitable if the output substitutes for imports on-farm or in markets near the site of production. Second, the extent of divergences (especially for tradable inputs and factor prices) observed in the three countries is relatively small (see tables A-16 through A-18 in the appendix); therefore, there is little scope for achieving easy improvements by removing significant price distortions.

Third, the simulation results indicate that the potential for governments to assist in income growth lies in areas other than commodity market price policy. In Nigeria and Ghana, protectionism can be viewed as an expression of an inward-looking import-substitution strategy. Thus, the

realization of income gains for cassava/maize farmers in Nigeria and Ghana depended in the 1980s and the early 1990s on a change in foreign exchange rate policy.

In Cote d'Ivoire and Ghana, simulation results indicate that cassava/maize farmers could benefit from growing IITA's variety and adopting mechanized processing methods. Baseline results for Nigeria clearly indicate that the *Impmech* technology combination reduces labor costs, which is good in case of labor constraints. The profitability of cassava/maize systems will encourage their expansion and the reduction of the area planted. One option is to invest in research and development programs that would facilitate the adoption of the ITTA's variety and mechanized processing methods.

REFERENCES

Babo, Alfred, Circuits de Commercialisation et de Transformation du Manioc dans la Region de Bouake. Memoire de Maitrise. Option: Socio-Economie du Developpement Rural. Universite de Bouake, 1996.

FAO, 1989-1992, Various issues

Monke, E.A. and S. Pearson. 1989. *The Policy Analysis Matrix for Agricultural Development.* Baltimore: John Hopkins University Press.

Nelson, G C and Panggabean, M (1991), The costs of Indonesian sugar policy: a policy analysis matrix approach, *American Journal of Agricultural Economics*, 73 (3) pp 703-712

Nweke, F.I., Cassava Distribution in Sub-Saharan Africa The Collaborative Study of Cassava in Africa, *Working Paper No. 12*, 1994

Nweke, Felix I., K. N'Goran, A.G.O. Dixon, B.O. Ugwu, O. Ajobo, and T. Kouadio. 1998, Cassava production and processing in Cote d'Ivoire. *COSCA Working Paper No. 23*, The Collaborative Study of Cassava in Africa, IITA, Ibadan, Nigeria.

Stryker J. Dirck, " Trade, Exchange Rate, and Agricultural Pricing Policies in Ghana," *World Bank Comparative Studies*, 1990

Yao, Shujie, 1997. "Rice Production in Thailand Seen Through a Policy Analysis Matrix". *Food Policy*, 22(6):547-560

World Bank. 1993. World Development Report 1996.

APPENDIX

CORN EARS YIELD ESTIMATION

The procedure used is the "Ear Weight Method". It involved the following steps.

STEP 1. : Hand shells 30 dry corn ears and put the grains in 30 different plastic bags. Weigh each bag and calculate the *average weight of grains* (in grams) on a cob. Then divide the result by 0.80, assuming that grain is about 80% of ear weight, to obtain the *average dry ear weight*.

STEP 2. : Convert each country's grain production from tons to grams and divide the result by 0.80, assuming that grain is about 80% of ear weight, to obtain the *total dry ear weight*.

STEP 3. : Divide the results obtained in the first two steps by 0.65 (assuming a wet corn with 35% moisture content) to get the *average fresh on the field corn weight* and the *total fresh on the field corn weight* for each country.

STEP 4.: Divide the *total fresh on the field corn weight* for each country by the *average fresh on the field corn weight* and to get the *total number of corn ears* for each country.

EXAMPLE: **the case of Cote d'Ivoire**

1) The *average weight of grains* on a cob was 145.08 grams.

The *average dry ear weight* was 181.35 grams (145.08/0.80)

2) The average grain production per hectare was 983628 grams and the total *dry ear weight* was 1229534.86 grams

3) The *average fresh on the field corn weight* was 279 grams (181.35/ .65) and the *total fresh on the field corn weight* for the country was 1891592.10 grams (1229534.86/0.65).

4) The *total fresh on the field corn weight* divided by the *average fresh on the field corn weight* gave the *total number of corn ears* of 6779.9 ears rounded off to 6780 ears.

Table A-1: Estimated Average Financial Budget for Cassava/Maize Production Systems, Cote d'Ivoire: 1989/1991

Budget Items		
1. INPUT USE	**Family**	**Hired**
Family/Hired Labor Use (person-days)	18	14
Land Clearing	22	20
Seedbed Preparation	12	14
Weeding		
Planting		
Cassava	17	15
Maize	15	0
Harvesting		
Cassava	27	11
Maize	23	0
Total	**134**	**74**
2. OUTPUTS		
Average Root Yield (kg/ha)	10737	
Average Maize Yield (ears/ha)[3]	6780	
Market Price of Root (fcfa/kg)[4]	15	
Market Price of Green Maize (fcfa/ears)[5]	25	
Revenues from Green Maize (fcfa/ha)	169500	
Revenues from Cassava Roots (fcfa/ha)	161055	
Gross Revenues (fcfa/ha)	330555	
3. COSTS		
Fixed Costs (fcfa/ha)[6]	0	
Operating costs (fcfa/ha)		
Hired Labor	46620	
Transportation field-to-home (fcfa/ton)	4960	
Interest on Working Capital (8%)	4126	
Total Operating Costs (fcfa/ha)	55706	
Family Labor (valued @ hired labor wage rate)	84420	
Opportunity Cost of land	60835	
4. PERFORMANCE MEASURES		
Gross Margin (fcfa/ha)	274849	
Net Returns to family Labor (fcfa/ha)	214014	
Net Returns per day of Family Labor (fcfa/day)	1597	
Total System Production Costs (fcfa/ha)	200961	
Net Enterprise Profits (fcfa/ha)	129594	

[3] Estimated using the "Ear Weight Method" discussed above. In West Africa, maize, which has a short cycle, is harvested before cassava establishes. Hence competition between maize and cassava is minimized, while sole plant density is maintained for both crops (COSCA Working Paper No.10, page 84).

[4] Weighted average farmgate price based on COSCA data

[5] Farmgate price based on personal communication with Centre Ivoirien de Recherches Economiques et Sociales (CIRES).

[6] Farmers did not purchase planting materials of food crops; they produced their own: for cassava, only one fifth of the stems from previous harvest are retained for replanting and for maize, only 2 to 3 percent of the harvest is retained for seed. Therefore, the opportunity cost of planting materials, which is relatively insignificant, is not counted.

Source: COSCA survey data

Table A-2: Estimated Average Financial Budget for Cassava/Maize Production Systems, Ghana: 1989/1991

Budget Items		
1. INPUT USE	**Family**	**Hired**
Family/Hired Labor Use (person-days)		
Land Clearing	21	19
Seedbed Preparation	19	16
Weeding	17	21
Planting		
Cassava	20	18
Maize	17	0
Harvesting		
Cassava	22	31
Maize	23	0
Total	**139**	**105**
2. OUTPUTS		
Average Root Yield (kg/ha)	13042	
Average Maize Yield (ears/ha)[7]	11526	
Market Price of Root (cedis/kg)[8]	22	
Market Price of Green Maize (cedis/ears)[9]	38	
Revenues from Green Maize (cedis/ha)	437988	
Revenues from Cassava Roots (cedis/ha)	286924	
Gross Revenues (cedis/ha)	724912	
3. COSTS		
Fixed Costs (cedis/ha)[10]	0	
Operating costs (cedis/ha)	105000	
Hired Labor	10825	
Transportation field-to-home (cedis/ton of roots)	9266	
Interest on Working Capital (8%)	125091	
Total Operating Costs (cedis/ha)	139000	
Family Labor (valued @ hired labor wage rate)	280508	
Opportunity Cost of Land (cedis)		
4. PERFORMANCE MEASURES		
Gross Margin (cedis/ha)	599821	
Net Returns to family Labor (cedis/ha)	319313	
Net Returns per day of Family Labor (cedis/day)	2297	
Total System Production Costs (cedis/ha)	544599	
Net Enterprise Profits (cedis/ha)	180313	

[7] Estimated using the "Ear Weight Method" described earlier in the appendix. In West Africa, maize, which has a short cycle, is harvested before cassava establishes. Hence competition between maize and cassava is minimized, while sole plant density is maintained for both crops. (COSCA Working Paper No.10, page 84)

[8] Weighted average farmgate price based on COSCA data

[9] Farmgate price based on secondary source of information: the Dept. of Planning, Monitoring and Evaluation (Ministry of Food and Agriculture, Accra, Ghana)

[10] Farmers did not purchase planting materials of food crops; they produced their own: for cassava, only one fifth of the stems from previous harvest is retained for replanting, and for maize only 2 to 3 percent of the harvest is retained for seed. Therefore, the opportunity cost of planting materials, which is relatively insignificant, is not counted.

Source: COSCA survey data

Table A-3: Estimated Average Financial Budget for Cassava/Maize Systems *For Local Landraces,* Nigeria: 1989/1991

Budget Items		
1. INPUT USE	**Family**	**Hired**
Family/Hired Labor Use (person-days)	28	22
Land Clearing	23	21
Seedbed Preparation	23	18
Weeding		
Planting		
Cassava	19	16
Maize	15	0
Harvesting		
Cassava	30	22
Maize	23	0
Total	**161**	**99**
2. OUTPUTS		
Average Root Yield (kg/ha)	11215	
Average Maize Yield (ears/ha)[11]	9614	
Market Price of Root (nairas/kg)[12]	0.57	
Market Price of Green Maize (nairas/ears)[13]	1.5	
Revenues from Green Maize (nairas/ha)	14421	
Revenues from Cassava Roots (nairas/ha)	6393	
Gross Revenues (nairas/ha)	20814	
3. COSTS		
Fixed Costs (nairas/ha)[14]	0	
Operating costs (nairas/ha)		
Hired Labor	2079	
Transportation (nairas)	1271	
Interest on Working Capital (8%)	268	
Total Operating Costs (nairas/ha)	3618	
Family Labor (valued @ hired labor wage rate)	3381	
Opportunity Cost of land (nairas)	8362	
4. PERFORMANCE MEASURES		
Gross Margin (nairas/ha)	17196	
Net Returns to family Labor (nairas/ha)	8834	
Net Returns per day of Family Labor (nairas/day)	55	
Total System Production Costs (nairas/ha)	15361	
Net Enterprise Profits (nairas/ha)	5453	

Source: COSCA survey data

[11] Estimated using the "Ear Weight Method" discussed earlier in the appendix. In West Africa, maize, which has a short cycle, is harvested before cassava establishes. Hence competition between maize and cassava is minimized, while sole plant density is maintained for both crops. (COSCA Working Paper No.10, page 84)

[12] Weighted average farmgate price based on COSCA data

[13] Farmgate price based on secondary source of information (personal communication with IITA)

[14] Farmers did not purchase planting materials of food crops; they produced their own: for cassava, only one fifth of the stems from previous harvest are retained for replanting and for maize, only 2 to 3 percent of harvest is used for seed. Therefore, the opportunity cost of planting materials, which is relatively insignificant, is not counted.

Table A-4: Estimated Average Financial Budget per hectare for *Attieke* Production[15] in Cote d'Ivoire, 1989-1991, *assuming that 45% of roots production goes into attieke production*

Budget Items

1. INPUT USE	**Family**	**Hired**
Family/Hired Labor Use (person-days)[16]	57	0
Raw Material (kgs of roots)[17]	4832	
2. OUTPUTS		
Transformation Rate	0.56	
Kilograms of Processed Output per ha	2706	
Village Market Price of Processed Output (fcfa/kg)18	47	
Gross Revenues (fcfa/ha)	127169	
3. COSTS		
Fixed Costs (fcfa/ha)19	0	
Operating costs (fcfa/ha)		
Hired Labor (persondays)	0	
Raw Material (roots)20	72475	
Bagging Materials	16234	
Firewood	2205	
Transportation21	7670	
Interest on Working Capital (8%)	7887	
Total Operating Costs (fcfa/ha)	106471	
Family Labor (valued @ hired labor wage rate) (fcfa/ha)	35910	
4. PERFORMANCE MEASURES		
Gross Margin (fcfa/ha)	20698	
Net Returns to family Labor (fcfa/ha)	20698	
Net Returns per day of Family Labor (fcfa/day)	363	
Total production Costs (fcfa/ha)	142381	
Net Enterprise Profits (fcfa/ha)	-15212	
Production Costs per Kg of attieke (fcfa/kg)	53	

[15] There were forty-three (43) farmers using traditional techniques versus three (3) using modern techniques. Therefore, this budget includes only farmers using traditional (manual) processing techniques.
[16] This item includes labor for Peeling, Washing, Grating. Pressing, Sieving and Steaming.
[17] This represents 45% of the average root yield per hectare (page 23 in COSCA Working Paper No 6)
[18] Weighted average village market price estimated from COSCA data
[19] No mechanical equipment was used in any processing activity. Grating was performed manually (COSCA Working Paper No.14, page 15).
[20] Valued at its opportunity cost which is the weighted average farmgate price computed from the COSCA data
[21] This item includes home-to-market transportation costs only.

Table A-5: Estimated Average Financial Budget per hectare for *Gari P*roduction[22] in Ghana, 1989-1991, *assuming that 50% of roots production goes into gari production*

Budget Items		
1. INPUT USE	**Family**	**Hired**
Family/Hired Labor Use (person-days)[23]	32	19
Raw Material (kgs of roots)[24]	6521	
2. OUTPUTS		
Transformation Rate	0.31	
Kilograms of Processed Output per ha	2022	
Village Market Price of Processed Output (cedis/kg)[25]	117	
Gross Revenues (cedis/ha)	236517	
3. COSTS		
Fixed Costs (cedis/ha)[26]	0	
Operating costs (cedis/ha)		
Hired Labor (persondays)	19000	
Bagging Materials	1738	
Raw Material (roots)[27]	143462	
Firewood	1961	
Transportation[28]	25855	
Interest on Working Capital (8%)	15361	
Total Operating Costs (cedis/ha)	207377	
Family Labor (valued @ hired labor wage rate) (cedis/ha)	32000	
4. PERFORMANCE MEASURES		
Gross Margin (cedis/ha)	29139	
Net Returns to family Labor (cedis/ha)	29139	
Net Returns per day of Family Labor (cedis/day)	911	
Average Total production Costs (cedis/ha)	239377	
Net Enterprise Profits (cedis/ha)	-2861	
Average Production Costs per Kg of gari (cedis/kg)	118	

Source: COSCA data

[22] There were thirty-six (36) farmers using traditional techniques versus six (6) farmers using modern techniques. Therefore, this budget includes only farmers using traditional (manual) processing techniques.
[23] This item includes labor for peeling, washing, grating, pressing, sieving and roasting.
[24] This represents 50% of the average root yield per hectare (see page 23 in COSCA Working Paper No 6)
[25] Weighted average village market price estimated from COSCA data
[26] No mechanical equipment was used in any processing activity. Grating was performed manually (COSCA Working Paper No.14, page 15)
[27] Valued at its opportunity cost which is the weighted average farmgate price computed from the COSCA data.
[28] This item includes home-to-market transportation costs only.

Table A-6: Estimated Average Financial Budget per hectare for *Gari* Production under Technology Combination "LOCMAN"29, Nigeria, 1989/1991, *assuming 80% root production goes into gari production*.

Budget Items		
1. INPUT USE	**Family**	**Hired**
Family/Hired Labor Use (person-days)[30]	60	17
Raw Material (kgs of roots)[31]	8972	
2. OUTPUTS		
Transformation Rate	0.31	
Kilograms of Processed Output per ha	2781	
Village Market Price of Processed Output (nairas/kg)[32]	3.14	
Gross Revenues (nairas/ha)	8733	
3. COSTS		
Fixed Costs (nairas/ha)[33]	0	
Operating costs (nairas/ha)		
Hired Labor (person-days)	357	
Raw material[34]	5114	
Bagging Materials	259	
Firewood	676	
Transportation[35]	752	
Interest on Working Capital (8%)	573	
Total Operating Costs (nairas/ha)	7731	
Family Labor (valued @ hired labor wage rate) (nairas/ha)	1260	
4.PERFORMANCE MEASURES		
Gross Margin (nairas/ha)	1003	
Net Returns to family Labor (nairas/ha)	1003	
Net Returns per day of Family Labor (nairas/day)	17	
Total production Costs (nairas/ha)	8891	
Net Enterprise Profits (nairas/ha)	-257	
Production Costs per Kg of gari (nairas/kg)	3.23	

Source: COSCA data

[29] Local variety and manual Processing
[30] This item includes labor for washing, cleaning, grating, pressing sieving and roasting.
[31] This represents 80% of the average root yield per hectare (see page 128 in COSCA Working Paper No.20)
[32] Weighted average village market price estimated from COSCA data
[33] No mechanical equipment was used in any processing activity. Grating was done manually (COSCA Working Paper No.14, page 15)
[34] Valued at its opportunity cost, which is the weighted average farmgate, price computed from the COSCA data.
[35] This item includes home-to-market transportation costs only.

Table A-7: Economic Import Parity Price of Cassava Root *For Sale in Regional Output Markets,* Ghana: 1989/1991.

Items	*Regional Output Markets*	
	Koforidua	**Kumassi**
1. World Price (FOB-$US/mt tapioca)	221	221
2. Freight and insurance ($US/mt tapioca)	8	48
3. CIF, port in Accra ($US/mt tapioca) (1+2)	269	269
4. Shadow Exchange rate (cedis / $US)	645	645
5. CIF price at the port in Accra (cedis/mt tapioca) (3*4)	173666	173666
6. Domestic costs (cedis/mt tapioca)		
a. Port charges (cedis/mt tapioca)	47227	47227
b. Transit and Transport (cedis/mt tapioca)	7233	7233
c. Storage and Handling (cedis/mt tapioca)	15276	15276
7. Accra gate price (5+ 6a…c) (cedis/mt tapioca)	243402	243402
8. Importer marketing margin (%)	5%	5%
9. Wholesale price in Accra (7* (1+ 8))	255572	255572
10. Accra to Regional Market Center		
a Distance (km)	75	254
b. Transport cost (cedis/mt tapioca)	6828	23114
c. Handling (cedis/mt tapioca)	4233	4233
11. Regional Market Center (Reference Price)		
Farmgate price (cedis/mt tapioca) (9 + 10a..c)	266630	282919
12. Wholesale marketing margin (%)	5%	5%
13. Wholesale price		
in Regional Market (cedis/mt tapioca) (11* (1+12))	279962	297065
14. Regional Market Center to Village		
a. Distance (kms)	47	83
b. Transport and Handling cost (cedis/mt tapioca)	5076	8964
15. Village gate price (cedis/mt tapioca) (13-14b)	274886	288101
16. Semi-wholesale marketing margin (%)	5%	5%
17. Village Level Semi-wholesale price ((1-16)*15)/1000	261	274
18.Transformation rate (kg of tapioca / kg of root)	0.50	0.50
19. Processing cost (cedis/kg of root)	114	114
20. Import Parity Price in the Village (cedis /kg of root) (17*18) -19	16	23

Source: COSCA data, Ghana Yearly Statistical Digests (1989-1991), Economic and Social Commission for Asia and the Pacific, Reports of 1989 through 1991.

Table A-8: Economic Import Parity Price of Cassava Root *For Sale in Regional Output Markets,* Cote d'Ivoire: 1989/1991

Items	*Regional Output Markets*	
	Bonoua	**N'douci**
1. World Price (FOB-$US/mt tapioca)	221	221
2. Freight and insurance ($US/mt tapioca)	48	48
3. CIF, port in Abidjan ($US/mt tapioca) (1+2)	269	269
4. Shadow Exchange rate (fcfa / $US)	394	394
5. CIF price at the port in Abidjan (fcfa/mt tapioca) (3*4)	105998	105998
6. Domestic costs (fcfa/mt tapioca)		
a. Port charges (fcfa/mt tapioca)	700	700
b. Transit and Transport (fcfa/mt tapioca)	2000	2000
c. Storage and Handling (fcfa/mt tapioca)	2000	2000
7. Abidjan gate price (5+ 6a…c) (fcfa/mt tapioca)	110698	110698
8. Importer marketing margin (%)	5%	5%
9. Wholesale price in Abidjan (7* (1+ 8))	116233	116233
10. Abidjan to Regional Market Center		
a Distance (km)	75	130
b. Transport cost (fcfa/mt tapioca)	2625	4550
c. Handling (fcfa/mt tapioca)	2000	2000
11. Regional Market Center (Reference Price)		
Farmgate price (fcfa/mt tapioca) (9 + 10a..c)	120858	122783
12. Wholesale marketing margin (%)	5%	5%
13. Wholesale price		
in Regional Market (fcfa/mt tapioca) (11* (1+12))	126901	128922
14. Regional Market Center to Village		
a. Distance (kms)	37	56
b. Transport and Handling cost (fcfa/mt tapioca)	3665	4520
15. Village gate price (fcfa/mt tapioca) (13-14b)	123236	124402
16. Semi-wholesale marketing margin (%)	5%	5%
17. Village Level Semi-wholesale price		
(1-16)*15)/1000	117	118
18.Transformation rate (kg of tapioca / kg of root)	.5	.5
19. Processing cost (fcfa/kg of root)	46	43
20. Import Parity Price in the Village (fcfa /kg of root)		
(17*18) -19	12	16

Source: COSCA data, Institut de Documentaion de Recherches et d'Etudes Maritimes of the Ivorian Marine Ministry; UN Economic and Social Commission For Asia and the Pacific, Reports of 1989 through 1991.

Table A-9a: Economic Import Parity Price of Cassava Root, by Alternative Technology Combinations. *For Sale in the Regional Output Market of Abeokuta,* Nigeria: 1989/1991.

Items	*Regional Output Market*			
	Abeokuta			
	Impmech	*Locmech*	*Locman*	*Impman*
1. World Price (FOB-$US/mt tapioca)	221	221	221	221
2. Freight and insurance ($US/mt tapioca)	48	48	48	48
3. CIF, port in Lagos ($US/mt tapioca) (1+2)	269	269	269	269
4. Shadow Exchange rate (nairas / $US)	22	22	22	22
5. CIF price at the port in Lagos (nairas/mt tapioca) (3*4)	5950	5950	5950	5950
6. Domestic costs (nairas/mt tapioca)				
a. Port charges (nairas/mt tapioca)	95	95	95	95
b. Transit and Transport (nairas/mt tapioca)	206	206	206	206
c. Storage and Handling (nairas/mt tapioca)	203	203	203	203
7. Lagos gate price (5+ 6a…c) (nairas/mt tapioca)				
8. Importer marketing margin (%)	6454	6454	6454	6454
9. Wholesale price in Lagos (7* (1+ 8))	5%	5%	5%	5%
10. Lagos to Regional Market Center	6777	6777	6777	6777
a Distance (km)				
b. Transport cost (nairas/mt tapioca)	80	80	80	80
c. Handling (nairas/mt tapioca)	288	288	288	288
11. Regional Market Center (Reference Price)	114	114	114	114
Farmgate price (nairas/mt tapioca) (9 +10a..c)				
12. Wholesale marketing margin (%)	7179	7179	7179	7179
13. Wholesale price in Regional Market	5%	5%	5%	5%
(nairas/mt tapioca) (11* (1+12))				
14. Regional Market Center to Village	7538	7538	7538	7538
a. Distance (kms)	34	34	34	34
b. Transport and Handling cost (nairas/mt	176	176	176	176
tapioca)	7362	7362	7362	7362
15. Village gate price (nairas/mt tapioca) (13-	5%	5%	5%	5%
14b)				
16. Semi-wholesale marketing margin (%)	6.99	6.99	6.99	6.99
17. Village Level Semi-wholesale price	0.50	0.50	0.50	0.50
(1-16)*15)/1000	3.05	3.14	3.26	3.41
18.Transformation rate (kg of tap./ kg of root)				
19. Processing cost (nairas/kg of root)	0.45	0.36	0.24	0.08
20. Import Parity Price in the Village (nairas /kg of root) (17*18) -19				

Source: COSCA data, UNCTAD's Review of Maritime Transport 1989-1992, Nigerian Port Authority Statistical Reports 1989-1992, UN Economic and Social Commission For Asia and the Pacific, Reports of 1989 through 1991.

Table A-9b: Economic Import Parity Price of Cassava Root, by Alternative Technology Combinations. *For Sale in the Regional Output Market of Onitsha,* Nigeria: 1989/1991.

Items	*Regional Output Market*			
	Onitsha			
	Impmech	***Locmech***	***Locman***	***Impman***
1. World Price (FOB-$US/mt tapioca)	221	221	221	221
2. Freight and insurance ($US/mt tapioca)	48	48	48	48
3. CIF, port in Lagos ($US/mt tapioca) (1+2)	269	269	269	269
4. Shadow Exchange rate (nairas / $US)	22	22	22	22
5. CIF price at the port in Lagos (3*4)	5950	5950	5950	5950
6. Domestic costs (nairas/mt tapioca)				
a. Port charges (nairas/mt tapioca)	95	95	95	95
b.Transit and Transport (nairas/mt tapioca)	206	206	206	206
c. Storage and Handling (nairas/mt tapioca)	203	203	203	203
7.Lagos gate price (5+ 6a.c)(nairas/mt tapioca)				
8. Importer marketing margin (%)	6454	6454	6454	6454
9. Wholesale price in Lagos (7* (1+ 8))	5%	5%	5%	5%
10. Lagos to Regional Market Center	6777	6777	6777	6777
a Distance (km)				
b. Transport cost (nairas/mt tapioca)	420	420	420	420
c. Handling (nairas/mt tapioca)	1512	1512	1512	1512
11. Regional Market Center (Reference Price)	114	114	114	114
Farmgate price(nairas/mt tapioca) (9 + 10a..c)				
12. Wholesale marketing margin (%)	8403	8403	8403	8403
13. Wholesale price in Regional Market	5%	5%	5%	5%
(nairas/mt tapioca) (11* (1+12))				
14.Regional Market Center to Village	8823	8823	8823	8823
a. Distance (kms)	97	97	97	97
b. Transport and Handling cost (nairas/mt	497	497	497	497
tapioca)				
15.Village gate price (nairas/mt tapioca)13-14b)	8326	8326	8326	8326
16. Semi-wholesale marketing margin (%)	5%	5%	5%	5%
17.Village Level Semi-wholesale price((1-16				
)*15)/1000	8	8	8	8
18.Transformation rate (kg tap./ kg of root)	.50	.50	.50	.50
19. Processing cost (nairas/kg of root)	3.09	3.21	3.36	3.60
20. Import Parity Price in the Village (nairas /kg of				
root) (17*18) -19	0.89	0.77	0.61	0.38

Source: COSCA data, UNCTAD's Review of Maritime Transport 1989-1992, Nigerian Port Authority Statistical Reports (1989-1992), UN Economic and Social Commission For Asia and the Pacific, Reports of 1989 through 1991.

Table A-10: Estimated Economic Farm Level Budget for *Commercial* Cassava/Maize Production Systems, by Regional Output Markets, Ghana, 1989/1991

Budget Items	*Regional Output Markets*	
	Koforidua	**Kumassi**
1. OUTPUTS		
Average Root Yield (kg/ha)	14346	13694
Average Green Maize Yield (ears/ha)[36]	11526	11526
Market Price of root (cedis/kg)[37]	16	23
Market Price of Green Maize (cedis/ear)[38]	38	38
Revenues from Root (cedis /ha)	232278	317113
Revenues from Green Maize (cedis /ha)	437988	437988
Gross Revenues (cedis /ha)	670266	755101
2. COSTS		
Fixed Costs (/ha)[39]	0	0
Operating costs (/ha)		
Hired Labor[40]	95000	91000
Transportation (cedis/ton)		
Tradable	14256	13640
Nontradable	2376	2273
Interest on Working Capital (8%)	8931	8553
Total Operating Costs (cedis /ha)	120563	115466
Family Labor (@ hired labor wage rate) (cedis /ha)	145000	158000
Opportunity Cost of Land41 (cedis/ha)	280508	280508
3. PERFORMANCE MEASURES		
Gross Margin (cedis /ha)	549703	639636
Net Returns to family Labor (cedis /ha)	269195	359128
Net Returns per day of Family Labor (cedis /day)	1857	2273
Total production Costs (cedis /ha)	546071	553974
Net Economic Profits (cedis /ha)	124195	201128

Source: COSCA survey data

[36] Estimated Farmgate price using the "Ear Weight Method" earlier in the appendix.
[37] Estimated farm level import parity price of root.
[38] Farmgate price based on secondary source of information: the Dept. of Planning, Monitoring and Evaluation (Ministry of food and Agriculture, Accra, Ghana).
[39] Farmers did not purchase planting materials of food crops; they produced their own: for cassava, only one fifth of the stems from previous harvest is retained for replanting and for maize, only 2 to 3 percent of the harvest is retained for seed. Therefore, the opportunity cost of planting materials, which is relatively insignificant, is not counted.
[40] Although rural labor markets in West Africa are complex, it is reasonable to assume that market wages offer good approximations to shadow wages (Humphreys in Rice in West Africa, p. 80, 1981).
[41] Land is very rarely sold or rented. In this budget, the opportunity cost of land is estimated as the net return to land that farmers would enjoy if they produced green maize only.

TableA-11: Estimated Financial Farm Level Budget for Commercial Cassava/Maize Production Systems, by Regional Output Markets, Ghana, 1989/1991

Budget Items	*Regional Output Markets*	
	Koforidua	Kumassi
1. OUTPUTS		
Average Root Yield (kg/ha)	14346	13694
Average Green Maize Yield (ears/ha)[42]	11526	11526
Market Price of root (cedis/kg)[43]	22	22
Market Price of Green Maize (cedis/ear)[44]	38	38
Revenues from Root (cedis /ha)	315616	301270
Revenues from Green Maize (cedis /ha)	437988	437988
Gross Revenues (cedis /ha)	753604	739258
2. COSTS		
Fixed Costs (/ha)[45]	0	0
Operating costs (/ha)		
Hired Labor[46]	95000	91000
Transportation (cedis/ton)		
Tradable	9504	9093
Nontradable	2376	2273
Interest on Working Capital (8%)	8550	8189
Total Operating Costs (cedis /ha)	115430	110555
Family Labor (@ hired labor wage rate) (cedis /ha)	145000	158000
Opportunity Cost of Land[47] (cedis/ha)	280508	280508
3. PERFORMANCE MEASURES		
Gross Margin (cedis /ha)	638174	628703
Net Returns to family Labor (cedis /ha)	357666	348195
Net Returns per day of Family Labor (cedis /day)	2467	2204
Total production Costs (cedis /ha)	540938	549063
Net Economic Profits (cedis /ha)	212666	190195

Source: COSCA survey data

[42] Estimated Farmgate price using the "Ear Weight Method" discussed earlier in the appendix.
[43] Weigthed average farmgate price based on COSCA data.
[44] Farmgate price based on secondary source of information: the Dept. of Planning, Monitoring and Evaluation (Ministry of food and Agriculture, Accra, Ghana).
[45] Farmers did not purchase planting materials of food crops; they produced their own: for cassava, only one fifth of the stems from previous harvest per hectare and for maize only 1 to 2 percent of harvest. Therefore, the opportunity cost of planting materials, which is relatively insignificant, is not counted.
[46] Given that available labor in West African rural areas are mostly unskilled, it is assumed that financial labor cost per day reflects the economic cost of labor.
[47] Land is very rarely sold or rented. In this budget, the opportunity cost of land is estimated as the return to land that farmers would enjoy if they produced green maize only.

Table A-12: Estimated Economic Farm Level Budget for Commercial Cassava/Maize Production Systems, by Regional Output Markets, Cote d'Ivoire, 1989-1991

Budget Items	*Regional Output Markets*	
	Bonoua	**N'douci**
1. OUTPUTS		
Average Root Yield (kg/ha)	11811	11274
Average Green Maize Yield (ears/ha)[48]	3994	3994
Market Price of root (fcfa/kg)[49]	12	16
Market Price of Green Maize (fcfa/ear)[50]	25	25
Revenues from Root (fcfa /ha)	142989	183303
Revenues from Green Maize (fcfa /ha)	99850	99850
Gross Revenues (fcfa /ha)	242839	283153
2. COSTS		
Fixed Costs (/ha)[51]	0	0
Operating costs (/ha)		
Hired Labor[52]	49140	47880
Transportation field-to-home (fcfa)		
Tradable	6460	6166
Nontradable	1091	1042
Interest on Working Capital (8%)	4535	4247
Total Operating Costs (fcfa /ha)	61226	57335
Family Labor (valued @ hired labor wage rate) (fcfa /ha)	88830	90090
Opportunity Cost of Land[53] (fcfa/ha)	60835	60835
3. PERFORMANCE MEASURES		
Gross Margin (fcfa /ha)	181613	223658
Net Returns to family Labor (fcfa /ha)	120778	162823
Net Returns per day of Family Labor (fcfa /day)	857	1139
Total production Costs (fcfa /ha)	210891	210420
Net Social Profits (fcfa /ha)	31948	72733

Source: COSCA survey data

[48] Estimated Farmgate price using the "Ear Weight Method" discussed earlier in the appendix.
[49] Estimated farm level import parity price of root
[50] Farmgate price based on personal communication with Centre Ivoirien de Recherches Economiques et Sociales (CIRES).
[51] Farmers did not purchase planting materials of food crops; they produced their own: for cassava, only one fifth of the stems from previous harvest is retained for replanting and for maize, only 2 to 3 percent of the harvest is retained for seed. Therefore, the opportunity cost of planting materials, which is relatively insignificant, is not counted
[52] Although rural labor markets in West Africa are complex, it is reasonable to assume that market wages offer good approximations to shadow wages (Humphreys in Rice in West Africa, p. 80, 1981).
[53] Land is very rarely sold or rented. In this budget, the opportunity cost of land is estimated as the net return to land that farmers would enjoy if they produced green maize only.

Table A-13: Estimated Financial Farm Level Budget for *Commercial* Cassava/Maize Production Systems, by Regional Output Markets, Cote d'Ivoire, 1989-1991

Budget Items	*Regional Output Markets*	
	Bonoua	**N'douci**
1. OUTPUTS		
Average Root Yield (kg/ha)	11811	11274
Average Green Maize Yield (ears/ha)[54]	3994	3994
Market Price of root (fcfa/kg)[55]	15	15
Market Price of Green Maize (fcfa/ear)[56]	25	25
Revenues from Root (fcfa /ha)	177161	169108
Revenues from Green Maize (fcfa /ha)	99850	99850
Gross Revenues (fcfa /ha)	277011	268958
2. COSTS		
Fixed Costs (/ha)[57]	0	0
Operating costs (/ha)		
Hired Labor	49140	47880
Transportation (fcfa)		
Tradable	4365	4166
Nontradable	1091	1042
Interest on Working Capital (8%)	4368	4247
Total Operating Costs (fcfa /ha)	58964	57335
Family Labor (valued @ hired labor wage rate) (fcfa /ha)	88830	90090
Opportunity Cost of Land[58] (fcfa/ha)	60835	60835
3. PERFORMANCE MEASURES		
Gross Margin (fcfa /ha)	218047	211623
Net Returns to family Labor (fcfa /ha)	157212	150788
Net Returns per day of Family Labor (fcfa /day)	1115	1054
Total production Costs (fcfa /ha)	208629	208260
Net Enterprise Profits (fcfa /ha)	68382	60698

Source: COSCA survey data

[54] Estimated Farmgate price using the "Ear Weight Method" discussed earlier in the appendix.
[55] Weighted average farmgate price based on COSCA data.
[56] Farmgate price based on personal communication with Centre Ivoirien de Recherches Economiques et Sociales (CIRES).
[57] Farmers did not purchase planting materials of food crops; they produced their own: for cassava, only one fifth of the stems from previous harvest is retained for replanting and for maize, only 2 to 3 percent of harvest. Therefore, the opportunity cost of planting materials, which is relatively insignificant, is not counted.
[58] Land is very rarely sold or rented. In this budget, the opportunity cost of land is estimated as the net return to land that farmers would enjoy if they produced green maize only.

Table A-14: Estimated Economic Budget for Commercial Cassava/Maize Systems under Technology Combination "LOCMAN"[59], by Regional Output Markets, Nigeria, 1989/1991

Budget Items	*Regional Output Markets*	
	Abeokuta	**Onitsha**
1. OUTPUTS		
Average Root Yield (kg/ha)	12337	11776
Average Green Maize Yield (ears/ha)[60]	9614	9614
Market Price of root (nairas/kg)[61]	0.24	0.61
Market Price of Green Maize (nairas/ear)[62]	1.5	1.5
Revenues from Root (nairas /ha)	2911	7230
Revenues from Green Maize (nairas /ha)	14421	14421
Gross Revenues (nairas /ha)	17332	21651
2. COSTS		
Fixed Costs (nairas/ha)[63]	0	0
Operating costs (nairas/ha)		
Hired Labor[64]	1680	1995
Transportation (nairas)		
Tradable	1538	1472
Nontradable	296	283
Interest on Working Capital (8%)	281	300
Total Operating Costs (nairas /ha)	3795	4050
Family Labor (@ hired labor wage rate) (nairas /ha)	2688	3486
Opportunity Cost of Land[65] (nairas/ha)	8362	8362
3. PERFORMANCE MEASURES		
Gross Margin (nairas /ha)	13536	17601
Net Returns to family Labor (nairas /ha)	5174	9239
Net Returns per day of Family Labor (nairas /day)	40	56
Total production Costs (nairas /ha)	14845	15898
Net Economic Profits (nairas /ha)	2486	5753

Source: COSCA survey data

[59] Local variety and manual processing

[60] Estimated using the "Ear Weight Method" discussed earlier in the appendix.

[61] Estimated Farm Level Import Parity Price of root

[62] Farmgate price based on secondary source of information (personal communication with IITA).

[63] Farmers did not purchase planting materials of food crops but produced their own: for cassava, only one fifth of the stems from previous harvest are retained for replanting and for maize, only 2 to 3% of the previous harvest is saved for seed. Therefore, the opportunity cost of planting materials, which is relatively insignificant, is not counted.

[64] Although rural labor markets in West Africa are complex, it is reasonable to assume that market wages offer good approximations to shadow wages (Humphreys in Rice in West Africa, p. 80, 1981).

[65] Land is very rarely sold or rented. In this budget, the opportunity cost of land is estimated as the Gross Margin that farmers would enjoy if the produce green maize only.

Table A-15: Estimated Financial Budget for Commercial Cassava/Maize Systems under Technology Combination "LOCMAN"[66], by Regional Output Markets, Nigeria, 1989/1991

Budget Items	*Regional Output Markets*	
	Abeokuta	**Onitsha**
1. OUTPUTS		
Average Root Yield (kg/ha)	12337	11776
Average Green Maize Yield (ears/ha)[67]	9614	9614
Market Price of root (nairas/kg)[68]	0.57	0.57
Market Price of Green Maize (nairas/ear)[69]	1.5	1.5
Revenues from Root (nairas /ha)	7032	6712
Revenues from Green Maize (nairas /ha)	14421	14421
Gross Revenues (nairas /ha)	21453	21133
2. COSTS		
Fixed Costs (nairas/ha)[70]	0	0
Operating costs (nairas/ha)		
Hired Labor	1680	1995
Transportation (nairas)		
Tradable	1183	1132
Nontradable	296	283
Interest on Working Capital (8%)	253	273
Total Operating Costs (nairas /ha)	3412	3683
Family Labor (@ hired labor wage rate) (nairas /ha)	2688	3486
Opportunity Cost of Land71 (nairas/ha)	8362	8362
3. PERFORMANCE MEASURES		
Gross Margin (nairas /ha)	18041	17450
Net Returns to family Labor (nairas /ha)	9679	9088
Net Returns per day of Family Labor (nairas /day)	76	55
Total production Costs (nairas /ha)	14462	15531
Net Enterprise Profits (nairas /ha)	6991	5602

Source: COSCA survey data

[66] Local variety and manual processing

[67] Estimated using the "Ear Weight Method" discussed earlier in the appendix.

[68] Weighted average farmgate price based on COSCA data.

[69] Farmgate price based on secondary source of information (personal communication with IITA).

[70] Farmers did not purchase planting materials of food crops but produced their own: for cassava, only one fifth of the stems from previous harvest are retained for replanting and for maize, only 2 to 3% of the previous harvest is saved for seed. Therefore, the opportunity cost of planting materials, which is relatively insignificant, is not counted.

[71] Land is very rarely sold or rented. In this budget, the opportunity cost of land is estimated as the net return to land that farmers would enjoy if the produce green maize only.

Table A-16: Policy Analysis Matrix (PAM) for *Commercial* Cassava/Maize Systems in Nigeria under Alternative production and processing combinations and by distance between output markets and the village/farm: Net Financial Profitability (nairas /ha), Net Social Profitability (nairas/ha), and Net Effects of Policy-Induced Transfers: 1989/1991.

	Regional Output Markets							
	Abeokuta				Onitsha			
Technology	Revenues	Costs		Profits	Revenues	Costs		Profits
		Tradable Inputs	Domestic Factors			Tradable Inputs	Domestic Factors	
IMPMECH								
Financial Prices	26466	1666	15267	9532	25918	1594	15124	9200
Social Prices	23851	2166	15307	6378	32281	2064	15161	15055
Divergences	2614	-500	-40	3154	-6362	-470	-38	-5855
LOCMECH								
Financial Prices	21453	1183	13279	6991	21133	1132	14399	5602
Social Prices	18823	1538	13307	3978	23500	1472	14426	7602
Divergences	2630	-355	-28	3013	-2367	-340	-27	-2000
LOCMAN								
Financial Prices	21453	1183	13279	6991	21133	1132	14399	5602
Social Prices	17332	1538	13307	2486	21651	1472	14426	5753
Divergences	4121	-355	-28	4505	-518	-340	-27	-151
IMPMAN								
Financial Prices	26466	1666	15267	9532	25918	1594	15124	9200
Social Prices	16184	2166	15307	-1289	22030	2064	15161	4805
Divergences	10282	-500	-40	10822	3888	-470	-38	4396

Source: 1) PAM Model constructed by the author but not shown due to space limitation;
2) Tables A3-9 through A3-16.

Note: Divergences are calculated as financial prices *minus* economic prices

Table A-17: Policy Analysis Matrix (PAM) for Commercial Cassava/Maize Production Systems in Ghana: Net Financial Profitability ($US /ha), Net Social Profitability ($US/ha), Comparative Advantage and Net Effects of Policy-Induced Transfers, 1989-1991.

	Regional Output Markets						
	Koforidua				**Kumassi**		
	Revenues	Costs		Profits	Revenues	Costs	
		Tradable Inputs	Domestic Factors			Tradable Inputs	Dome Fact
Financial Prices	1168	15	824	330	1146	14	83
Social Prices	1039	22	825	193	1171	21	83
Divergences	129	-7	-1	137	-25	-7	-1

Source: PAM Model constructed by the authors

Following Monke and Pearson (1989), for each production system, let A= revenues in private prices, B= tradable inputs at private prices, C= domestic factors valued at private prices, E= revenues valued at social prices, F= tradable inputs valued at social prices, G= domestic factors valuedat social prices. Then:
D = A - (B+C) = private profits which indicate competitiveness under existing policies
H = E - (F+G) = social profits which measure efficiency or comparative advantage
I = A - E = output transfers
J = B - F = input transfers
K = C - G = factors transfers
L = D - H = I - (J+K) = net transfers

Table A-18: Policy Analysis Matrix (PAM) for *Commercial* Cassava/Maize Production Systems in Cote d'Ivoire: Net Financial Profitability ($US /ha), Net Social Profitability ($US/ha), and Net Effects of Policy-Induced Transfers, 1989-1991.

	Regional Output Markets						
	Bonoua				**N'douci**		
	Revenues	Costs		Profit	Revenues	Costs	
		Tradable Inputs	Domestic Factors			Tradable Inputs	Do F
Financial Prices	703	11	518	92	683	11	
Social Prices	616	16	519	81	719	16	
Divergences	87	-5	-0.4	92	-36	-5	

Source: PAM Model constructed by the author but not shown due to space limitation
Note: Divergences calculated as financial prices *minu*s economic prices

Table A-19: Summary Estimates (in naira) of Post-farm-Level Financial Budget Indicators for Gari Production, by Technology Combinations: Nigeria, 1989/91

Technologies Combinations	Returns to Family Labor Per Ha	Returns to Family Labor Per Person-day	Total System Production Costs	Average Costs of Production Per Kg of Gari	Net Enterprise Profits
Impmech	2310	33	14120	2.96	840
Locmech	1127	20	8761	3.15	-28
Locman	1003	17	8891	3.23	-257
Impman	1094	13	15650	3.28	-691

.